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# Brief Description of Process

This ‘Operating Manual’ contains the procedures for start up, running and shut down of the plant for the production of 120,000 TPH of colourless polypropylene pellets with spheripol process, the same including the ‘homopolymer’ and ‘random copolymer’ types.

The plant consists of a production line of polymer pellets of a 120,000 TPH capacity, completed with the facilities relevant to the process, that is, high pressure and low pressure blow-down, chilled water refrigeration units, condensate recovery, nitrogen booster compression and exhaust oil recovery unit, hydrogen storage facility.

The process unit are numbered from 100 to 900.

**Area 100 – Catalyst and Co-catalysts Storage and Metering**.

The solid catalyst is dispersed into a grease-oil mixture. The three catalyst components.(supported titanium, Aluminium alkyl and donor) are fed to the pre-contacting pot V-201 in the required ratio.

**Area 200 – Bulk Polymerization**.

The catalyst complex is formed in the precontacting pot V-201 and Prepolymerized in R-201.The prepolymerized product is sent to the polymerization reactor R-202 also fed with propylene (to maintain a constant solid concentration) and hydrogen (to control the molecular weight of the polymer) and ethylene ( in case of random copolymers production).

The heat of reaction is removed by DM water circulating in the jacket. The total catalyst residence time in the reactor varies from 1-2 hours based on plant load.

**Area 300 – Polymer Degassing and Propylene Recovery**.

The polymer slurry is continuously discharged to the first stage degassing V-301 through a steam-jacketed pipe, where the monomer evaporates. The gas leaving the flash drum, which is operated at about 18 kg/cm2g, is condensed and recycled to the reaction, via C-301 column.

The polymer is continuously fed to the second stage degasser F-301, which is operated near atmospheric pressure. The monomer obtained, after recompression, joins the gas from V-301.

**Area 400 – Block Copolymerization**. (The Block copolymer is kept for future)

**Area 500 – Polymer Steaming and Drying**.

The polymer leaving the low pressure degasser F-301 flows to the steam fluid bed FB501, where the catalyst is completely deactivated and the monomer still absorbed in the polymer is stripped out. The monomer released is scrubbed to separate the carried polymer with condensate water and then recompressed to Cracker for recovery.

From the steaming bed, the polymer flows by gravity to the fluid bed dryer FB-502.

The water absorbed by the polymer during steaming is removed with hot nitrogen in a closed loop.

From the dryer the polymer powder is pneumatically conveyed to the two storage silos that feed the extrusion and palletizing line.

**Area 600 – Polymer Powder Storage and Extrusion**.

From the storage silos SI 601A/B the polymer powder is metered to the continuous mixer WM-602, which also receives in the required ratio the additives master batch prepared in the batch mixer WM 601.

Additivated powder is discharged to the extrusion unit PK 603, where it is pelletized with an underwater cut.

PP Pellets are conveyed to the centrifugal dryer PK 604, where water is separated, and then to the screen WS 601 for coarse elimination.

Pellets are weighed on continuous belt weigher (if working) and sent by a pneumatic transport in air to the storage silos. These pellets are analysed hourly during making.

**Area 700 – Pellets Analysis, Homogenization, Storage and bagging** – Bag Palletizing and Shipment.

PP Pellets coming from the extrusion line are bi-hourly analyzed and stored in the four silos SI701 A to D.

A pneumatic transport feeds the analyzed product to the homogenizer silo SI702 and from here to the bagging silo SI-703 / SI-704 (that can be also fed directly from extruder)

These silos feed the bagging units PK 701A/B by gravity

**Area 800 – Process Facilities**.

This section includes:

High pressure and low pressure blow-down.

Chilled water refrigeration unit.

Condensate recovery.

Nitrogen booster compression

Hydrogen compression and storage

**Area 900 – Liquid Effluent Treatment**.

This section includes:

Exhaust oil recovery unit, where the oil contaminated by TEAL is batch wise regenerated by neutralization with caustic and sent to stores for further disposal.

Waste water primary treatment.

# DETAILED PROCESS DESCRIPTION/ STARTUP/SHUT DOWN

# [CATALYST-TEAL-DONOR](#ctd)

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# [Catalyst](#catalyst) – [Teal](#teal) - [Donor](#donor)

# Process Description

**TEAL Storage and Metering**

This unit includes:

Teal cylinder storage in 10 boxes. (Currently maximum two in use)

Two unloading stations for transfer to a surge drum V-101. (Currently only one in use)

Surge drum V-101.

Teal filter F-101.

Teal metering pumps P-101A/S.

Hydraulic pot T-102.

Exhaust oil tank T-103

Flushing(fresh) oil tank T-104.

Flushing oil pump P-102.

Flushing oil filter F-102.

Safety pot V-102.

Teal cylinders are stored in r.c.c. boxes arranged in a comb pattern way and opened at the front side only to allow their handling through fork lifts. Adjacent to the storage boxes there are two unloading stations( presently only one in use), each of them accommodating one additional concentrated TEAL cylinders located on weighing scales and ready to be transferred into intermediate tank V101. These two stations are also housed in boxes similar to those provided for storage. Since manual operations are carried out in these two boxes(connection of the process lines to the cylinder), a flame detector BSH 1201-1202 is provided in each of them and connected to an interlock cutting-off the transfer in case of TEAL leaks. The connection of the nitrogen and TEAL transfer lines to the cylinder is the only operation carried out inside the boxes. All the other valves mounted on the nitrogen pressurization, blanketing and TEAL transfer lines are pneumatically controlled from a local control panel safely mounted outside the unloading station.

Each cylinder has feature as follows :

Nitrogen pressurization line connected to the cylinder with hand operated root valve and pneumatically remote controlled valve (HV-1201 – HV-1203).

Cylinder depressurization line to the hydraulic seal T-102 branched off the above line with remote-controlled valve (HV 1202 – HV 1204).

Concentrated TEAL transfer line to intermediate tank V-101, connected to the cylinder through a hand-operated root valve with a drain ring and fitted with an additional pneumatically remote-controlled cut-off valve (HV 1207- HV 1208). This line can be totally purged with nitrogen or scrubbed with oil from the branch off on the cylinder to the intermediate tank.

Two push buttons, one remote and one housed in the local control panel (HS 1205 A/B – HS 1206 A/B), shall allow the operator to stop the transfer in case of danger. In fact, they shall simultaneously close the valve on the Teal transfer line from the cylinder and the nitrogen pressurization value, and open the depressurization valve to the hydraulic seal.

The surge drum V-101 is housed in a small room. Due to the hazardousness of the concentrated Teal, this room is of small dimensions with all connections at the top to avoid bottom leaks, except for the ½” attachment required to feed the metering pumps. This line is fitted with valve HV 1302 directly connected to the tank, which can be actuated with a remote push-button. This tank is fed with two separate line from the two unloading stations. Charging is effected through remote opening of one of the two pneumatic valves mounted on these lines (HV 1309.1 or HV 1309.2). The feed valves are closed by means of level switches LSH1301 or LSH1302 when the charging at 75% or 80% of the measuring range respectively is reached.

The tank useful volume (approx. 200 l) ensures a day’s operation of the plant running under full load and a daily make up is done in morning at about 40% level.

The metering pumps P-101A/S located in a separate room sucks TEAL from the bottom of surge drum V-101 and feed it to the reaction unit. The cartridge filter F-101 shall protect it against any solid particle traces.

The remote controlled valve HV 1303 located on the lines to the pumps upstream the filter allows to stop the Teal withdrawal from the surge drum V-101 when calibrating the pumps. In this case withdrawal shall directly occur through the level gauge LI 1306. The level decrease in the gauge shall indicate the flow rate of the pump in operation.

The surge drum V-101 shall be blanketed to the hydraulic seal T-102 having a volume of 0.4m3 and containing Vaseline oil. Its function is to trap drops of liquid Teal entrained by the gases during the tank filling operation. It is fitted with minimum level alarm LAL1305 and level gauge LG 1308.

The blanketing line collecting all vents from the TEAL unit is connected to the hydraulic seal through the small safety pot V-102 designed to trap any liquids. The safety pot is fitted at bottom with a connection line to the hydraulic seal with normally closed valve and a line at top, which remains open for the gas flow. The level switch LSH1304 stops the Teal transfer in case of high liquid level in the safety pot.

A continuous nitrogen flushing through PCV 1304 ensures the presence of an inert environment in V-101.

The breathing valve PSV 1313 set at 300 mm water releases the overpressures to a sand pit.

The Teal storage unit is located at a safe distance from the other operating areas. A washing system with Vaseline oil is provided for maintenance of the Teal carrying lines and equipment.

This flushing oil unit includes the following equipments:

A fresh oil storage tank T-104 of 2 m3 volume receiving the Vaseline oil from drums.

Geared pump P-102 used to empty the drums, let the washing oil circulate and transfer the exhausted oil to the recovery unit (area 900).

Cartridge filter F-102 on the oil line to protect counter FI 1303.

Exhaust oil tank T-103 of 2 m3 volume collecting the scrubbing oil.

This system allows to scrub both lines for Teal transfer from the cylinders to the surge drum, the surge drum itself, the suction line to the pumps, the Teal filter F-101, the metering pumps P-101 A/S, the blanketing line, the level gauge LI 1306 used to set the pumps and the micromotion type Teal flow rate gauge FE 1302.

The oil scrubbing of the various equipment before maintenance is carried out by checking the utilized amount of scrubbing oil on counter FI 1303. This amount must be at least 10 times the volume of the concerned items of equipment and scrubbing lines.

A combined blanketing is provided for both oil tanks, and hydraulic seal T-102.

**Donor storage and metering.**

This unit includes

Two Donor storage tanks T-101 A/B with their related stirrer (A 101 A/B).

Pump for transfer of Donor and diluting agent from the drums into the storage tanks P-103.

Donor/diluting agent filter F-103.

Donor filters F-104 A/S.

Donor metering pumps P-104A/S.

This Plant has been designed to operate with different Donor types, i.e. PES(phenylethoxysilane) or DPMS( diphenylmethoxysilane)according to the type of polymer being produced. The consumptions also vary in accordance with the production. We currently use cyclohexyl methyl dimethoxy silane (CMDMSi; CM; C-donor) with LYNX2010HA and ZN127M catalyst

As for production with high T/D ratios requiring too small Donor flow-rates it is necessary to increase the pumpable amounts by diluting Donor with Vaseline oil.

The two storage tanks allow to provide a higher operational flexibility to the different concentration/type of donor in the tanks.

Donor and Vaseline oil shall be charged into the 0.9 m3 vol. tanks in the required amounts using the gear pump P-103 that withdraws the product from the drums and feeds it through the cartridge filter F-103 trapping large solid particles.

The tanks is fitted with board-mounted level indicator, with minimum and maximum level alarm (LAHL 1403 A/B) and local level gauges (LG 1401 A/B).

These tanks are kept under blanketing pressure (approx. 100 mm water) through the self-reducing valve PCV 1405. The breathing valve PSV 1410 set at 300 mm water releases the overpressure to the atmosphere during the tank filling or under abnormal operating conditions.

The metering pumps P-104A/S withdraw Donor from the bottom of the storage/dilution tanks through filters F-104 A/S and meter it to the reaction unit.

Drop test: For pump setting withdrawal from the tank is cut-off by inserting level gauge LG 1404A (or B) according to the pump in operation. The level fluctuations in the long run are measured by means of a timer to check for the pump flow rate by checking the drop in level when only tank LG is lined up to pump.

**Catalyst Paste Preparation and Catalyst Metering**

This unit includes

Grease mixing / storage tank T-105 with related stirrer A 102.

Oil storage tank T501 with related stirrer A501

Oil – Grease transfer pump P-105.

Oil – Grease filter F-105.

Catalyst paste preparation tanks V-103A/S with related stirrer A-103 A/S.

Thermosetting fluid circulating pump P-106 to jacket of disperser V-103A/S.

Heat exchanger E-101 for heating up the thermosetting fluid.

Catalyst metering unit PK 101.

Hydraulic oil surge drum T-106.

Hydraulic oil filter F-107.

Pressurization oil surge drum T-107.

Oil drum transfer pump P-109.

Pressurization oil filter F-106.

Pressurization oil pumps P-107 A/S.

Pressure dampner V-105 and V105A.

The 2M3 vol. stirred tank T-105 is periodically filled with grease up to 80% of its capacity. Transfer from the drums is carried out with geared pump P-105.

The grease is previously melted. To do this, grease drum is kept in steam chamber one day before unloading. During the grease transfer the drum is taken out with drum trolley and unloaded to T 105 by putting a SS hose connected at other end to suction of P 105.

The grease is heated up by starting the stirrer and keeping the circulating pump P-105 in operation. The tank is kept under nitrogen at a blanketing pressure of approx. 100 mm water through the self-reducing valve PCV 1508. The breathing valve PSV 1512 set at 300 mm water releases the overpressure to the atmosphere during the tank filling.

Tank T 105 temperature is kept at approx. 90 – 100 oC with TIC 1501 and maintained under these conditions. Transfer of grease from T105 to V-103 A/S is carried out by means of pump P-105 through the cartridge filter F-105 and counter FQS 1501 pre-setting the transfer amount.

Oil is transferred from oil storage tank T501.

The 1 M3 vol. Catalyst paste preparation tank V103A/S is cylindrical with tapered bottom and thermosetting jacket and equipped with double ribbon stirrer and double mechanical seal. It receives heated oil and grease and then the solid catalyst (LYNX2010/ZN127M/ZN128M)~~MCMI/ MCGF2A /LYNX 1010 / MCHP2Vs~~) in the amounts required to give the necessary concentration (approx 100 – 160 gms of catalyst per lit of oil/grease).

Oil and grease is measured with counter FQ1501. The catalyst charged into tank from top is weighed by difference between the full and empty drum on the weigh scale.

The tank is fitted with a board-mounted level indicator with minimum level alarm LI1501 plus local indicator.

The catalytic suspension is homogenized by switching on heater E-101 and keeping the thermosetting fluid circulating in a closed loop in the jacket. The blanketing pressure is provided in the tank. The catalytic paste is cooled down to approx 10 oC by switching off the heater, opening the valves on chilled water inlet and outlet and letting it circulate inside the jacket with blanketing on again.

Once cooled, the catalytic paste is transferred to the syringes. This operation requires cutting-off the blanketing and pressurizing tank V-103 with medium pressure nitrogen up to approx 3 kg/cm2g. max. The transfer line is all jacketed with chilled water.

A separate blanketing system is provided for tank V103A/S and grease storage tank T-105. Though PCV 1508 is common but breathing valve PSV 1510(for V103A/S) and PSV 1512 (for T-105) are separate.

In case of external fire, this item of equipment is protected with depressurization valve HV 1504 that is pneumatically remote controlled through push-button HS 1504 housed in the local panel provided for in this unit.

Both syringes V-104 A/B also acts as intermediate storage for the catalytic paste metered to the reaction unit. Each of them ensures an operation of approx 10-14 hours under the plant full load depending upon catalyst type and grade.

The syringes too are chilled water jacketed to keep the catalytic paste cold in order to provide the required paste consistency and to prevent the catalyst settling.

The catalyst is metered through oil feed under controlled flow rate to one side of the piston from pumps P-108A/S and hydraulic drainage of the catalyst from the other side.

The Metering pumps withdraw oil out of storage tank T-106 (0.6 m3 vol). Tank T 106 has a local level gauge LG 1602 and a panel mounted minimum level alarm LAL 1603. It is blanketed to the atmosphere, however, continuously flushed with a small nitrogen flow through FICV 1601. Purpose is to avoid any effect on catalyst due to humidity in case of leaks on the syringe piston with consequent catalyst deactivation.

The cartridge filter F-107 protects the pumps against solid particle traces.

The gear pump P-109 is used to transfer the Vaseline oil from drums into tanks T-106 and T-107, the latter acting as intermediate tank for pumps P-107A/S used to pressurize both the syringes and the various pressure sealing systems.

Tank T-107 is absolutely equal to T-106. Both these tanks are connected at bottom so that if level is less in T-107, it can be made up by balancing. Pumps P-107 A/S withdraws through the cartridge filter F-106. They are normally idle and simultaneously operate, when the pressure switch PSL 1609 monitoring minimum pressure drops to 50 kg/cm2g. They shall be stopped through PSH 1610, when the pressure rises to 60 kg/cm2g.

Non-starting of one of these two pumps is monitored through alarm QA1601. The plant requirements can be met, if only one pump is in operation.

# Operating Parameters.

Teal Storage and Metering

|  |  |  |  |
| --- | --- | --- | --- |
|  | Pressure  (mm water) | Temp  oC | Level  % |
| T-102 | 100(max.300) | amb | 50 |
| T-103 | 100(max.300) | amb | 50(80 max) |
| T-104 | 100(max.300) | amb | 50(80 max) |
| V-101 | 600(max.800) | amb | 20 to 75(80 max) |
| T-101A/B | 100(max.300) | amb | 20 to 75  (15 min. 80 max) |
| T-105 | 100(max 300) | 70 | 25 to 80 |
| V103A/S | 10 mm Hg abs 70(\*) | 15 to 75  (<20: Holding time  75: During batch preparation) | 3 kg/cm2g(max) 20(\*\*) |
| T106/T107 | atm | amb | 50 |

# Flow Rates:

**Teal to reaction.**

The flow rate is fixed in relation to the total propylene fed to the reaction.

For homopolymer running: Teal/C3 = 0.14 kg/t during start up and0.14-0.17 kg/t. in normal.

For random copolymer running : Teal/C3 = 0.14-0.17 kg/t.

These rates are optimized from the experience.

**DONOR to reaction.**

PES or DPMS or CHMMS can be used to any type of the polymer to be produced. Also the consumption varies according to the types of the polymer.

In case of homopolymer running, the flow-rate to be sent to the precontacting pot is too much low to guarantee a good dosage.

The DONOR is therefore diluted to about 30% by wt in Vaseline oil.

For the random copolymer running, as far as possible pure DONOR shall be used. Fix the DONOR flow-rate in relation with the fed TEAL.

For homopolymer running, TEAL/PES = 15 to 20 by weight.

TEAL/DPMS = 40 to 50 by weight.

TEAL/CHMMS= 40 to 50 by weight.

For random copolymer running TEAL/PES = 3 to 5 by weight.

TEAL/DPMS = 3 to 5 by weight.

TEAL/CHMMS = 3 to 5 by weight.

**Catalyst to Reaction.**

According to the polymer to be produced, ZN127M ( for high MFI grades) and LYNX2010 for all other grades can be used. The first is the most useful for the production of the higher MFI copolymers, the second is instead preferable for the production of homopolymers and Random copolymers because supplying a product having a lower average particle size and with a limited particle size distribution, it permits to operate with lower specific consumptions of utilities.It is fed to the reaction, in suspension, and in a mixture of oil and grease.

The ratio oil/grease to be kept in about 1.5:1 by weight, that of catalyst/oil-grease mixture is about 1.5 by weight.

The flow-rate of catalyst to be proportioned to the precontacting pot is according to the capacity of the plant. Which in turn will also depend upon type of catalyst(high yield/low yield) and quality of propylene.

# Start up and operation:

**TEAL Storage and Metering.**

At this stage a portion of the concentrated TEAL is transferred from the cylinder into V-101. Due to the extreme hazard of TEAL, no operations is carried out in this unit without the prior authorization of the shift in charge.

The personnel in charge of manual operations inside the TEAL cylinder area shall be duly protected.

The operations is carried out in following manner:

Locate the cylinder being unloaded under the unloading station. Carefully remove the blind flanges of valves located on the Teal cylinder. Connect the pressurization nitrogen line (PIC 1201 set at about 2 kg/cm2g) and the Teal transfer line from the cylinder. The root valves of both lines shall remain closed during coupling. New gaskets must always provided when coupling the flanges after removal of the blind flanges.

Carefully tighten the bolts and check for the coupling sealing by pressurizing the lines including the couplings being tested.

Pressurizing the coupling

It is assumed to empty the cylinder located on scale WE 1201.

Make sure that valve HV 1202 is closed.

Open the root valve on the line.

Open valve HV 1201 on the pressurization nitrogen line through the pneumatic switch HS 1201.

Through PG 1203 make sure that the pressure in the line reaches 2 kg/cm2.Close pneumatic valve HV 1201 through the related switch. After 5 minutes verify through PG 1203 that the pressure remains constant at 2 kg/cm2 to ensure the perfect sealing of the coupling.

Now, depressurize the line by opening pneumatic valve HV 1202 to hydraulic seal T-102.

Pressurizing the coupling on the Teal transfer line to V-101.

Open the manual root valve located at the initial point of the Teal transfer

line (the manual valve on Teal cylinder shall remain closed)

Close the root valves on the oil scrubbing lines from P-102 and to T-103 and the pneumatic valve HV 1207.

Open the two manual valves on the network nitrogen line and pressurize the Teal line in between HV 1207 and cylinder.

Make sure through PG 1202 that the pressure in the line reaches the network value of approx 6 kg/cm2g.

After 5 minutes, make sure that the pressure did not lower down. Then, depressurize the line and discharge to tank T-103.

Open valve HV 1207 and newly carry out the pressurization test on the entire Teal line up to HV 1309.2.

Depressurize the line again and close HV 1207.

The personnel entrusted with the above mentioned operations must always wear

accidental prevention outfits.

Before starting the cylinder unloading operations, make sure that the safety devices of vessel V-101 are in line by checking for the operation and calibration of alarms and interlocks.

Connect the nitrogen self-control valve PCV 1304 to the blanketing system, open the continuous nitrogen flushing to V-101 (FI CV 1301) and make sure that the pressure in the vessel is at about 600 mm water (100 mm due to the blanketing pressure, 500 mm due to the deep pipe in the hydraulic seal T-102.

Then start the Teal transfer operations:

Open manually the two valves on the cylinder, the valves at V-101 and the root valves on lines leaving the cylinder.

Close valve HV-1202 on depressurization line.

Open from the local panel QLI the pneumatic valves HV 1207 (on transfer line),

HV 1201 (pressurization line) and HV 1309.2 (V-101 loading).

Gradually adjust the nitrogen pressure through PIC 1201, until a value of 2 kg/cm2 is attained, and check through the load cells scale WI 1201 for any weight decrease that denote transfer of the concentrated TEAL from the cylinder to vessel V-101.

Actuation of LSH 1302 shall automatically stop the discharge and close valve HV 1309.2, when the level in tank V-101 is 75% should this switch fail, the level switch LSH 1301 shall in turn close the valve on the V-101 filling line, when the level is 80%.

As soon as filling of V-101 is completed, close HV 1201 and HV 1207, and open HV 1202 to hydraulic seal T-102 in order to lower the cylinder pressure down to the blanketing pressure (approx. 500 mm water).

If the cylinder still contains some TEAL, keep it under nitrogen at the above mentioned pressure and connected to the hydraulic seal through HV-1202.

If the cylinder was emptied, after depressurization of the hydraulic seal, purge the TEAL transfer line section in between HV 1207 and cylinder.

Discharge the TEAL content out of the line section and blow it with network nitrogen through the line to T-103.

Scrub this line section with Vaseline oil. This requires start-up of pump P-102 and suction of fresh oil from tank T-104, the scrubbing oil amount is counted through counter FI 1303. Scrub this line section by opening the scrubbing valve purposely designed for and recirculating the exhaust oil to tank T-103.

Check through FI 1303 that the oil amount be at least 10 times of the volume of the line.

To replace the cylinder, carefully disconnect the flanged couplings and mount the blind flanges on both the cylinder valves and the nitrogen and Teal line valves.

Teal Section Operation:

The pump P-101 A/S be started after making sure that the downstream system is ready to receive Teal.

During the operation all blanketings must be always on.

Pumps P-101A/S must be immediately stopped, when nitrogen fails.

Vaseline oil filling in T-104 to be equal to 80% of its volume. If the level goes down to 50% make it up by totally emptying the drums.

Every time T-104 is loaded, it shall be drained from bottom to eliminate any water contained therein. Then a sample must be withdrawn and sent to lab for a water content analysis (max. 100 ppm). Should the water content be higher than expected, let the sample decant and re-make the analysis.

Vaseline oil content in T-103 must not be higher than half of its volume. If it is, the surplus must be fed to tank V-901.

Teal charging into V-101 is preferably executed during normal working hours.

During normal operating conditions, the Teal flow rate to the reaction unit is proportional to the propylene fed to the reactor. This is recorded and controlled through FIC 1302.

Any time doubts exist on the Teal amount actually fed through pump P-101A/S, a flow rate test can be conducted through LI 1306 by cutting off the suction line through HS 1303. Should the indicated value be other than that shown in FIC 1302, the instrument calibration to be checked.

Any failure, product leak or replacement of the operating pump following operations is to be carried:

Switch the stand-by pump on the put it in line with V-201.

Cut-off suction of the pump previously in operations through HS 1304A(or S) and its discharge through HS 1305 A(or S).

Have access to the box and close the manual valve located downstream HV 1305A (or S).

Put the oil circuit in line : T104 – P-102 – F-102 – FI 1303 – P-101A(or S) – T-103.

Open discharge of P-101A(or S) through HS 1305A (or S).

Start pump P-102 and scrub with approx 40 lts Vaseline oil.

Close HS 1305A (or S).

Reset the hand-operated valves in the scrubbing loop to their initial position and stop pump P-102.

The line and the pump shall be purged every time whenever there is shut down to ensure that both are full of Vaseline oil.

After maintenance, flange removal or cleaning (for ex-filter F-102) the air must be totally vented out of its related vent, until Vaseline oil comes out.

The capacity of pumps P-101A/S is zeroed by stopping the piston stroke due to the actuation of interlock I-1701 (see interlock description).

Each pump is fitted with a rupture sensor with alarm for monitoring any diaphragm failure.

Donor Section

Make sure that the blanketing pressure be at least 100 mm water. In any case, some nitrogen should flow out of the breathing valve PSV 1410, Blanketing is always on (PCV 1405 open).

Connect pump P-103 to the Donor drum by opening the suction and delivery valves and empty the drum.

Load Donor into T-101A (or B) and avoid to leave residues in the drum.

Load Vaseline oil into the tank in order to obtain a concentration of approx 50% by wt.

Ensure that Donor and Vaseline oil drums, are empty, and calculate the weights actually transferred. Check the concentration from Lab.

Fill the tank upto a maximum level of 75% and start the stirrer A-101A (or B) for a proper homogenization of the mixture. Keep the stirrer always in operation.

Upon the homogenization completion withdraw a solution sample from the T-101A (or B) bottom valve and determine its concentration through a lab analysis.

Align Tank T-101A (or B) to suction of the metering pump P-104A (or S) through filter F-104A (or B).

The pump shall now be ready for start-up that will be effected upon availability of the downstream units.

The amount actually fed through pump P-104A/S shall be checked every eight hours through LG 1402 A/B. The suction line from tank shall be cut off. Should the indicated value be other than that shown on FICA 1401, a checking of the instrument calibration shall be necessary.

In case of failure or replacement of the operating pump, stop the pump, cut off the suction and discharge lines and drain it before maintenance.

The capacity of pumps P-104A/S shall be zeroed due to actuation of interlock I-1701 (see interlock description), that stops the piston stroke.

Each pump is provided with a rupture sensor with alarm to monitor any diaphragm failures.

Catalyst section.

Make sure that the instrument air is on.

Since the catalyst is unstable to water or air, all lines, equipments, pumps and related instruments must be checked for dry and oxygen-free conditions when starting the unit.

Generally, all lines, equipments, instrumentation and pumps are blown with nitrogen.

The execution of these operations are done as per the instructions issued by the plant engineer according to the requirements.

Through connection of PCV 1508 to T-105 make sure that the blanketing pressure be at least 100 mm water. In any case, some nitrogen should flow out of the breathing valve PSV 1512. Blanketing shall be always on.

Molten Vaseline grease and Vaseline oil are transferred from drum into stirred tank T-105, steam heated at bottom, through pump P-105 upto 80% of its capacity. The oil-grease ratio is 60/40 by wt.

The mixture is continuously stirred by maintaining it at a temperature of 90-100 oC through TIC 1501.Overheating of oil may lead to formation of Ketones and aldehydes.

After approx 30 minute stirring the oil-grease mixture can be transferred into V103A/S. The amount being transferred is preset on FQS 1501.

While stirring, the thermosetting jacket is kept at 70 oC through TIC 1503, that regulates the steam feed to E-101, and the oil-grease mixture slowly degassed to avoid foam formation through vacuum pump K-101 upto 10 to 20mm Hg residues.This requires opening of HV 1505 and separation of V103A/S from blanketing by closing HV 1503.

HV 1505 shall be closed, the vacuum broken with HV 1502 upto a pressure of 0.1 to 0.2 kg/cm**2**g, and HV 1503 opened to switch blanketing on.

The required amount of catalyst MCM1/MCGF2A/LYNX1010/MCHP2VS is discharged from drum into V103A/S always at 70 **o**C.

Paste Preparation:

A catalyst drum is never partially unloaded. The entire contents and the drum are unloaded at one time.

Verify that the oil/grease blending tank(T-105) temp is 90-100**o**C.

Open the 1 ½” manual block valves upstream and downstream of automatic flow valve FV 1501.

Close HV 1502 by placing HS 1502 in ‘closed’ position: HS 1502 stops the high pressure nitrogen to V-103.

Open HV 1504 by placing switch HS 1504 in the open position: HS 1504 will allow V-103 to depressurize when in open position.

When V-103 reaches 0.01 kg/cm2g pressure open HV 1503 by placing HS 1503 on the ‘open’ position: HV 1503 is low pressure vent to atmosphere.

Calculate the no. of litres of oil/grease required based on the desired catalyst concentration 100-160 gm/lit of finished mud) and the wt. Of the catalyst in the drum.

Set up volumetric flow totalizer FQS-1501 in the oil/grease supply line to the catalyst dispersion drum.

Put HS 1501 in ‘start’ position.

Open the 1” block valve upstream of oil/grease filter F105.

Start the pump P-105.

Throttle the manual valve in the recirculation line to 50%.

Check flow totalizer FQS 1501 to confirm flow to the dispersion drum. When the volume of oil/grease set on the totalizer has been reached, FQS 1501 closes automatic valve FV 1501.

After the charge in finished close the manual valve to V-103 and put the oil/grease blending drum back on total recirculation.

Start dispersion drum mixer A-103 after checking seal oil level and valves.

Line up steam to in-line heater E-101.

Keep chilled water inlet Control valve as well as manual valve open so that expanded water will not increase the pressure of circuit

Line up and start jacket circulation pump P-106.

Set local temp controller TIC 1503 for the dispersion drum to maintain 70 **o**C.

Close the low pressure nitrogen and the vent valve to the dispersion drum.

Open automatic valve HV 1505 by HS 1505 in the suction line of vacuum pump K-101.

Before the powdered catalyst is charged, the operator must put on a respirator, goggles, a face shield and rubber gloves, if catalyst comes in contact with the skin or eyes, the affected area must be washed thoroughly with water.

Connect N2 hose to drum, close valve on unloading line leaving a small amount of nitrogen pressure between valve and drum.

Release most of the nitrogen pressure from catalyst drum by opening ¼” bleed on drum. Open slide gate on drum.

Raise the catalyst drum with hoist WL 101.

Attach the drum to the 3” unloading connection on top of the dispersion drum.

Attach the hose between the low pressure nitrogen header and the nitrogen header and the nitrogen connection on the catalyst drum.

Open 3” automatic value HV 1506 on top of the dispersion drum, through HS 1506 housed in local panel QL 2. Acknowledge to discharge will be given by I-1501 of V-103 is not under pressure or vacuum (p< 20 mm and > 500 mm water column)

Open the 3” manual block valve at the catalyst drum.

Line up low pressure nitrogen to the catalyst drum.

When the entire contents of the catalyst drum have been unloaded close HV 1506 and the block valve at the base of the catalyst drum.

Remove the empty drum.

Close the low pressure nitrogen valve and the vent valve (HV 1503 and HV 1504)

Slowly lower local temp controller TIC 1503 stepwise to 10 **o**C controlling the chilled water make-up, close manual steam valve to E-101.

Allow the catalyst to cool. It will require two to three hours to cool the catalyst from 70**o**C to 10**o**C. During the residence time the catalyst suspension to be kept cold and stirred.

SEQUENCE OF OPERATION OF HYDROSERVICE

CATALYST PASTE INJECTION

The fourway valve HV 1601 shows which of the cylinders V-104 A/B is aligned to P-108. There are two possible positions of valve on panel.

HV1602 P108 HV1602 P108

V104A V104B V104A V104B

HV1602 HV1602

V104A V104B V104A V104B

P108

P108

HV1601 IN “A” POSITION HV1601 IN “B” POSITION

In A position V-104 B aligns with HV 1602 and V-104A aligns with P-108. This is confirmed by ZS 1603.

In B position V-104A aligns with HV 1602 and V-104B aligns with P-108.

The three way valve 1602 has also two possible positions:

T106 P107 T106 P107

HV1601 HV1601

T106 P107 T106 P107

HV1601 HV1601

HV1602 IN “A”POSITION HV1602 IN “B”POSITION

In A position of HV 1602, HV 1601 aligns with T 106 and HV 1602.

In B position means HV 1601 aligns with seal pressuring pump.

## FILLING OF SYRINGE V-104A

Preconditions:

HV 1601 in B position (Permission by ZS 1603).

The discharge valves (HV 1603 AC/AD) should be closed (permission by HZ 1603 AC/AD).

OPERATIONS:

Actuation of HS 1603 A (Opening) which causes.

Valve HV 1602 in A position means aligns with T-106 (confirmation ZS 1604).

Inlet valves HV 1603 AA/AB automatically opens (HZ 1603 AA/AB).

Filling of Cylinder V-104A can start now, when filling is over ZAH 1602 A gives an acoustic signal in the field and closes the valves HV 1603 AA/AB. If HV 1603 AA/AB fails to close automatically then manually HS 1603 A is to be closed. HS 1603 A will cause closure of inlet valve HV 1603 AA/AB. After getting permission from the limit switch HZ 1603 AA/AB, HV 1602 automatically switches to the pressure oil lines (HV 1602 in B position) should filling have been stopped by ZAH 1602 A. The operator must actuate HS 1603 A (closure) in any case to pressurize the cylinder.

## TRANSFERRING THE CONTENT FROM V-104 A TO V-103

If it is necessary to transfer the content of the cylinder V-104A back to V-103 proceed as follow:

Actuation of HS 1603 A (Opening)

Actuation of HS 1602 to switch HV 1602 in B position.

When the cylinder is empty, actuate HS 1603 A(closure).

## FILLING OF SYRINGE V-104B

Preconditions

HV 1601 in A position (ZS 1603).

When V 104A pressurization is over (refer V-104A filling and pressurization) by seal oil(P-107) then PSL 1602A, permits the switching of HV 1601 in A position by HS 1601 A.

The discharge valve HV 1603 BC/BD should be closed (permission by HZ 1603 BC/BD).

OPERATIONS

Actuation of HS 1603 B (opening) which causes:

HV 1602 in A position means V-104 B aligns with T-106 (ZS 1604).

Inlet valves HV 1603 BA/BB automatically opens (HZ 1603 BA/BB).

Filling of V-104B can start now, when filling is over ZAH 1602 B gives an acoustic signal in the field and closes the valves HV 1603 BA/BB. If HV 1603 BA/BB fails to close then manually HS 1603 B is to be made close. HS 1603 B will cause closure of inlet valves HV 1603 BA/BB. After getting permission from the limit switch HZ 1603 BA/BB, HV 1602 automatically switches to the pressure oil line (i.e. HV 1602 in B position) should filling have been stopped by ZAH 1602 B operator must actuate HS 1603 B (closure) in any case to pressurize the cylinder.

#### TRANSFERRING THE CONTENT FROM V-104 B TO V-103

If it is necessary to transfer the content back to V-103 from V-104 B then proceed as follows:

Actuation of HS 1603 B (opening)

Actuation of HS 1602 to switch HV 1602 in B position.

When the cylinder is empty, actuate HS 1603 B (closure).

## CATALYST METERING TO THE REACTOR

FROM V 104 A

Preconditions

The valves HV 1603 AA/AB are closed (HZ 1603 AA/BB)

PSL 1602 A gives permission that V 104 A is under pressure.

Operations

Start pump P 108 A or S at minimum stroke.

Select the cylinder V104A by means of HS 1601 A to feed to the reaction HS 1601 A connects V 104 A to the reaction.

HS 1601 A actuation causes

The valves HV 1603 BC/BD closes automatically (HZ 1603 BC/BD)

After permission from the limit switches HZ 1603 BC/BD, HV 1601 switches over to A position (i.e. V 104 A aligns with P 108).

After permission from the limit switch ZS 1603 (HV 1601 A), the valves HV 1603 AC/AD opens automatically.

## CYLINDER AUTOMATIC SWITCHING

In the case explained above V 104 A feeding the reaction, when V 104 A is empty the limit switch ZSL 1602 A (ZSL 1602 A in the limit switch showing that V 104 A is empty) or HS 1601 B (which connects V 104 B to the reaction) starts the automatic switching cycle as follows:

Preconditions:

The pressure switch PSL 1602 B gives permission (cylinder V 104 B is already under pressure).

The valves HV 1603 BA/BB are already closed.

Operations:

The following operations are performed one after the other:

The discharge valves HV 1603 AC/AD closes (HZ 1603 AC/AD).

After permission by the limit switches HZ 1603 AC/AD, the valve HV 1601 switches over to B position (V 104B aligns with P 108).

After permission by the limit switch ZS 1603, the valves HV 1603 BC/BD opens.

The switching cycle must proceed 1 to 3. A failure to perform any operation stops the sequence and sounds the alarm.

## CATALYST METERING TO THE REACTOR FROM V104 B

Preconditions

The Valves HV 1603 BA/BB are closed (HZ 1603 BA/BB).

PSL 1602 B gives permission that V-104B is under pressure.

Operations:

Start pump P-108 at minimum stroke.

Actuate HS 1601 B which causes:

The valves HV 1603 AC/AD closes automatically (HZ 1603 AC/AD).

After permission from the limit switches HZ 1603 AC/AD. HV 1601 switches over to B position (ZS 1603).

After permission from the limit switch ZS 1603, the valves HV 1603 BC/BD opens automatically.

CYLINDER AUTOMATIC SWITCHING

It is assumed that V-104 B is metering the catalyst to the reactor. The limit switch ZSL 1602 B (which shows V 104 is empty) Or HS 1601 A starts the automatic switching cycle as follows :

Preconditions

PSL 1602 A gives permission that V-104A is under pressure.

The valves HV 1603 AA/AB are already closed.

B. Operations:

The following operations are performed one after the other as follows :

The discharge valves HV 1603 BC/BD gets closed (HZ-1603 BC/BD).

After permission by the limit switches HZ 1603 BC/BD, HV 1601 switches over to A position (ZS 1603).

After permission by the limit switch ZS 1603, the valves HV 1603 AC/AD opens.

The switching cycle must proceed from 1 to 3, A failure to perform any operation stops the sequence and sounds the alarm.

## Calibration of Teal/Donor/Catalyst Pumps

The calibration of the pumps P-101A/S, P104A/S and P 108 A/S will be carried out measuring the volume of the liquid pumped in a time unit.

The sucked volume is measured by the level variation of the liquid in a level gauge specially provided for calibration purpose.

Four of these calibration gauges are installed: one on V 101 TEAL vessel for calibration of the P-101A/S pumps (LI 1306), two on T-101 A/B Donor tanks for calibration of the P 104 A/S pumps (LG 1402 A/B), the last on T 106 oil tank for calibration of the catalyst pumps P 108 A/S (LG 1601).

To carry out the calibration use a stop – watch timer.

In normal running conditions these instruments remain isolated.

For the calibration proceed as follows :

Open the valve on the balancing line between the vessel and the level gauge.

Open the valve between the level gauge and the pump suction: wait that the liquid rises in the level as far as to get over the upper reference mark.

Close quickly the valve on the vessel bottom: wait that the liquid level reaches exactly the upper reference mark and start the stop watch timer.

Stop the stop watch as soon as the liquid reaches in the level the lower reference mark and note the time shown.

Open quickly the valve on the vessel bottom.

Close the valve on the balancing line.

The pump flow-rate in lit/h is given by the ratio:

Sucked litres

--------------- x 3600

seconds

# SHUT DOWN PROCEDURES

Temporary Shut down:

A short scheduled shut down prompted by the necessity of carrying out works in the downstream units does not require a shut-down of the operating unit. However, the catalyst metering pumps and subsequently the TEAL and Donor metering pumps are shut down by providing a delay in between according to the type to failure in the downstream units.

General Shut down with emptying of the equipment.

To avoid overflows or catalyst wastes, storage should be the least possible at the shut down stage.

Catalyst:

Cut-off the catalyst paste feed line immediately before V-201.

Stop metering pump P-108A/S.

Keep on feeding TEAL and Donor for approx 30 min in order to eliminate the most catalyst possible out of V-201 and downstream line upto R-201.

Re-start pump P-108A/S and pour into drum the residual catalyst paste contained in the syringes through the sampling plug located beneath V-104 A/B.

Close the syringe bottom valve HV 1603 AA/AB/AC/AD and HV 1603 BA/BB/BC/BD.

Close the chilled water feed to V-103 jacket and pour into drums the residual catalyst paste through the sampling plug located on the discharge line.

Scrub tank V 103 either using a properly heated oil-grease mixture or pouring into it a hot oil drum through pump P105. Then drain it and send the contents to the disposal area.

Drain tank T 105 and collect the oil-grease mixture in drums for future utilization.

Depressurize the circuit and purge it according to the ruling safety standards.

All lines shall be drained, nitrogen blown and purged.

TEAL

Cut-off the TEAL feed line immediately before V-201.

Stop the metering pump P 101 A/S.

Close the V-101 bottom valve through HS 1302 and the LI 1306 bottom valve as well.

Also cut-off the Donor feed line immediately before V-201.

Stop the metering pump P-101 A/S.

Set T 104 in line with P-102- F-102- FI 1303- P 101 A/S-V 201.

Start P 102 and P 101 A/S.

When the discharge line of P 101 A/S is at approx 40 kg/cm2, open the manual valve immediately before V 201 and wash it with abundant oil.

The teal lines and pumps are thus scrubbed from drain in V 101 to V 201

Manually cut-off before H 1703 A/S.

Stop pump P 102 and then P 101 A/S.

Depressurize all lines and connect V 201 to T 103.

Drain and purge with nitrogen according to the ruling safety standards.

For safety reasons keep V-101 separate from the rest of the plant and close valve HV 1303.

DONOR

After cutting off the Donor line to V 201 and stopping pump P 104 A/S (see point b).

Depressurize the entire line and set P 104A/S in line with V-201 and T 103. Manual cut-off before H 1703 A/S has been already executed.

Transfer Donor contained in tanks T-101 A/B into drums under nitrogen blanketing.

Drain and purge with nitrogen according to the ruling safety standards.

# LIST OF ALARMS IN THE CO-CATALYST AND CATALYTIC PASTE STORAGE AND METERING UNIT.

Teal Storage and Metering.

BSAH 1201/1202 Flame around Teal cylinder in line – It actuates

Interlocks I 1201/1202.

LSAH 1301 Level in V-101 at 80% - It actuates interlock I 1301.

LAH 1302 Level in V 101 at 75% - It actuates interlock I 1301.

LAH 1303 Level in T 103 at 80%

LSAH 1304 Liquid in V-102 – It actuates interlocks I 1201/1202.

LAL 1305 Level in T 102 at 50%.

FDA 1302 Teal flow-rate to the reaction unit + 5% of the set

Point.

PAH 1301 A/S Breakage of P 101 A/S diaphragms.

XAL 1301 Stoppage of P 101 A/S motor.

DONOR Storage and Metering

LAL 1403 A/B Level in T 101 A/B at 15%.

LAH 1403 A/B Level in T 101 A/B at 80%.

FDA 1401 Donor flow-rate to the reaction unit - + 5% of the

set point.

PAH 1404 Breakage of P 104 A/S diaphragms.

XAL 1401 Stoppage of P 104 A/S motor.

Catalyst Paste Preparation and Metering.

TAH 1502 Temperature of oil-grease in T 105 at 110 **o**C.

FQSA 1501 Total amount of oil-grease to V 103. It closes FV1501

LAL 1501 Level in V 103 at 15% of the volume.

LAL 1504 Level in V 106

PSL 1507 Pressure in V 103 at 20 mm water Actuates I 1501

PSH 1507 Pressure in V 103 at 500 mm water Actuates I 1501

IAH 1502 Amperage in A 103 at 80% of the range.

LAL 1603 Level in T 106 at 25% of the volume.

LAL 1604 Level in T 107 at 25% of the volume.

ZSAL 1602 A/B Emptying of V 104 A/B actuates interlock

I-1 in package PK 101.

ZSAH 1602 A/B Filling of V 104 A/B. Actuates I-1 in package

PK 101

XAL 1602 Stoppage of P 108 A/S motor.

PAL 1604 Pressure of catalyst to V 201 at 35 kg/cm2g.

PAH 1604 Pressure of catalyst to V 201 at 40 kg/cm2g.

XAL 1601 Stoppage of P 107 A/S motor.

PALL 1605 Pressure in P 107 A/S discharge line at 48 kg/cm2.

PAHH 1606 Pressure in P 107 A/S discharge line at 62 kg/cm2g.

PSL 1609 P107 A/S discharge Press:50 kg/cm2g Starts P107A/S

PSH 1610 P107 A/S discharge Press:60 kg/cm2g Stops P107 A/S

QA 1601 Monitoring of failure in PK 101 package sequence.

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##### **B. POLYMERISATION UNIT**

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##### **C.** [DEGASSING AND FEED DRUM](#DEGASS)

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# POLYMERISATION UNIT

# PROCESS DESCRIPTION.

Prepolymerization:

This unit includes:

Propylene filter F 201 A/S.

Hydrogen filters F 202 A/S

Prepoly feed cooler E 201.

Precontacting pot V 201 with its agitator A 201.

V 201 jacket circulation pump P 206

Catalyst injectors H 1703 A/S.

Prepoly reactor R 201.

R 201 circulation pump P 201.

The propylene fed to the reaction by pumps P 301A/S is filtered in the cartridge filters F 201A/S (25 microns filtering degree) to retain the rust or other solid particles present in it. The filters are protected by safety valves against the thermal expansion as well as by automatic depressurization valves towards the flare in case of fire (XV 1702 A/S).

The hydrogen from the Battery Limits is in turn filtered in the cartridge filters F 202 A/S (10 microns filtering degree) and sent under flow rate control to premixing with the total stream of propylene to the reaction.

According to the polymer to be produced the hydrogen quantity to be fed may slightly vary, for which the flow rate controller FIC 1701 can be inserted on the one or the other of the two transmitters provided to cover the whole range of the flow rate.

The FIC 1701 is adjusted by the signal from the gas chromatograph ARC 1701 which analyzes the content of hydrogen in the propylene stream sent to the reaction.

The hydrogen flow rate is corrected with temperature and pressure and is utilized for material balance measurement.

The total propylene flow rate is measured by FT1702: a portion of it, which quantity is rigidly kept constant also when the load of the plant has been reduced, is fed under flow rate control by FIC 1703 towards the prepolymerizer R 201.

In order to reduce the reaction speed, this propylene is cooled upto 10 **o**C in the chilled water cooler E 201.

The outlet temperature is controlled by TRC 1702, regulating the flow rate of the chilled water to the heat exchanger.

Catalyst paste, TEAL and Donor, proportioned by their respective pumps, are put in pre-contact pot,a small agitated vessel V 201, of about 1 litre volume, to activate the catalyst. The precontacting pot is kept cool at about 10 **o**C, putting into circulation cold water in its jacket with the centrifugal pump P 206. The feeds are sent in from the top through dip pipes and the mixture is made to overflow to prevent gas pockets. The pot agitator A 201 has an outer tandem type double mechanical seal and a inner grafoil stuffing box seal. The space in between is kept under pressure by barrier and flushing oil. In case of deterioration of the inner seal, the flushing oil flow is limited to 200-300 cm3/h by a restricted orifice.

The temperature control of V 201 is made by TIC 1701, placed on the pump delivery, which calls the necessary quantity of chilled water in the circuit.

The precontacted catalysts are injected into the cold propylene in H 1703 A/S; the propylene flowing to the injectors – which will determine the catalyst residence time in the prepolymerizer – must never be less than 1600 kg/h to prevent plugging of the prepolymerizer feeding and discharge line.

Then the mixture flows to the prepolymerizer R 201.

This consists of a small loop reactor (0.44 m**3** volume) with the two vertical legs jacketed and the circulating pump of the slurry (P-201) inserted in the lower curve.

The low reaction temperature ( 20 **o**C) and the reduced residence time operate in such a way as to get only a very reduced (i.e. about 2% lot) polymerization of the propylene around the particle sizes of the catalyst.

Temperature recorders are provided on both curves of the reactor (TR 1804 – TR 1806).

The polymerization heat is removed letting the chilled water circulate in the jacket using the pump P 203A. The temperature in the prepolymerization is kept constant by TRC 1801, which acts in cascade on the set of the TRC 1802 regulating the flow rate of chilled water from the circuit.

The chilled water flow rate value entering the circuit (FR 1802), multiplied by its inlet and outlet temperature difference (DTR 1805), allows to verify the quantity of the polymerized propylene.

A continuous flow of propylene (400 kg/h) must be fed as flushing to the circulation pump P 201, in order to keep the sealing surface cleaned. Such a flow rate is controlled by FIC 1801.

The P 201 is equipped with the double back-to-back mechanical seal lubricated with Vaseline oil at a pressure a little higher than that of the prepolymerization by means of the piston intensifer WP 201.

The prepolymerizer works full with liquid at a pressure a little higher than that of the main reactor (it is kept constant by the pressure controller installed on the surge drum V 202: all the inlet flowrate is freely discharged through the bottom vee-ball HV 1803.

The bottom piston valve HV 1804 permits the execution of a rapid drainage towards the blow down of the prepolymerizer and of the lines and equipment connected to it in emergency case (shut down of P 201,clogging of the discharge line,propylene lack, etc).

b. Polymerization:

The unit includes:

Polymerization Reactor R 202.

R-202 circulation pump P 202.

P 202 flush propylene filters F 204A/S

Ethylene filters F 203.

Reactor surge drum V 202.

Propylene vaporizer E 203.

Jacket water expansion drum T 201.

Jacket water Heater J 201.

Demi water booster pump P 205.

Cooling water circulating pumps P 204A/S.

Jacket water cooler E 202.

Additive pot V 204.

The polymerization reaction takes place in a tubular reactor, 53.5 m**3** volume, constituted by 6 vertical legs, 27 m high, connected between them in series by six 180**o** curves, three in the top and three in bottom. The slurry circulation pump (P 202, 7,000 m3/h flow rate) is installed on one of the bottom curves. The legs are provided with cooling jacket.

The prepolymerized catalyst is directly fed on the suction line of the axial pump, while the major quantity of the propylene, already added with the hydrogen, is fed to the balancing line between V 202 and R 202 (adjusted by the FIC 1702) and a lower quantity as flushing to the pump P 202 (measured by FIC 1901) and a small portion in vapour phase to the top of the V 202 to keep constant pressure in the system.

The flushing propylene to the pump (1200 kg/h) must be always kept constant to maintain the sealing surface cleaned.

Since, it is necessary to eliminate as much as possible the presence of solid particle which limit the life of the internal support of the impeller i.e. bush, this propylene is previously filtered in the cartridge filters F 204A/S with 2 microns filtering degree.

The ethylene is used only during the production of the random copolymers and then is fed to the balancing line between V 202 and R 202 after filteration in the cartridge filters F 203 A/S (25 microns).

Its flowrate ,variable according to the random copolymers types – is adjusted by FIC 18004, which is set ratioed to the total flowrate of the propylene fed to the reaction (measured by FIC 1702).

The concentration of the polymer in the reactor is maintained by the density controller DIC 1901 which regulates the propylene flowrate fed to the reactor by acting on the set of FIC 1702. During the standard operation the polymer shall be about 50% by weight.

The pressure in the reactor is kept constant by the PIC 1802.1 which is installed on the top of the surge drum V 202 which is connected to the reactor through a balancing line: it calls propylene vaporized in E 203.

The flow rate discharge from the reactor is regulated by the level controller LIC 1801, installed on the same surge drum and controlling the bottom vee ball of the reactor (LV 1801).

The polymerization heat is removed from demi-water circulating in the jacket, pumped by the pumps P 204 A/S and cooled into the heat exchanger E 202. The temperature is controlled on the bottom of the reactor by the TRC 1901 fixing the set of the TRC 2001 (D.M. water to the jacket) and regulating the distribution of the water between E 202 and its bypass.

The checking of the exchanged heat (polymerization heat plus pumping heat, minus sensible heat of the feeds to the reactor ) may be effected by measuring the circulating demi-water flow rate (FR 2001) and by T between the inlet and out let water of the reactor (dTR 2003).

The expansion tank T 201, placed above the highest point of the jackets ensures the total filling of the thermostating circuit; its level is maintained by the level switches LSL 1903 and LSH 1902: the first starts the pump P 205, making up demi-water in case of low level, the second stops the pump when the level has been restored. The tank is continuously flushed with nitrogen through the FICV 1902 to avoid any air inlets in the demi water circuit which could cause corrosions. For the same reason, a small pot where anticorrosives are loaded is installed on the suction line of the pumps P 204A/S.

A by-pass line has been provided between the jackets of two legs at the top of the reactor in order to heat, using the steam ejector J 201, the circuit water during the starting phase. The steam feeding valve is controlled by control room using HIC 1903.

The two bottom curves without pump are equipped with pressure recorders: one of the two transmitters is connected to two pressure switches (PSH 1901 – PSHH 1901), which depressurize the reactor to the blowdown when the pressure in the reactor reaches dangerous levels, opening the three piston valves HV 1905.1/2/3 on bottom curves.

Each single top curve is moreover fitted with valves controlled by the control room (HV 1906, HV 1907, HV 1908), in order to eliminate the gases present in the reactor during the filling phase purging them to the blowdown.

The bottom curves are, equipped with piston valves operated by the common push button HS 1905A/S to drain the reactor to blowdown if the circulating pump stops (thickening consequently the polymer on the bottom).

The two vee-balls, in addition to that controlled by the level controller, is provided for the other two bottom curves to drain the reactor to the flash line (HV 1909 – HV 1910).

Each reactor leg is complete with thermometers to signal, in case of emergency shut down due to the pump stopping, the effective action of the killer on all legs of the reactor.

In case of emergency on the reactor (huge propylene leakage, failure of the slurry circulation pump, etc) it can be automatically shut off from the rest of the plant.

Following steps are provided to protect the reactor:

Emergency killing: whenever it is necessary to stop the reaction quickly, a mixture of nitrogen and 1% carbon monoxide can be injected into the reactor.

Polymer discharge from the bottom: in case of failure of the slurry circulation pump and ineffective killings, the thickened solid phase can be discharged to the high pressure blowdown vessel V 801, where the reaction will be stopped by the low temperature.

The discharge must be performed stepwise and stopped as soon as the reactor pressure declines, to avoid transferring too much material to the blowdown vessel.

As ultimate solution, the reactor is protected by safety valves on the upper elbows that vent to the high pressure blowdown. Each of them is capable of venting 1/3 of the maximum flowrate to be discharged under the emergency conditions.

Reactor Killings:

The killing system of the reaction is used whenever it is necessary to stop quickly the reaction in case of emergency. In such a case, from the control room it is possible to introduce a 1% of CO in nitrogen mixture to poison the catalyst depressing in this way its activity, on each single leg of the main reactor.

The CO-nitrogen mixture is stored into four cylinders of 47 litres each at a pressure of 120-150 kg/cm2g.

Seal Pressurizatation System:

The slurry circulation pump P 201 on the prepoly is equipped with a double back to back mechanical seal, lubricated with Vaseline oil (thermosiphon circulation) and kept a pressure of about 10% higher than that compared with the prepoly and this is due to the piston hydraulic intensifier WP 201.

It consists of a syringe with piston, generally full with oil for the 90% of the stroke. The pressure of the prepoly acts on the lower surface of the piston, i.e. on an area higher than that in contact with the oil owing to the presence of the piston rod.

The oil is in this way brought to a pressure higher than that present in the prepolymerizer according to the ratio of the areas.

The position alarm ZAH 2102 on the rod indicates oil losses through the intensifier or the mechanical seal.

The pump P 202 for the circulation of the slurry in the reactor has the same system as for P 201 for the back to back internal seal (WP 202). Furthermore, it is equipped with a third external seal (in tandem) operating at low pressure and lubricated with Vaseline oil(thermosiphon circulating through the drum V 205). The purpose of the third seal is to increase the safety of the pump from the propylene discharging risks to the atmosphere.

The package system PK 201 is provided for the lubrication of the external bearing supporting the shaft of the pump P 202. Splash lubrication type at atmospheric pressure in oil pumped by P1 A/S shall be used and returned, by gravity, to the collection basin T1.

Operating Parameters and flow rates.

Propylene to pre-polymerizer R 201

The propylene flow rate to be fed shall be kept constant to prevent the residence time in the prepolymerizer from varying.

The flushing flow rate to the pump is controlled by FIC 1801 which se is adjusted to 400 kg/hr.

The flow rate mixed with the catalyst after precontacting is controlled by FIC 1703 which is set at 2000 kg/hr ( and never less than 1600 kg/hr)

The temperature of this stream is maintained at 10**o**C by TRC 1702, which controls the flow rate of the chilled water to E 201 to reduce kinetics of the polymerization:

Prepolymerizer R 201:

Temperature (TRC 1801) : 20 **o**C

Pressure (PR 1801) : 33.5 kg/cm2

Propylene to R 202:

Once the concentration to be maintained in Reactor is fixed, about 50% by weight of polymer is suspended in liquid – corresponding to a density read in DIC 1901 to 560 kg/m3 – The total flow rate of propylene to be fed to reactor under operating conditions is about 14000 kg/hr. This flow rate, shown by FIC 1702, will be subdivided as follows:

400 kg/hr sent to P 201.

2000 kg/hr sent to R 201.

1200 kg/hr sent as flushing to the pump P 202 controlled by FIC 1901.

10400 kg/hr subdivided between the small stream fed to the evaporator E 203, called by the pressure controller PIC 1802.1 and the difference sent on the balancing line between V 202 and R 202, controlled by FV 1702.

The over all flow rate is fixed by DIC 1901.

### Hydrogen to reaction

It is according to the polymer to be produced. Its flow rate varies remarkably for products with low M.F.I. and high M.F.I. Under operating conditions, the flow rate varies from 0.07 NM3h to 7 NM3/h.

The flow rate value is fixed on FIC 1701 by the composition controller ARC 1701, a gas chromatographic analyzer which analyzes the hydrogen contained into the total stream of the propylene to the reaction, determining consequently, the set to be maintained.

The absolute values of the hydrogen percentage to be kept in the analyzed stream in order to get the various M.F.I. are to be experimentally determined during the running of the plant.

The interventions made on the flow rate to correct the M.F.I. are effected on the ground of the analysis results of the products.

In case of flow rate variations, remember that they must be carried out gradually.

Ethylene to reaction:

Its flow rates is determined according to the propylene load to the reaction and with the percentage of bond ethylene desired in the final product. Since the ethylene reacts almost completely at the reaction conditions, it is easy to determine the flow rate for the various types of random copolymers. The bond ethylene content various for the random copolymers for 1% to 4% approximately by weight.

Therefore, the flow rate range to be set on the FIC 1804, varies from 80 to 320 kg/h under the operating conditions. The suitable variations of the ethylene quantities is carried out according to the analytical checking of the bond ethylene in the final product.

Polymerization Reactor:

Temperature (TRC 1901 – TI 1902 to 1906) : 70 **o**C

Pressure (PR 1901 and PC1904) : about 33 kg /cm2g.

Density of slurry (DIC 1901) : 560-570 kg/m3

### Surge drum V 202

Pressure (PIC 1802.1): 33 kg/cm**2** g.

Level (LIC 1801. A - LR 1801.B : 40% of the volume.

Jacket water expansion drum T 201.

Pressure : Atmospheric

Level (LG 1901): Min 25% of the volume.

Max 70% of the volume

**START UP AND OPERATION OF THE POLYMERIZATION UNIT**:

Starting of Seal Pressurization System:

Before starting with the pressurization of the system it is necessary to check for the efficiency of the pressurization system of the mechanical seals of the pumps P 201, P 202.

The circuits must be already filled with oil.

Cut of the manual valves on the lines connecting the lower part of the pistons to the process.

Pressurize the lower part of the pistons with the nitrogen at 10 kg/cm2 by discharging at the same time gas and oil from the manual vents installed on the highest part of the oil circuits by lifting almost completely the piston rods (empty the oil pistons almost completely).

Intercept the nitrogen to the lower part of the pistons by keeping the pressure at 10 kg/cm2.

Now fill the pistons with oil by the pumps P 107A/S bringing the pressure to about 20 kg/cm2. Check that the pressure remains constant and check that no oil leakage is present in the circuit.

When the pressure is higher than 15 kg/cm2 in the equipment, the valves connecting the lower part of the pistons to the process can be opened.

b. Filling of Reactors with Vapour Propylene:

Let the water circulate in the jacket of the reactor R 202 keeping it at 50/53 **o**C. The chilled water circuit to R 201 must be completely empty.

Open the tracing steam of the compensation branches of the transmitters LT 1801.1, LT 1801.2.

With the gas phase of V 304 pressurize with propylene R 201, R 202 and V 202 at 18 kg/cm2g approximately by connecting them and check for the seal.

For this purpose, operate as follows – close hand operated cut-off valves of the HV 1906, HV 1907 and HV 1908 (top of the reactor) and open the manual valves on the line connecting V 202 with the reactor top.

Open the manual valves on the line connecting E 302 with the top of V 202, operating gradually, so that the pressure in V 304 is not reduced below 18 kg/cm2g.

When the pressure of the system has reached the required value, verifiable by the pressure recorders (PR 1801 – PR 1802.1 – PR 1904), check for any leakages in the lines and in the safety valves.

Once the leaks of the reactor system has been verified, through LV 1801 (reactor bottom) connect the reactor with V 301 isolating it completely. By maintaining always the pressure at 18 kg/cm2g, connecting the lines both of the primary and the secondary flash.

Open the steam to the jackets of the primary and secondary flash by adjusting the PIC 2201 at 0.3 kg/cm**2**g.

Then connect V 301 with the scrubber C 301, isolated from the rest of the plant, and check for the leak at 18 kg/cm2g.

In this way and proceeding step by step, check for the leak of the plant, it is full with gas propylene only.

c. Filling of the Reactors with Liquid Propylene:

Before sending liquid propylene to the reaction, it is necessary to arrange for the downstream sections i.e. V 301 / C 301 stabilized through feed from FV 2201 for the collection of the fed propylene.

The reactors contain vapour propylene at 18 kg /cm2g.

Close the top HIC (HIC 1906 – 1907 –1908). Close the hand operated valves on the lines connecting V 202 – R 201 and R 202, and those on the line between V 202 and E 302 and open the manual cut-off valves of the discharge of the top HIC of the reactors.

Open the manual valve on the line connecting V 202 bottom and R 202.

Start with the filling of the reactor by sending the following flow rates.

FIC 1801: 400 kg/h ( to flushing P 201)

FIC 1702: abt. 10,000 kg/h (total to R 202)

FIC 1901: 1,200 kg/h (to flushing P 202)

Keep in manual the level LIC 1801.A of the V 202 (valve off).

Open the steam to E 203.

Set on automatic PIC 1802.2 at 34.5 kg/cm2g.

When LIC 1801.A indicates 10% connect the pressure regulation in V 202 by means of PIC 1802.1, gradually increasing the set of PIC so that the level is always visible.

When the pressure in the reactors reaches 30 kg/cm2g, open the top HIC (15 to 20% opening) for the venting of the inerts.

When the reactors are full and the liquid propylene start to flow, the TI’s installed on the discharge of the HIC to the blowdown V 802 (TAL 1803 – 1907 –1908 – 1909) signal the minimum temperature alarm.

At this point the reactors are full and it is necessary to connect LIC 1801.A in automatic at 40% and PIC 1802.1 at 33 kg/cm2g simultaneously closing FV 2201. Since downstream the whole system is already aligned, the propylene fed to the reactors goes back to V 304 via V 301 – C 301 system.

Establishing of Cold Run:

Once the above stated operations have been carried out, proceed as follows:

Full the jacket of R 201 with chilled water and adjust the temperature at 20 **o**C using TRC 1801.

Start P 201 and then P 202.

Set TIC 2001 in automatic at 70 **o**C.

Bring the reactor R 202 to the standard operating temperature (70 **o**C) by opening the steam to J 201 and adjusting HIC 1903 so that the temperature increase is 3 to 4 **o**C every 15 minutes.

When 70 **o**C is reached, act on HIC 1903 in such a way as to get TIC 2001 regulated at 10 to 20 % output.

N.B. During the cold-filling and during the heating phases propylene leakages from the flanged couplings can occur and they must immediately be eliminated

Feeding of Catalyst to the Reaction:

(Detailed start-up procedure for Catalyst/Teal/Donor is given in Chapter II A-2).

Open the flushing oil to A-201 (V-201) seal and check for the aligned of V-203.

Start – A 201.

Fill V 201 with oil checking it with FI 1704. Keeping Vaseline oil opened maintain V 201 pressure at 45 kg/cm2 and close Vaseline oil valve.

Start the pump of Donor with FICA 1401 in automatic at 1.5 kg/hr, when the pressure on the delivery of the pump reaches 50 kg/cm2g, open the manual valves to introduce the Donor into V 201.

Open, immediately after, the discharge from V 201 aligning it with H 1703 under operation.

Check for the Donor flow rate.

Start Teal pump with FICA in automatic mode at 3 kg/hr when the pressure on the delivery of the pump reaches 50 kg/cm2g, open the manual valve to introduce the Teal into V 201, check for flow rate.

Set FIC 1401 and FIC 1302 in cascade with FIC 1702 at specification ratio.

Keep this condition for two hours.

When the concentration of TEAL and Donor is reached feed Hydrogen to propylene (after about 1.5 hrs of Teal/Donor injection) and try to bring the required hydrogen concentration in 0.5 hrs and keep FIC 1701 in auto.

Start P 108 A/S with 20% output.

By means of HS 1601 select the syringe already pressurized for feeding the reaction.

When the pressure read on the PG 1602 and PI 1604 (paste from V 104 A/B) reaches 50 kg/cm2g, open the manual valve which introduces the catalystic paste into V 201.

Catalyst Delivery pressure:

an anomalous pressure increase on the feeding line of the catalystic paste to the reaction, warned by PASH 1604 and loss of flow of Teal/Donor will detect a partial or total clogging of the injector H 1703 A/S (inline mixer)under operation.

Should it be impossible to unclog the injector and should the pressure alarm signal persist, it is necessary to stop immediately the catalyst pumps. The precontacting pot V 201 shall be excluded, cutting of the inlet and outlet valves.

Connect the stand-by injector and feed it with propylene. Feed again Teal and Donor to the pre-contacting pot and when the pressure in it rises to 50 kg/cm2, align it to the new injector. Start again with the proportioning of the catalyst going back, gradually, to the normal conditions. In-line mixer change over procedure is given hereunder.

**Inline mixer change over procedure.**

Let us assume that in-line mixer ‘A’ is plugged and ‘S’ has to be taken in-line. The steps for changing over of in-line mixer are as follows:

Reduce TEAL, Donor and Catalyst pump strokes to 5% manually.

Open flush oil inlet valve (10) to in line mixer ‘S’.

Close catalyst co-catalyst mixture inlet valve to in-line mixer ‘A’ (1).

Open propylene inlet valves (7) and (8) to in-line mixer ‘S”.

11 12 oil

V802 V802

**13****14****1 6**

**V201** C**3 2 3 5 10 7 9**

**A S**

**4****9**

R201 R201

Open inlet valve of R 201 (9) from in line mixer ‘S’.

Close inlet valve of R 201 (4) from in line mixer ‘A’.

Close propylene inlet valve (2) and (3) to in line mixer ‘A’.

Increase Teal and Donor pumps strokes to their previous values.

Open catalyst, co-catalyst mixture over flow valve from V 201 to in-line mixer ‘S’ (6) and close flush oil in-let to in-line mixer ‘S’ (10).

Gradually increase catalyst pump stroke to its previous value

Operating Irregularities in the Prepolymerizer R 201.

An increase of the temperature in the prepoly warned by TAH 1801 and TAH 1804, will show either a lack of cooling in the jacket or an anomalous polymerization.

In such a case, it is necessary to check for the passage of the chilled water through the FR 1802, for the exchanged heat through the flow rate and T of the chilled water itself (dTR 1805) and for the inlet quantity of the catalyst through the variation of the level in the feed syringe.

If necessary, provide for the calibration of the pump P-108 A/S.

A pressure increase in the prepoly shown by PAH 1801, without the corresponding increase in the reactor and in the surge drum, will show a clogging in the discharge line to the reactor.

If it tends to rise continuously, stop all the feeds, intercept the discharge to the reactor and drain the equipment to the blow down.

A high absorption of the power by the pump P-201, shown by JRAH 1801, can be due to either clogging problems of the discharge or density increase of the slurry which is caused by an incorrect entrance of the catalyst.

R-202 Reactor Temperature Control:

During the polymerization the reactor internal temperature must be frequently controlled.

Besides the temperature recorded on TRC 1901, also the reactor internal temperature in the other measure points foreseen in each lower part of the legs must be periodically observed (TI 1902 to 1906).

If the temperature of a reactor, shown by these instruments, are different from each other, after the necessary instrumental checkings, the set point of the controller must be fixed at a value such as that none of the other instruments shows a temperature above 70 **o**C.

The increase of reactor temperature above the setting value of the controller shows that the thermal exchange capacity of the reactor is insufficient for the elimination of the reactor heat.

This can be due to different grounds, e.g.

Too high temperature of cooling water.

Too high flowrate of catalyst paste.

When a trend to a reactor temperature increase occurs, it is necessary to stem it even before the temperature reaches the limit of activation of the alarm TAH 1902 to 1906.

Thus first thing to do is to drastically reduce the catalyst flow rate to run at low load till the origin of the failure is identified.

Following checks must be carried out:

Functionality of the instrumentation.

Calibration of the catalyst pump.

Check of the cooling loop.

Check of the propylene feeding system.

In case of tendency to a quick temperature increase in the reactor, the intervention procedure is as follows:

Increase at the maximum the cooling capacity through the E 202 cooler (by reducing the set of TIC 2001).

Disconnect DIC 1901 – FIC 1702 cascade maintaining normal flow.

Set to zero the catalyst flow rate.

If the temperature stops to rise.

Reset the temperature controller on automatic with set at 70 **o**C.

Start again with the sending of the catalyst at a reduced flow rate (about 50% of the old value) and continue with the polymerization at 70 **o**C and low capacity until the origin of the failure is identified and removed.

Gradually increase the catalyst flow rate until the standard operating conditions are reached.

If, on the contrary, it is not possible to get again the temperature control, in that case proceed with the emergency shutdown of the reaction according to the procedures described in the relevant chapter.

R 202 Reactor Pressure Control:

The pressure in the reactor and in the system connected to it prepolymerizer and precontacting pot is controlled ensuring that the pressure in the surge drum V 202 is constant.

It is necessary to keep under control the PIC 1802.1 installed on the upper part of the surge drum, comparing the value read on it with the two recorders PR 1901 and PR 1904 on the lower curves of the reactor.

A lowering of the pressure, warned by PAL 1802.1 can cause cavitation problems to the circulation pump of the slurry P 202 (due to formation of gas inside the reactor. This cause is to be searched in the inefficiency of the pressurization system, e.g. instrumentation failure, lack of propylene and lack of steam to the evaporator E 203.

A pressure increase in the surge drum warned by PAH 1802.1 at 36.5 kg/cm2g will reveal either an anomalous operation of the evaporator or problems on the discharge line of the reactor or on the balancing line between the reactor and the surge drum.

In this letter case, if the pressure in the reactor is continuously rising (this warned by the alarm PSH 1901), it will be necessary to cut off immediately the reactor by pressing the shut down push button HS 1809/S, which actuates the interlock I 1803 (see interlocks description).

If, in spite of the block of the feeds, the pressure increase further, it is necessary to stop immediately the reaction before the release of the safety valves.

Reactor system level control:

A reduction in the level of the surge drum V 202, warned by LRAL 1801 A/B, under normal running conditions, will reveal an anomalous operation of the discharge valve of the reactor LV 1801. In such a case, problems can arise also in the downstream sections (especially flash and degassing).

The cause of the failure is to be searched in the instrumentation or in the block in open position of the discharging vee ball valve.

A level increase is also due to discharging problems from the reactor.

It is necessary to check for all the flow rates fed to the reactor, verifying also the compliance with the set values through the comparison with the vapours flow rate from V-301.

If the level rises to dangerous values, the intervention of the level switch LSH 1804 will stop all the feeds to the reactor actuating the interlock I 1802 (see interlocks description).

Density Control in the Reactor R 202

The concentration in the reactor is controlled by the density meter DIC 1901, which maintains the density of the slurry to the optimal running values (about 560-570 kg/m3), operating in cascade on the set of the flow rate controller of the propylene to the reaction (FIC 1702).

The highest density values involve remarkable increase of the power absorbed by the motor of the circulation pump P 202, whose operation tends to become unstable.The propylene flow is to be increased to control higher density and if the density still rises,cut off the catalyst.

The density controller is, obviously, excluded during the starting phases and during the dilutions in the reactor emergency.

Yield and Production Control:

They can be calculated as follows:

Hourly production calculation.



PP Product = F**H20**.----- + F**P ----------- +** F**R--------- -** KW**ABS------**

470 470 470 470

F**H2O** = Water flow rate circulating in the R 202 jacket expressed in kg/h (read on FR 2001)

T = Value read on dTR 2003.

F**P** = Propylene flow rate to R 201, in kg/h (FR 1703+ FR 1801)

F**R** = Propylene flow rate to R 202 in kg/h

(FR 1702 – FR 1703 – FR 1801)

KW **ABS**= Power absorbed by P 202, in KW, read on KWR 1901.

470 = kCalories produced in the polymerization of 1 kg of propylene.

The hourly production can also be directly obtained from the difference of

propylene receipt minus vents out under steady state.

**Yield calculation**:

PP X 100

Yield = --------------

FC \* C

Where,

Yield = g PP/g catalyst

PP = hourly production, expressed in g/h

FC = catalystic paste flow rate, in lit/h

C = catalyst concentration in the catalystic paste, expressed in g/lit

SHUT DOWN PROCEDURE:

The procedures herein illustrated refer to the shut down of the polymerization unit starting from the normal operating conditions.

Three types of shut down have been considered:

Temporary shut down providing for the subsequent restarting, without emptying the equipment.

General shut down for programmed maintenance including the emptying of the plant.

Emergency shut-down (This is dealt separately).

Temporary Shut down:

If a short shut down of the unit is foreseen – e.g. to carry out short maintenance on the downstream section – the reactor can remain full with the circulating slurry, but at a reduced temperature of 45/50**o**C and reduced polymer concentration.

The operations to be carried out for the shut down are the following:

Bring to zero the catalyst flow rate acting on the panel mounted HIC 1606 which regulates the stroke of the pumps P 108 A/S.

Disconnect the cascade DIC 1901 – FIC 1702.

Continue propylene and hydrogen, Teal and Donor feeds (proportional to the propylene) until the complete exhaustion of the residual catalyst and therefore of the reaction.

Continue the feed until the reactor is diluted to 50 g/lit.

Keeping under running the circulation pumps P 201 and P 202, close the hydrogen and propylene feeds, exception for those sent to the flushing of the pumps and the one necessary to the pressurization of the surge drum V-202: reduce consequently the Teal and Donor flow rates.

Since the discharge from the reactor is reduced, the FIC 2201 calls some propylene to flush the primary flash.

When the reaction is exhausted, lack of the polymerization heat will happen and in this way the trend of the system is to reach, gradually, a temperature a little higher than that of the inlet propylene.

If the downstream sections are capable of receiving the reactor discharge, the injected propylene is recovered into the feed drum V 304.

b. General Shut down with the emptying of the equipment:

As already mentioned in the section ‘catalyst shut down’, the filling of the relevant intermediate tanks is programmed in order to exhaust them as much as possible before the programmed maintenance shut down.

The operations to be carried out for the polymerization shut down are:

Stop the feeding of the catalyst paste.

Disconnect the cascade between DIC 1901 and FIC 1702.

Continue to feed propylene and hydrogen until the exhaustion of the reaction and the dilution of the slurry to a concentration of 50 g/l.

During the dilution the reactor temperature will diminish owing to the exhaustion of the reaction. To maintain the reactor at the standard temperature of reaction, feed, as soon as necessary, steam to the cooling circuit.

Cut off H2 after about 1.5 hrs of catalyst cut.

Stop the Teal and Donor feeding after about 2 hrs from catalyst cut.

Disconnect the cascade between TRC 1901 and TRC 2001 adjusting the latter at 70**o** C.

Stop P 201 and P 202.

Put on manual TRC 1802 and close the relevant valve.

Stop P 203.

Cut off the propylene to the reaction except the flow sent to E 203 for the pressurization of the system.

Start with the emptying of the reactor through the bottom drains HIC 1909, HIC 1910 and LIC 1801. ‘A’ set on manual and adjusting the valves at a degree of opening in such a way as to discharge a total flow rate (read on FIC 2201) not higher than 10 T/H.

When LIC 1801 shows the total emptying of V 202, close the manual valve placed on the connecting line between the bottom of V 202 and the reactor.

Put on manual FIC 2201 and close the relevant valve.

When the flow rate discharged from the reactor shows a sensible reduction (indicating the emptying of the reactor leges) open again the valve on the line connecting the bottom of V 202 with the reactor.

Close HIC 1909, LIC 1801 and then open them one by one in order to make sure that the legs of the reactor have been drained off completely.

Close the propylene to E 203 and reduce the pressure in the reactor upto 19-20 kg/cm2g by discharging alternatively gas from LIC 1801, HIC 1909, HIC 1910 always to ascertain that the reactor has been drained off.

Open completely the three valves of HIC 1909, HIC 1910 and LIC 1801.

Cut-off the manual valve on the V 202 gas outlet.

Proceed with the final depressurization of the reactors discharging the gas from the bottom of V 301 and recovering it on the suction of K 301 A/S keeping under control the flow rate through FR 2203 (max flow rate K 301A/S = 1,500 kg/h). At the completion of the operation, the reactors R 201 and R 202, the surge drum V 202, the evaporator E 203 and the flash drum V 301 will reach a pressure of about 0.3/0.4 kg/cm2g.

Cut-off each individual equipment and complete depressurization to the flare through the several discharging lines.

Open the pressurization nitrogen to the reactors and bring them to about 3 kg/cm2g.

Cool the reactors at about 40 **o**C and stop the pump P 204 A/S.

Depressurize to the flare from the top HIC and proceed with the nitrogen purging of the reactors and of other equipment according to the ruling standards.

LIST OF ALARMS OF THE PROPOLYMERIZATION AND POLYMERIZATION UNITS:

FAHL 1701 : H2 flow rate to the reactor +/- 10% of the set.

FDA 1702 : Propylene total flow rate to reaction +/- 10% of the set.

FSAHL 1703 : Propylene flow rate to E 201: + 10% of the set- it actuates

the interlock I 1701 at 3 m3/h. 1600 kg/hr.

TAH 1702 : Temperature of Propylene from E 201: + 5% of the set.

XAL 1701 : A-201 motor shut down.

LAL 1702 : Level in V 203: 30% of the volume.

PAH 1708 : Pressure in V 203 : 1kg /cm2g.

QA 1701 : Signaling of I 1701 intervention.

FAHL 1801 : Flushing propylene flowrate to P 201: +/-10% of the set.

FAH 1802 : Chilled water flow rate to the R 201 jacket : 1 m3/h.

FDA 1803 : Flushing propylene flowrate to secondary flush:+ 20%

Of the set.

FDA 1804 : Ethylene flowrate to the reaction + 10% of the set.

JAH 1801 : Power absorbed by P 201 : 8 KW.

LAHL 1801A : Level in V 202 : +/- 10% of the set.

LAH 1801B : Level in V 202 : 4800 mm on L.T.L.

LAL 1801B : Level in V 202: 1500 mm on L.T.L.

LSAH 1804 : Level in V 202 : 5400 mm on L.T.L. – it actuates I 1802.

PAH 1801 : High pressure in R 201 : 36.5 kg/cm2g.

PSAH 1801 : Very high pressure in R 201 : 38 kg/cm2g, It actuates I1801.

PAH 1802.1 : Pressure in V 202: 36.5 kg/cm2g.

PAL 1802.1 : Pressure in V 202: 32.5 kg/cm2g.

PSAH 1803 : Pressure in V 202 : 37.5 kg/cm2g.

PSAH 1804 : Steam pressure to E 203: 6 kg/cm2g – it actuates I 1804.

TAH 1801 : R 201 temperature : 2 **o**C above the set point.

TAHH 1801 : R 201 very high temperature 28 **o**C, it actuates I 1801.

TAH 1802 : Chilled water temperature to R 201 jacket : 20 **o**C.

TAL 1803 : R 201 vent temperature : 10 **o**C

TAH 1804 : R 201 temperature 25 **o**C

QA 1801 : Signaling of I 1801 intervention.

QA 1802 : Signaling of I 1802 intervention.

QA 1803 : Signaling of I 1803 intervention.

XSAL 1801 : P 201 motor shutdown – it actuates I 1801.

FAL 1901 : Flushing propylene flowrate to P 202: -10% of set.

LSAH 1902 : Level in T 201: 1500 mm on L.T.L. – it stops P 205.

LSAL 1903 : Level in T 201 : 400 mm on L.T.L. – it starts P 205.

DDA 1901 : Density in R 202: + 5% of set.

PSAH 1901 : Pressure in R 202: 36 kg/cm2g – it actuates I 1902

(reset HV 1905.1/2/3)

PSAHH 1901: Pressure in R 202: 38 kg/cm2g – it actuates I 1902

(open HV1905.1/2/3)

JAH 1901 : Power absorbed by P 202 : 400 KW.

TAH 1901 : High temperature in R 202: 72 **o**C.

TAL 1901 : Low temperature in R 202 : 65 **o**C.

TAH 1902-3-4-5-6: R 202 temperature : 75 **o**C

TAL 1907-8-9 : R 202 vent temperature :–10 **o**C

QA 1901 : Signaling of I 1901 intervention.

QA 1902 : Signaling of I 1902 intervention.

XSAL 1901 : P 202 motor shutdown – it actuates I 1901.

FAL 2001 : Demi-water flowrate to R 202 jacket: 500 m3/h.

TDA 2001 : Demi water temp. to R 202 jacket + 1 **o**C as to Set.

XSAL 2001 : P 204 A/S motor shutdown – it actuates I 2001.

PAH 2001 : Killer pressure to reaction : 70 kg/cm2g.

PAL 2003 : Killer pressure to reaction : 50 kg/cm2g.

FSAL 2101 : Oil flowrate on the PK 201-P1 A/S delivery – it

Actuates I 2101.

LAL 2104 : Level in PK 201.

PAH 2105 : Oil pressure on the PK 201 – PI A/S delivery.

XSAL 2101 : PK 201 – PI A/S motor shutdown – it actuates I 2101

LAL 2102 : Level in V 205.

PAH 2104 : Pressure in V 205 : 1 kg/cm2g.

ZAH 2102 : Position of intensifier rod WP 201.

ZAH 2104 : Position of intensifier rod WP 202.

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**C. DEGASSING AND FEED DRUM AREA**

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# DEGASSING AND FEED DRUM AREA

PROCESS DESCRIPTION:

Polymer degassing:

This unit includes :

Primary flash heater E –306.

Secondary flash heater.

Flash drum V 301 with dynamic seperator A 301.

Recycle gas filter F 301.

Recycle gas guard filter F 302.

Blow back gas drum V 302.

The polymer slurry, discharged from the reactor under the level control through the vee ball LV 1801, flows by pressure difference in the primary flash jacketed pipe E 306.

The 3 way ball valve HV 1904 permits to divert directly from the panel,the discharge on the stand by flash line and then to the blow down in case of problems on the flash drum V 301.

The stand by line is continuously flushed, in order to keep it clean, with a small gaseous propylene flowrate from the top of the surge drum V 202. Flow rate is controlled by the FIC 1803.

The propylene vaporization heat is supplied by sending steam to the jacket. Its flow rate is controlled by pressure controller PIC 2201, whose set is slave of the TRC 2201 which maintains constant temperature of the propylene vapours at 70 - 80 **o**C to the flash drum V 301.

A second 3 way ball valve, HV 2204, permits to send the flow through the secondary flash to the flash drum or to the low pressure blow down V 802. Said valve is normally diverted towards V 301 and is rotated towards the blowdown when it is necessary to exclude the V 301 from the process line.

The polymer is separated from the gas in the cyclone separator V 301 at a working pressure of about 18.0 kg/cm2g, in order to condensate the outlet vapour propylene in C 301. The press is controlled by PIC 2301, placed on the top of the scrubber C 301.

The working temperature of 80 **o**C results of about 35 **o**C higher than that of the dew point and therefore guarantees the absence of the condensations in the tank.The temperature switch TSAL 2206, warning the lowering of the outlet temperature from V 301 and therefore the presence of the liquid, excludes the cyclone from the process line.

On the top of the cyclone the dynamic separator A 301 will restrict the fine polymer entrained by the superheated vapours flowing out to the scrubber C 301.

The controller FIC 2201 calls fresh propylene to the primary flash pipe, when the flow rate of the vapours flowing from V 301 is reduced to values dangerous for the transfer of the polymer in the flash pipe.

The Vortex flow meter is continuously flushed with vapour propylene.

The polymer is discharged under level control (LIC 2201) through the bottom vee-ball towards the bag filters F 301, operating at low pressure. The high pressure difference existing between the two equipment permits the transfer.

The manual valve will be opened on the line between the top and the bottom of the cyclone only in case of running at reduced capacity in order to help the transfer of the polymer.

The level switch LSH 2202 intercepts the flow from the reactor towards the flash drum in case of high level of the polymer.

The recycle from the bottom of the scrubber C 301 and the feed line of the additive are connected on the line between the cyclone and the bag filter. Further more, in case of anomalies in the bag filter, a third 3-way ball valve (HV 2201) is provided therein to direct the polymer stream to the blow down, so permitting to keep the cyclone in operation.

Another TI with low temperature alarm (TIAL 2203) warns the presence of the liquid propylene, if any, on the line to the filter F 301.

The polymer going to the bag filter still contains a good quantity of the monomer(with the portion recycled from the scrubber C 301 is about of 20% as to the total quantity discharged from the reactor). The gas solid separation takes place in a vessel, conical bottom and cylindrical shell type, containing the polypropylene bags acting as filtering means. The bags are flushed in a cyclical manner by the timer KC 2201 with gaseous propylene taken from the top of the scrubber C 301.

The self-regulating pressure valve PCV 2204 reduces the pressure to the value desired for the flushing. The small vessel V 302 acts as intermediate tank to face the short discontinuities in the sending of the flushing.

The working pressure of the bag filter, equal to about 0.5 kg/cm2g, is ensured by the PIC 2501, which keeps constant the suction pressure of the compressor K 301A/S.

A second pressure regulator, PIC 2202, will discharge the gaseous propylene coming from the filter to the flare under controlled flow rate, when, in case of anomalies of the down stream section (e.g. compressor shut down, the filter pressure rises over the safety limits.

At last, the pressure switch PSH 2203 stops the feed to the filter when the pressure further rises, to avoid the release of the safety valve.

The filter dPR 2205 gives the pressure difference through the bag filter, signaling by the alarm the clogging of the bag.

The dTR 2206 records the pressure difference between F 301 and the steamer FB 501 : it is connected with a switch which closes the discharge vee-ball valve from the filter, in case of low P, to prevent the steam from rising from the steamer towards the filter.

The cartridge filter F 302 placed on the gas line from F 301, will act as guard in the downstream section against the solid entrainment in case of rupture of the F 301 bags.

The gas flow rate to the scrubber C 302 and therefore to the compressor K 301 A/S is kept constant by the FIC 2203 which controls the propylene drainage from the C 301 bottom.

The polymer level in the bag filter is controlled by LIC 2203 acting on the LV discharging to the steamer. In case of high level, the level switch LSH 2204 will cut off the discharge from the flush drum V 301, in case of low level, the LSL 2205 will close the discharge towards the steamer to avoid that large quantities of propylene flow to the steamer. The LV 2203 is also automatically closed by TSL 2207, placed on the bottom of the bag filter to warn the presence of liquid propylene: this, in fact, must not reach the steamer where the rapid vapourization would cause the opening of the safety valve.

b. High Pressure Propylene Scrubbing:

The unit includes:

High pressure propylene scrubber C 301:

C-301 Reboiler.

Propylene Condenser E 301.

C-301 reflux pumps P 302 A/S.

The vapour propylene separated at high pressure in the flash drum V 301 and that compressed by the compressor K 301A/S are mixed before entering the tray column C 301. The five trays on the lower part of the column are segmental-baffle type, while the eight trays on the upper part are sieve type. The column has no rectifying function, but that of scrubbing to abate fine powder escaping from the flash drum.

The working pressure (18 kg/cm2g) is maintained by the controller PIC 2301 which adjusts the outlet condensate propylene flowrate towards the storage tank V 304. The regulation is made by flooding the condenser.

A small vent is provided on the condenser E 301 top and its flow rate is controlled by the FIC 2304 to eliminate the inerts which could be accumulated in the system.

In C301 the reflux is controlled by the column level through the LIC 2301 thus deriving that an increase of the level reduces the reflux flowrate.

A thermal recovery is made in the reboiler: the heat is in face supplied by cooling a portion of the condensate circulating in the scrubber C 501 of the steaming section. Its flow rate is measured by the FI 2302, while the two thermocouples TI 2306 and TI 2307 give the temperature difference between the inlet and the outlet.

The temperature of the total column feed stream is indicated by TI 2305; the gases pressure drop in the column is recorded by the dPR 2304.

A small portion of liquid is taken from the column bottom in order to drain any accumulated polymer; its flowrate is controlled by the FIC 2203, which sets the gas flowrate fed to the compressor K301 A/S. A steam jacketed pipe allows to vaporize the liquid propylene which is recycled as polymer carrier gas to the bag filter F 301 inlet.

The desuperheated vapours flowing from the column top are condensed with water in the horizontal heat exchanger E 301: it is fitted with a small bottom boot which ensure a small liquid surge on the suction line of the reflux pumps P 302A/S.

A small portion of vapours is recycled to the F 301 for the flushing of the bags.

The condensed liquid is in part recycled to the column as reflux and in part recovered in the feed drum V 304.

A line with a restriction orifice is provided on the pumps delivery for the start up or running at reduced load of the section.

The extracted flowrate towards the V304 is measured through the orifice place FR 2303.

c. Reactor Feed Drum:

This unit includes:

Reactor feed drum V304.

Propylene vaporizer E 302

Propylene feed pumps P301A/S

Feed pump cooler E 305

The propylene recovered from the plant and the fresh propylene from the B.L. are stored in the tank V304.

It consists of a horizontal cylindrical vessel, 100 m3 volume, located in a separate area of the plant for safety purposes. This tank is normally operated with a liquid volume equal to 40 m3 in order to have enough propylene to dilute the reactors in case of shut down and, at the same time, to keep available a sufficient volume to drain the plant in case of emptying.

Moreover, it can also store all the propylene present in the plant if, at the start up after washing the equipment and the lines with water, the propylene results to be wet. In such a case it will be sent back to the B.L. in liquid or gas phase through the suitable lines provided for this unit.

The fresh propylene, measured by FQ1101 at B.L., is called into the tank under level control through the LIC 2401.

The feed drum pressure is kept constant by the PIC 2401 which controls the propylene flowrate sent to the evaporator E 302 to pressurize the system.

The kettle type evaporator is heated with steam. The pressure switch PSH 2403 on the steam line will cut off the propylene flow to the heat exchanger in case of pipe rupture.

The pumps P 301 A/S delivering to the reaction withdraw the propylene by means of separate lines. Remote controlled pneumatic valves (HV 2401 A/S) are installed on each single line and they are located immediately beneath the tank. Low pressure switches (PSL 2404 A/S) are installed down stream to cut off the flow in case of leakages to the atmosphere.

The propylene feed to the reaction is measured as temperature (TI 2402), pressure (PR 2402) and flowrate (FR 2403).

The recycle line to the tank through the water cooler E 305 ensure, by means of the FIC 2402, a constant propylene flowrate in order to avoid caviation risks in the pumps (minimum flow rate = 70% of the nominal) and keep constant the pressure of the delivery line.

As cited above, the tank works at constant level; the level alarms LAHH 2402 and LALL 2403 warn any anomaly.

Since it is absolutely necessary to guarantee the propylene flow to the reaction, the two pump P 301 A/S are equipped with automatic starting device for the standby one, in case the pump under running is off service( I 2401).

A remote operated vent valve,HC 2402 at V 304 top is provided to vent excess pressure or venting for removal of CO after S/D

Low pressure propylene scrubbing and compression:

This unit includes:

Low pressure propylene scrubber C-302.

Recycle gas cooler E 304.

Oil pump P 303.

Absorption oil pumps P 304A/S.

Compressor K.O. drum V 303.

Recycle gas compressor K 301 A/S.

The gaseous propylene separated at low pressure in the bag filter F 301 is washed with Vaseline oil in the sieve tray column C 302, to abate the entrained polymer dust.

The oil circulation is carried out by the pumps P 304A/S, flowrate of which is measured by the orifice plate FI 2501.

The column level with remain constant falling any condensation; the low level alarm LAL 2502 warns any anomalous lowering.

Moreover, it is used to stop the partial emptying of the column bottom during the periodical regeneration of the exhaust oil, when the Teal content reaches the safety limit(5 % of TEAL by wt)

For this latter service, the gear pump P 303 will be used, which pumps the oil to be generated to the relevant unit. The pump P 303 is also used for charging the circuit with the fresh oil taken from the commercial drums and to wash with oil the equipment and the lines before the maintenance.

The gases from the top of the scrubber are cooled in the water heat exchanger E 304: the liquid deriving from condensation or entrainment is abated in the K.O. drum V 303 fitted with a suitable demister.

On the cooler outlet, the remote –controlled pneumatic valve HV 2501 protects the whole system in case of external fire by discharging the pressure towards the flare.

The pressure of the whole low pressure degassing unit is maintained constant at 0.4 – 0.5 kg/cm2g by the PIC 2501 controller, acting on the by pass of the compressor K 301 A/S.

The two stage reciprocating type compressor will compress the gas at about 19 kg/cm2g necessary for the condensation in E 301.

A very high level switch in the K.O. drum (LSHH 2504) and a low pressure one on the suction line (PSL 2502) is provided for the protection of the compressors.

Area 300 – Seal Pressurization System:

This unit includes:

A301 seal pressurization system WA 301.

P301 A/S seal oil pots V305A/S

P302 A/S seal oil pots V306 A/S.

P304A/S seal oil pot V307 A/S.

The dynamic separator A 301, installed on the top of the flash drum V301, is fitted with balanced double mechanical seal, lubricated with Vaseline oil(thermosiphon ciculation) and kept at a pressure higher than 15% approx as to that of the flash drum operating pressure.

On the piston rod the pre-alarm ZAH 2602 warns the lack of oil, while the switch ZSHH 2602 stops the agitator in order not to damage the sealing.

The pumps P 301 A/S are provided with double mechanical seal, tandem type. The interior seal is self-flushed, the exterior one is flushed with Vaseline oil, thermosiphon circulating through the small pot V305A/S, kept at flare pressure.

Oil low-level and high pressure alarms in the pot signal any seal failure in control room.

The pumps P 304A/S have, on the contrary, a double back to back mechanical seal which is lubricated with Vaseline oil, thermosiphon circulation, kept at 5-6 kg/cm2g pressure with medium-pressure nitrogen and by means of the self regulating valve PCV 2612.

The low level alarm LAL 2603 A/S warns in the control room any failure in the seal system

Operating Parameters/Flow rates:

High pressure degassing (flash drum V 301)

Temperature(TRC 2201) 80 **o**C for homopolymer running

70 **o**C for random copolymer

Pressure(PG 2208) 18.5 kg/cm2

Level (LIC 2201) 30%

High pressure propylene scrubber C 301

Pressure 18 kg/cm2

Top temperature (TI 2308) The equilibrium temp at working

pressure 45 **o**C.

Level (LIC 2301) 50%

Propylene feed drum V 304

Volume 100 m3

Standard level (LIC 2401) 50-60%

Pressure (PIC 2401) 18 kg/cm2

Liquid temp. (TI 2401 A/S) 45 **o**C

Low pressure degassing (F301)

Pressure (PR 2202) 0.5 kg/cm2 set by PIC 2501on suction

of K301 A/S(set at 0.4 kg/cm2).

Temp(TI 2203 –2204) 70 **o**C

Level(LIC 2203) 30% - 50%

START UP AND OPERATION OF DEGASSING/FEED DRUM:

Feed Drum(V304)

Line up the fresh propylene line to V304 by keeping the LV 2401 close on manual.

With LIC 2401 in manual, gradually send the propylene to V304 at flowrates increasing little by little, beginning from 500 kg/h.

During the loading, carry out short venting to the flare from the by-passing of the safety valve to remove the inerts if at all it is required.

When the liquid level in V-304 is within the range measured by LIC 2401, set the instrument in automatic by 30%.

Open the manual valve of the steam to E 302 and those on cooling water to E 305.

Feed propylene to E 302 by opening in manual the valve by 10% until 15 kg/cm2 is reached. Then adjust PIC 2401 to 15 kg/cm2 and change it in automatic.

Gradually increase the pressure upto 18 to 20 kg/cm2g. When the plant is ready for the liquid propylene receiving, proceed with the starting of the pumps P 301A/S.

Perform as follows:

Check oil level in V305 A/S.

Open the manual purge valve on the pump chamber towards V304, it may remain always open when the pump is working..

Ensure that the valves on the delivery are closed.

Open the valves on the suction and delivery line of the pump to be started.

Open in manual the FIC 2402 by 100% and start the pump putting it under recycling to the V 304.

NB:If the main delivery line is closed or if it is under pressure with the consequent closing of the check valve, it is necessary to open the 1” by-pass which jumps over the FV 2402 group(line 1” – PR 2408 – B4A) to start the pump.

b. Degassing (V301/C301/F301/C302):

Check that all the valves in the flash section are close except for:

Connection of V 301 with C 301.

Connection of E 301 with P 302A/S.

Connection of P302 A/S delivery with top of C301 and with V304.

Set the LIC 2301 at 50% and PIC 2301 at 18 kg/cm2g in automatic.

Check that the steam to the flash pipe and the cooling water to E301 is open.

Steam of V 301 bottom coil to be opened.

All other tracing steam to be lined up.

Open flushing line to FT 2201.

Check that the seal pots V306 A/S are with oil and connect them to the pumps P302A/S.

Feed about 2000 kg/h of propylene to the primary flash through FIC 2201 and adjust the TRC 2201 at 70-80 **o**C.

When the level in F301 has reached the 50%, start one of the pump P302 A/S, opening the manual by pass line through RO 2301 (such a connection is necessary to guarantee to the pump a minimum flow rate).

Keeping the valve on the bottom of C301 close, form a liquid propylene head in the scrubber until the pipes of the reboiler E303 are covered. Then, connect LIC 2301 in automatic.

Now, the low pressure degassing section can be started.

Check that the steam to the jacket of the discharge line from C301 is open.

Line up F 301 with C 302 and K 301 A/S and this later with C 301, keeping the polymer discharge valve from V301 (LV 2201) and that from F301 (LV 2203) closed.

Using the pump P 303 charge C302 with oil upto 50% of the level gauge.

Check that cooling water is circulating into E 304.

Start the flushing of the F301 bags (pulsating propylene).

Open the manual valve on the line connecting the top and the bottom of V301.

Using FIC 2203 adjust manually the bottom discharge of the C 301 until the pressure of 0.3 kg/cm2g on the suction line of K301 A/S is reached, after the exclusion of the pressure switch PSL 2502.

Start the compressor K301A (or S).

By FIC 2203 reach the flow rate of 1,000 kg/h.

In this way, the whole degassing section (high and low pressure) is ready for the polymer receiving.

SHUT DOWN PROCEDURE OF DEGASSING AREA:

Temporary shut down:

In case of short programmed shutdown, due to the necessity of soft maintenance interventions either on the reaction or on the downstream section(streaming-drying), its degassing section can run all the same, by operating as follows:

For shut-down due to interventions to be carried out on the reaction:

The reaction shall be stopped, by diluting the reactor and decreasing its temperature by following the formalities cited under “Temporary shut down” procedure in polymerization unit.

Discharge all the polymer along the main process line kept under normal condition running.

Remove the polymer from the flash drum V 301 to avoid agglomerate caused by the reaction on the bottom of the same; therefore close the bottom discharging valve and proceed with the recovery of the propylene vapours by condensating them into E 301 and the storage into V304.

Once the discharge of the polymer (from cyclone V301 into F 301) has been completed, the level controller LIC 2203 is positioned in manual by lowering the level in F301 just above the intervention value of LSL 2205, then close the discharge vee-ball keeping open the gas flow coming from the bottom of the scrubber C301 and from the washing of the bags and flowing out from the top of the bag filter.

The compressor K301 A/S is regularly kept under operation by running under total bypass.

In case of shut down due to interventions to be performed in the downstream sections:

If the steamer or the dryer are to be excluded, the reaction shall be stopped by diluting and cooling as described under “Temporary shut down” procedure in polymerization unit.

All the polymer is discharged from the reactor and from the flash drum, deviating the three way valves HV 2201 placed upstream the bag filter, towards the blowdown V802, where the polymer shall be accumulated and then discharged.

Before stopping the steamer, the level in F 301 shall be reduced to the minimum.

Proceed as usual to the recovery of the vapours from the flash drum.

Failing the gases from the filter, the compressor K301 A/S will automatically circulate on itself through the by-pass line between delivery and suction.

b. General shutdown with emptying of the equipment:

The section is kept under running at normal operation conditions during the whole phase of emptying of the reaction and all the propylene discharged from the bottom of E 301 is sent to the storage.

For the shut down and the emptying of the section, operate as follows:

Completely discharge the powder contained into F 301 and cut off the bottom discharging line.

Empty the bottom of the scrubber C301 setting to zero LIC 2301 and then drain the lower boot through the bottom jacketed line.Ensure that there is a water flow in E303 while draining.

Empty E301 by discharging the liquid to V304 and stop the pumps P302A/S.

At this stage, the compressors K301 A/S and K501 A/S will operate under total recycle. Proceed with the stopping of the machines.

Depressurize to the flare the suction and delivery circuits of K 301 A/S (lines and equipment) through HS 2501 and proceed with the nitrogen purging.

Stop the pump P 304 A/S and proceed with the emptying of the oil from the column towards the exhaust oil recovery section using pump P-303.

In case interventions on the equipment F302, C302, P304 A/S, E304, V303, K301 A/S are required, it is necessary to carry out a washing with clean oil to eliminate any Teal residues by means of the suitable line and P 303.

Then proceed with the emptying of V304 towards the B.L. Inform OSBL to line up propylene receiving. The supply line itself is used to send it back via LV 2401 bypass valve, alternately using the header for the liquid drainage and operating as follows:

Close the propylene arriving from B.L. cutting of the manual valve upstream the LV 2401.

Stop the pump P301A/S and cut off both the delivery and the suction.

Align V304 with the header of the liquid drainage and start with the emptying.

At the completion of the emptying, close the steam to E 302.

Being the section without the liquid , it can be depressurized to the flare completely unless some stagnant point.

Cut-off each single equipment and proceed with the nitrogen purging.

In this phase it will be necessary to make sure that all the stand-by equipment is regularly emptied and then that all the lines involved in the process are treated with nitrogen.

The operator must carefully verify that the plant is firstly emptied and secondly purged everywhere.

The liquid propylene lines are emptied at the required moment by slowly depressurizing them to the flare through the by-pass of the safety valve and the drains provided on the equipment and the lines connected to them.

LIST OF ALARMS IN THE POLYMER DEGASSING AND PROPYLENE RECOVERY UNIT:

FAL 2201 : Vapors flowrate at V301 outlet : 2800 kg/h.

LAH 2201 : Level in V 301 + 20% of the set.

LSAH 2202 : Level in V 301 : 80 % of the range – it actuates I 2201 and

I 2202.

LDA 2203 : Level in F301: = 10% of the set.

LSAH 2204 : Level in F 301 : 2030 mm from top – it actuates I 2203.

LSAL 2205 : Level in F 301 : 1350mm from bottom – it actuates I2204.

IAH 2201 : A301 amperage.

PAH 2201 : Steam to flash pipes : 2 kg/cm2g.

PAL 2201 : Steam to flash pipes : 0.2 kg/cm2g.

PAH 2202 : Pressure in F 301 : 1 kg/cm2g.

PSAH 2203 : Pressure a F 301 outlet : 3 kg/cm2g – it actuates I 2203.

DPAH 2205 :  P between F301 inlet and outlet : 0.05 kg/cm2g.

DPSAL 2206 :  P between F301 and FB 501 : 0.02 kg/cm2 – it actuates

I 2204.

Then proceed with the emptying of V304 towards the B.L. Inform OSBL to line up propylene receiving. The supply line itself is used to send it back via LV 2401 bypass valve, alternately using the header for the liquid drainage and operating as follows:

Close the propylene arriving from B.L. cutting of the manual valve upstream the LV 2401.

Stop the pump P301A/S and cut off both the delivery and the suction.

Align V304 with the header of the liquid drainage and start with the emptying.

At the completion of the emptying, close the steam to E 302.

Being the section without the liquid completely unless some stagnant point, it can be depressurized to the flare.

Cut-off each single equipment and proceed with the nitrogen purging.

In this phase it will be necessary to make sure that all the stand by equipment is regularly emptied and then that all the lines involved in the process are treated with nitrogen.

The operator shall careful verify that the plant is firstly emptied and secondly purged everywhere.

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PAL 2201 : Steam to flash pipes : 0.2 kg/cm2g.

PAH 2202 : Pressure in F 301 : 1 kg/cm2g.

PSAH 2203 : Pressure a F 301 outlet : 3 kg/cm2g – it actuates I 2203.

DPAH 2205 : P between F301 inlet and outlet : 0.05 kg/cm2g.

DPSAL 2206 : P between F301 and FB 501 : 0.02 kg/cm2 – it actuates I-2204.

DPAH 2207 : P between F 302 inlet and outlet : 0.05 kg/cm2.

PAH 2213 : Pressure in V302 : 8 kg/cm2g.

TDA 2201 : Vapors temperature at V 301 outlet : + 10 0C of the set.

TAL 2203 : Temperature at F 301 inlet : 40 0C.

TSAL 2206 : Temperature at V 301 outlet : 50 0C – it activate I 2201.

TSAL 2207 : F301 bottom temperature : 10 0C.

QA 2201 : Intervention signal of I 2201.

QA 2203 : Intervention signal of I 2203.

QA 2204 : Intervention signal of I 2204.

XAL 2201 : A 301 motor shut down.

FAH 2301 : Reflex flowrate to C 301 : 7m3/h.

FAH 2302 : Condensate flow rate to E 303 : 22m3/h.

FAL 2302 : Condensate flow rate to E 303: 10 m3/h.

LAHL 2301 : C 301 level + 20% of the set.

LAL 2303 : E 301 level : 20% of the range.

PDA 2301 : C 301 top pressure : + 10% of the set.

DPAH 2304 : P between C 301 inlet and outlet : 0.2 kg/cm2.

TAL 2301 : Recycle temp. to F 301 : 40 0C.

XAL 2301 : P302 A/S motor shut down – it actuates I 2301.

LAHL 2401 : Level in V 304 : + 10% of the set.

LAHH 2402 : Level in V 304 : 2600 mm on bottom..

LALL 2403 : Level in V 304 : 600 mm on bottom.

PAHL 2401 : Pressure in V 304 : + 5% of the set.

PAH 2402 : Pressure at P 301 A/S delivery : 45 kg/cm2g.

PSAH 2403 : Steam pressure to E 302 : 6 kg/cm2g – it actuates I 2402.

PSAL 2404A/S: Pressure at P 301 A/S suction : 15 kg/cm2g – it actuates I 2403.

XAL 2401 : P301A/S motor shut down – it actuates I 2401.

LAL 2502 : Level in C 302 : 100 mm on L.T.L.

LAH 2503 :` Level in V 303 : 400 mm on L.T.L.

LSAHH 2504 : Level in V-303 : 700 mm on L.T.L. – It actuates I 2501

LAH 2506A/S : Level in K 301 A/S inter stage separator.

PAHL 2501 : Pressure at K 301 A/S suction: 0.4 kg/cm2g.

PSAL 2502 : Pressure at K 301 A/S suction : 0.2 kg/cm2g. It actuates I 2501.

TAH 2501 : Gas temperature at E 304 outlet : 45 0C.

XAL 2501 : P-304 A/S motor shut down.

XAL 2502 A/S: K301 A/S motor shut down.

QA 2501A/S : Signaling of first internal shutdown in K 302A/S

QA 2502 A/S : Signaling of first internal alarm in K 301 A/S.

LAL 2601 A/S : Level in V 305 A/S : 20% of volume.

LAL 2602 A/S : Level in V 306 A/S : 30% of volume.

LAL 2603 A/S : Level in V 307 A/S : 30% of volume.

PAH 2610 A/S: Pressure V 305 A/S : 1 kg /cm2g.

PAH 2611 A/S: Pressure in V 306 A/S : 1 kg/cm2g.

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ZAH 2602 : WS 301 rod position : oil = 40% of volume.

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# POLYMER STEAMING AND DRYING UNIT

Process Description:

Polymer steaming:

This unit includes:

Steaming fluid bed FB 501.( in 2010 fluidized bed replaced with higher capacity plug flow type steamer to cater for increased plant load and better hydrocarbon stripping from powder. This avoided hydrocarbon ingress to downstream with potential for flammable mixture in pellet silos)

.

Steamer cyclone WC 501.

Steamer scrubber C 501.

C-501 condenser E 501.

Steamer scrubber pumps P 501 A/S.

The polymer discharged from the bottom of the bag filter F 301 flows – by gravity – into the steaming fluid bed FB 501. This consists of a vertical – cylindrical vessel (11 m3 volume) fitted with a steam heating jacket, where the polymer comes in contact with steam stream sent to the bottom through a drilled plate.

The steam flow rate is regulated by FIC 2901 and mainteain about 600 kg/hr

The discharge takes place from a small central boot, which is fluidized on the bottom with a steam flow adjusted by FIC 2902 maintaining a flow of 250 kg/hr.

The polymer residence time is in such a way as to ensure the deactivation of the catalyst and the stripping of the monomers.

The wet polymer is discharged to the final drier FB 502 under the level controlled by LIC 2901.

In order to avoid undesired polymer heating the two streams of the fluidization steam are desuperheated by injection into the steam lines of small demi-water flows, controlled by the temperature controllers TIC 2912 and TIC 2913.

High and low pressure alarms (PAHL 2902 and 2903) will signal the clogging situation of the drilled plates and the lacking of the fluidization steam respectively.

The propylene residue entering with the polymer – together with the uncondensed steam flows out from the top of the equipment through the cyclone WC 501. The steam ejector J 501 helps the extraction of the polymer separated from the vapours flowing out.

The pressure in the equipment is depending on the one of the compressor suction K 501 A/S by the PIC 3002.1 and it is equal to 0.15 kg/cm2g approximately. The temperature of the outlet vapours is therefore not higher than 100 **o**C.

The function of the scrubber C 501 is to abate the entrained polymer. It consists of a column provided with 10 trays : the six on the lower part and segmental-baffle type and the four on the upper part are sieve type. The reflux condenser E 501 is directly mounted on the top of the column and it condenses almost all the portion of the steam accompanying the propylene residue.

The bottom of the column is designed in a special manner so that the propylene overflow from the bottom is avoided and the separation of the polymer from the condensate is allowed. It consists of two zones stacked one on top of the other and connected between them by suitable channels, in the lower zone the separation of the polymer takes place while in the upper one with clear water, the control of the level occurs.

The feed to the column is made above the first two trays while a small stream with continuous flow, regulated by FIC 2904, is sent to the top of the bottom zone to help the stripping of the propylene.

The level controller LC 2904 is installed on bottom part of the column and acts on the valve placed beneath which discharge the condensate to the sewer. Moreover it controls the water sent for the cooling of the discharge to sewer upto 50 **o**C approximately.

The pumps P501 A/S make the circulation to the column of the clean condensate taken from the bottom; a portion of this condensate is sent to the reboiler E 303 to supply the vaporization heat, controlled by the flowrate controller FIC 2302 and, therefore, it returns colder to the column by mixing it with the condensate portion remained in circulation.

The total reflux flow rate is measured by the orifice plate FI 2903.

The propylene saturated with water from the top of the C 501 is sent to the compressor K 501 A/S.

The steamer scrubber system is protected against the vacuum by the breathing valve PSV 2912 which calls nitrogen from the circuit of the drier in case of depressurization due to some inefficiency. The system is protected by the two safety valves PSV 2911.1/2 against the overpressures.

b. Purge Gas Compression (K501 A/S):

This unit includes:

Steamer off-gas compressors K501 A/S

Off gas cooler E 504.

Oily fraction collection tank V 502.

The wet propylene from the steamer scrubber C 501 is compressed by the liquid ring type compressors K 501A/S at the pressure required for its returning to the B.L., where it can be recovered in the cracking.

The suction pressure is adjusted by PIC 3002.1 which acts on the compressor by pass and keeps the pressure at 0.15 kg/cm2g, while the delivery pressure is controlled by PIC 3005 placed downstream the cooler E 504 and keeping the pressure of the stream returned to B.L. at 2.5 kg/cm2g.

The second pressure regulator PIC 3002.2 on the suction line of compressor will vent to the flare under a controlled flow rate in case of shut down of the latter.

The pressure switch PSL 3003 stops the compressors in case of low pressure on the suction line.

A small condensate flowrate is fed to the water circuit of the compressor in order to regenerate it. This stream of discharged under the level control by LIC 3001 A/S which are installed on the delivery separators of the compressors and it is recycled to the scrubber C 501.There is a selector switch near the compressors unit, which is required to be selected based on which compressor is running,so that concerned level controller is in line.

The heat exchanger E 504, cooled with chilled water, condenses almost all the water leaden with the propylene which by means of LC 3003 is discharged from the small boot provided beneath the shell of the heat exchanger.

A small tank, V 502, recovers and accumulates the oily water, which is let to decant before the recovery of the separated oily fraction into drums.

The off gases from E 504 are measured with FI 3001 and returned to the B.L.

Since this is practically the unique vent of the plant, it serves to eliminate from the process all the propane introduced with the fresh propylene.

The composition of the vent is therefore connected to the titre of the propylene from the B.L. The sampling point provided wherein will allow the performance of the suitable analysis in the laboratory.

c. Polymer Drying

This unit includes:

Drying fluid bed FB 502.

Dryer cyclone activator J 502

Dryer cyclone WC 502

Dryer scrubber C 502

C 502 cooler E 502

Dryer scrubber pumps P 502 A/S

K.O. drum T 503

Nitrogen blowers B 501 A/S

Nitrogen heater E 503 A/S

From the steamer, the polymer humid with water goes to a fluid bed, where its drying is carried out. It consists of a vertical cylindrical vessel (18.2 m3 volume), fluidized from the bottom with a hot nitrogen stream sent through a drilled plate. The fluidization zone contains a spiral shaped internal baffle which conveys the polymer from the periphery, where it is fed, towards the center of the tank, where the discharge takes place.

From the bottom, the dry polymer is discharged to the pneumatic haulage PK 605 under the level control (LIC 3101).

The level switch LSH 3102 will cut off the discharge from the steamer in case of high level in the dryer.

The dryer working pressure, equal to some hundreds of millimeters of water, is maintained by PIC 3106 which calls nitrogen into the loop on the suction line of the blowers B 501A/S.

The nitrogen from the top flows through the cyclone WC 502, where the entrained polymer dust is separated and extracted from the bottom by the ejector J 502 in which steam/nitrogen is used as activating medium and returned to the fluid bed. Then, it goes through the tray scrubber C 502 (with 4 segmental baffle trays in the lower part and 4 sieve type in the upper part), for the separation of the solid still present and to condense water in nitrogen.

At the bottom of the scrubber there is a decanting zone, where the floating polymer is extracted together with the condensed water through an overflow pipe, which maintains the level. The powder and condensed water fall in a pit from where, clear water goes to OWS as under flow and powder gets accumulated on the top. This powder is periodically removed manually and filled in the bags for further disposal.

The water is let to circulate from the pumps P 502 A/S through the water cooled external cooler E 502, which removes the sensible heat of the gases and that of condensed water. The circulating water flow rate is measured by the orifice plate FI 3105.

The gases from the top of the scrubber, water saturated at 45 **o**C, pass through the drop separator T 503 which has a demister pad and are then recycled to the fluid bed by the blower B 501 A/S, after heating them at 110 **o**C in the finned tube heat exchanger E 503 A/S.

The high level alarm LAH 3104 on T 503 warns the presence of liquid due to inefficiency of the drain line.

The hot nitrogen inlet temperature of the dryer is adjusted by TRC 3106 which controls the heating steam flow rate to E 503 A/S; its flowrates is measured by FI 3101, installed upstream the heat exchanger.

The low (PSL 3105) and high PSH 3108A/S pressure switches are provided upstream and downstream the blowers to protect the circuits and machines. They provide for the shutdown of the blowers in case of lack of nitrogen or clogging of the drilled plates.

The circuit is protected against the overpressures by the breathing valve PSV 3115 which discharges the suction pressure over the 500 mm of water to the atmosphere.

d. Operating Parameters/Flow rates:

Steamer FB 501.

Temperature (TR 2901 – TI 2901) : about 100 **o**C.

Press (PR 2905) : 0.2 kg/cm2g approximately

Level (LIC 2901) : about 50%

Main steam flow rate (FIC 2901) : 1500 kg/hr using MCM1 catalyst.

: 950 kg/hr using other catalysts

Boot Steam flow rate(FIC 2902) : 300 kg/hr with MCMI

: 200 kg/hr with others catalysts

Purge gas compressor K 501A/S.

Suction pressure (PIC 3002.1) : 0.15 kg/cm2g.

Delivery pressure (PIC 3005) : 2.5 kg/cm2g

E 504 temp (TI 3001/TR 3002) : 10 **o**C

Dryer FB 502

Pressure (PR 3101) : abt. 0.1 kg/cm2g

Gas outlet temp.(TR 3102) : abt. 80 **o**C

Fluid bed temperature (TR 3101) : 80 **o**C

Level (LIC 3101) : abt. 50%

Nitrogen flowrate (FR 3101) : 4500/5000 m3/h

Nitrogen temperature(TRC 3106) : 110 **o**C

B 501 A/S suct. press(PIC 3106) : 100 mm of water.

START UP OPERATION OF POLYMER STEAMING/DRYING

Steamer:

Open the steam to the jacket of the steamer FB 501, positioning the set of PIC at 0.3 kg/cm2g.

Send steam to the steamer with the following flow rates:

750 kg/h through FIC 2901

150 kg/h through FIC 2902

Put TRC 2912 and TIC 2913 on auto which will regulate the desuperheating demi water.

Make sure that the bottom discharge of the steamer (LV 2901) is closed and lining FB 501, C 501 and K 501 A/S with the line returning to the B.L.

Full the external circuit for the circulation on C 501 with water and prepare a water head on the bottom by starting one of the pump P 501 A/S.

Send the steam on the bottom of C 501 through FIC 2904 at a flow rate of 30 kg/h.

Open the steam to J 501 and to the jacket of the compensation branch of LT 2901.

Open the cooling water to E 501 and the chilled water to E 504.

Open the cooling water to the cooler of the loop of the compressor K 501 A (or S) and the demi water for the loop filling.

Open the bottom discharge of F 301 and bring the pressure to 0.1 Kg/cm2g on the suction of K 501 A/S.

Start K 501 A ( or S)

Put LC 2904 (C 501 level), PIC 3002.1 and PIC 3002.2 (suction of K 501A/S), LIC 3001 A or S (level of gas liquid separator in K 501 A or S), LC 3003 (boot level beneath E 504) and PIC 3005 (delivery of K 501 A/S) on auto.

b. Dryer:

Fill the external circuit circulating on C 502 with water and make the water head on the bottom, starting one of the pumps P 502 A/S.

Open the cooling water to E 502.

Make sure that the bottom discharge of the dryer FB 502 is closed (LV 3101) and line up FB 502, WC 502, C 502, T 503, B 501A (or S) and E 503 (or S)

Open the make up nitrogen to the circuit, positioning the set of PIC 3106 on the standard running value (100 mm of water) by excluding the PSL 3105.

Start one of the two blowers B 501 A(or S)

Gradually open the steam to E 503A/S, readjusting little by little the TRC 3106 until the standard running value of 110 **o**C has been reached.

Open the steam/ nitrogen to J 502 and open the flushing nitrogen to the compensation branch of LT 3101 and to FT 3101.

c. Operation.

FB 501:

The main variables are the temperature of the fluid bed and the fluidization steam flow rate.

The first is strictly subordinated to the working pressure of the system: temperature variations in the bed should be caused by pressure variations in the downstream gas section (due to problems in the scrubber or due to instrumentation deficiencies) or by problems in the fluidization steam feed lines (lack of steam or instrumentation failures).

Too much high temperatures, that too locally, are to be avoided, since they soften the polymer thus deriving fouling on the walls and clogging in the gratings.

Pressure variations in the fluidization steam shall be warned by PAHL 2902 and 2903, while those of the temperature by TAH 2912 and 2913. The pressure variations on the top of the fluid bed PAHL 2905.

The fluidization steam flow rate depend on the type of the catalysts used in the plant. MCMI and MCGF2A/MCHP2VS/LYNX 1010 gives polymers having different particle size and morphology: bigger for the first and smaller for the second: in relation with this the fluidization speeds are different too. 0.4 m/s for MCM1 and 0.25 m/s for others.

Once the catalyst type has been established, the set of FIC 2901 and FIC 2902 must remain constant irrespective of the load of the plant. In such a case only the bed level can be varied but keeping constant the residence time. If the steam flow rate is reduced, it will deviate from the fluidization optimal conditions, which are of paramount importance for getting the deactivation of the catalyst and the removal of the residual propylene.

FB 502:

Here, the water contained in the polymer must be removed; residence time of the polymer in the bed and the fluidization gas temperature and flow rate are the variables to be checked.

The nitrogen inlet temperature must be in such a way as to guarantee the evaporation of the residual water.

It is to be noticed that a large part of heat is supplied by the polymer itself that gives a portion of its sensible heat.

Said temperature must be neither too much high nor low, in the first case to prevent the polymer from softening, in the second case to avoid condensations in the bed with corrosion risks.

The temperature alarms TAHL 3106 warn the deviations from the set value on the inlet gas, the TAH 3101 warns the increase in the bed temperature.

The fluidization speeds to be kept are more or less the same as the steamer: their constancy is ensured by the roots blowers and measured by FI 3101 fitted with low point alarm to warn any troubles, in the nitrogen circuit.

Another variable to be considered in case of shutdown and subsequent restarts, is the oxygen content in the cycle; before loading the polymer, it is necessary to analyze in the laboratory its content which must be lower than 2000 ppm.

Higher values would make the quality of the polymer worse.

**SHUT DOWN PROCEDURE OF STEAMING AND DRYING SYSTEM**:

Temporary Shutdown:

In case of short programmed shut down due to interventions to be performed upstream section, operate as follows:

Operate in the reaction and degassing section as described, the temporary s/d of polymer degassing C-3 (a).

Discharge as much polymer as possible to FB 501; then set in manual the level controller LIC 2901, reducing the level until the completion of the emptying.

Keep the scrubber C 501 under operation and open the water to E 501 to condense the reduced flow rate of the inlet vapours.

Since there is no presence of propylene, the condenser E 501 will condense almost all the water vapours, therefore the compressor K501 A/S will run under nearly total recycle.

If possible, the dryer FB 502 will be emptied as much as possible from the polymer (completely, if desired) and then close the discharging valve LV 3101.

Keep the blower B 501 A/S under running; reduce the set of TRC 3106 in order to maintain the temperature of the residual polymer within the standard operating values (in case the dryer has not been emptied)

b. Long Term Shut Down:

After removal of the polymer from the bag filter F 301, the emptying operation of

the steamer FB 501 to be started.

By manually operating on LIC 2901, completely empty the FB 501. Then close the bottom valve LV 2901, the fluidization steam and that for jacket heating (PV 2901).

Close the demi water for desuperheating of the fluidization steam (TRC 2912 and TRC 2913).

Close the steam to the jacket of the compensation branch of LT 2901, the stripping steam to C 501 (FV 2904) and that to the ejector J 501.

When the outlet of the vapours from FB 501 is finished, the compressor K 501 A/S will run under total recycle. After the machines have been stopped, close the make up condensate to the compressor water circuit and the tower water to its cooler. Then, depressurize the line and the equipment upstream the compressor to the flare by opening the manual by pass valve of the PV 3002.2.

Drain the water of the compressor ring and of the gas liquid separator to the scrubber C 501.

Stop the pumps P 501 A/S and remove the water from the circuit using the appropriate manual valves.

Close the raw water for cooling of the water discharged to the sewer (LV 2904.2). Position in manual LC 2904 and discharge to the sewer the water contained in the scrubber C 501.

Close the cooling water to E 501.

Purge with nitrogen the whole suction system of K 501A/S and vent the flare.

Close the chilled water to E 504 and drain the heat exchanger boot to V 502 positioning in manual LC 3003.

Once the water is eliminated, depressurize to the flare all the delivery line upto the valve at the B.L., opening the manual by pass valve of the PSV 3010.1/2 and positioning the PIC 3005 in manual.

Then, proceed with the nitrogen purging.

After the complete emptying of the steamer and once the bottom valve beneath it is closed, it is possible to empty the drier FB 502.

By manually operating on LIC 3101, remove the polymer completely from the dryer.

The pressure of the pneumatic haulage PK 605 will indicate that the polymer discharge has been complete.

Close the bottom valve LV 3101 and stop the pneumatic haulage. Close the steam to the heaters E 503 A/S and steam/N2 to the ejector J 502.

Close the nitrogen through FICV 3104 (flushing of the tap of dPT 3601) and through FICV 3103 (flushing of the compensation branch of LT 3101).

Close the tower water to E 502 and stop the blower B 501 A/S, letting a small flow of nitrogen through the PIC 3106 to prevent the loop from going under vacuum due to natural cooling.

Stop the pumps P 502A/S and drain the external water circuit as well as the scrubber C 502 through the suitable valves.

At this stage, the whole dryer circuit is completely stopped and blanketed with nitrogen through PIC 3106. Close the nitrogen completely, after it has been cooled at ambient temperature.

**LIST OF ALARMS OF POLYMER STEAMING AND DRYING UNIT**:

FAL 2903 : Water flowrate to C 501 : 30 M3/h.

LAHL 2901 : FB 501 level + 10% of the set.

LAH 2902 : FB 501 level: 2700 mm on L.T.L. – it actuates I 2204.

LAH 2905 : C 501 level : 2800 mm on L.T.L.

PAH 2902 : Steam pressure to FB 501 : 0.7 kg/cm2g.

PAL 2902 : Steam pressure to FB 501 : 0.2 kg/cm2g.

PAH 2903 : Steam pressure to FB 501 boot : 0.4 kg/cm2g.

PAL 2903 : Steam pressure to FB 501 boot : 0.2 kg/cm2g.

PAH 2905 : FB 501 top pressure : 0.25 kg/cm2g.

PAL 2905 : FB 501 top pressure : 0.1 kg/cm2g.

TAH 2902 : FB 501 temperature : 105 **o**C

TAL 2902 : FB 501 temperature : 90 **o**C

TAH 2903 : E 501 outlet temperature : 48 **o**C

XAL 2901 : P 501 A/S motor shut down.

LAH 3007 : V 502 level : 700 mm on L.T.L.

PAHL 3002.1 : K 501 A/S suction pressure + 10% of the set.

PAH 3002.2 : K 501 A/S suction pressure : 0.17 kg/cm2g.

PSAL 3003 : K 501 A/S suction pressure : 300 mm of water – it actuates I-3001.

TAH 3001 : E 504 temperature : 12 **o**C

XAL 3001 : K 501 A/S motor shut down.

QA 3001 A/S : Signaling of first internal shut down in K 501 A/S.

QA 3002 A/S : Signaling of first internal alarm in K 501 A/S.

FAL 3101 : Nitrogen flow rate to FB 502 Low: 4000 Nm3/hr

FAL 3105 : Water flow rate to C 502 Low: 25 m3/h

LAHL 3101 : Level in FB 502 : + 10% of the set.

LSAH 3102 : Level in FB 502 : 2400 mm on L.T.L. – It actuates I 3101

LAH 3104 : Level in T 503 : 500 mm on L.T.L.

PAH 3101 : FB 502 top pressure : 0.12 kg/cm2g.

PSAL 3105 : B 501 A/S suction pressure : 50 mm of water– it actuates I 3102 – I 3103

PSAH 3108A/S: B501 A/S delivery pressure 0.37 kg/cm2g – it actuates I 3102 – I 3103

PAH 3110 : B501 A/S delivery pressure : 0.35 kg/cm2g.

PAL 3110 : B 501 A/S delivery pressure 0.15 kg/cm2g.

TAH 3101 : Temperature in FB 502 : 85 **o**C

TAH 3102 : WC 502 outlet temperature : 85 **o**C

TAH 3103 : C 502 inlet water temperature : 50 **o**C.

TAH 3104 : B 501 A/S suction temperature : 50 **o**C

TAH 3106 : FB 502 inlet nitrogen temperature : 125 **o**C

TAL 3106 : FB 502 inlet nitrogen temperature : 95 **o**C

XAL 3101A/S : B 501 A/S motor shutdown.

XAL 3102 : P502 A/S motor shutdown

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# BEAD PNEUMATIC CONVEYING AND POWDER STORAGE

PROCESS DESCRIPTION:

This unit includes:

PP beads transport to storage silos, PK 605 package, including:

Powder pneumatic haulage feed hopper T 601.

T 601 filter F 603.

Rotary feeders X 601 A/S

Silo filters F 601 A/B

Blower safety filters F 602 A/S

Pneumatic haulage fans B 601A/S

Blower intake cooler E 601

Pneumatic haulage blowers B 602A/S

PP beads/flakes storage silos SI 601 A/B.

Rotary feeder X 603.

Polymer cyclone WC601

PP Powder from drier is discharged to T 601 hopper; the dPIC 3601 keeps constant the pressure difference between FB 502 and T 601 venting nitrogen flowrate relevant to the vent from rotary feeder X601A/S to atm.

The rotary feeder X 601 A/S feeds the solid to the pneumatic haulage. This consists of the fans B 601A/S, which retake the outlet gas from silos giving it the required head to face the pressure drop on the return line and of the blowers B 602A/S which transfer the solid from hopper to storage silos and to additive proportioning line.

The pneumatic haulage pressure is regulated on the suction line of fans B 601 A/S by PIC 3604, which calls network nitrogen to compensate circuit leakages. It also establishes the working pressure of the silos.

The filters F 602 A/S on the delivery of fans protect the blowers from any massive entrainments of solid due to rupture of bags of filters F 601 A/B installed on silos.

The clogging of F 602 A/S is warned by dPAH 3607 in the panel.

The back nitrogen is water cooled in the finned pipe heat exchanger E 601 before its compression in blowers B 602 A/S. A further cooling is carried out in cooler E 604 (finned pipe heat exchanger) to avoid an excessive heating of gas carrying the polymer.

A vent provision at B602 suction is provided to vent out circuit nitrogen in case of potential hydrocarbon build up through PIC3604A.

Solid is conveyed to storage silos or to proportioning line of additives using diverter valves HV 3603-3604-3605; usually it is sent to one of the two storage silos SI 601 A/B and only periodically to cyclone WC 601 on the top of additives line.

The carrier gas from silos is filtered by bag filters F 601 A/B returns to fans B 601A/S. The cleaning of filter bags is carried out with nitrogen in cyclical manner by pulsator valves.

The silos are protected against the overpressure and the vacuum by the breathing valves PSV 3631 A/B.

The solid quantity in the silos is kept low to get available the maximum storage volume in case of shut down of the downstream line.

STARTING POWDER CONVEYING (PK 605)

Select powder silos SI 601 A/B which is to be loaded by operating HS 3618. This will automatically trigger KV 3605 A/B (depending on the silo selected), which is the pulse gas valve for cleaning of filter F 601A/B.

Thru HS 3606 select blower B 602 A/S which is to run.

Ensure:

Selected blower’s suction valve is open(permission from ZSH 3601 A/S). B 601 a or S is running.

Suction pressure is higher than 70 m bar i.e. set point of PSLL 3610. If suction pressure is less than an alarm is given thru PSL 3609. PSLL 3610 actuates stop of blower (can be bypassed).

Bypass thru exclusion key XSL 3601 A/S depending on the blower selected.

Discharge valve on PSV of concerned blower B 602 A/S is open

Select by means of HS 3615, B 601 A/S. Ensure all valves on the blower which is on line is open

Ensure: B601 A/S is running.

Press HS 3602, hold it pressed, and then release it.

Press HS 3614 start button to start B601A/S

Press HS 3601 start button to start B602 A/S

Check the B602 A/S delivery pressure is higher than set point of PSL 3613 which is 0.07 kg/cm2g. Otherwise X601 A/S will stop. Interlock can be bypassed thru key. Ensure delivery pressure of B602 A/S is lower than the set point of PSH 3613 which is 0.75 kg/cm2g. Otherwise X601 A/S will stop. Interlock can be bypassed.

Thru HS 3616 select X 601 A/S which is to be run. Press HS 3602 once more, hold it pressed, then release it. This will open HV 3620 A/S of selected rotary valve.Press HS 3607 Start button to start X 601 A/S.

Note : X 601 will not start if there is a valve opening mismatch or of LAHH exists in the silo selected for loading.

When HS 3601 is pressed following actions take place:

HV 3602 opens.

B602A/S starts.

HV 3602 closes after some delay

KV 3605 A/S starts.

When HS 3618 position is changed (silo changeover)

HV 3602 opens.

HV 3604 changes position.

HV 3602 closes.

When HS 3612 (blender loading) is pressed:

X601 A/S stops and HV 3619 A/S closes

HV 3603 and HV 3605 position changes.

HV 3608 opens.

X603 starts starting KV 3602.

X601 A/S starts and HV 3619 A/S opens

Meanwhile when HV 3603 and HV 3605 changes position, HV 3602 opens and closes to take care of pressure imbalance.

Blender loading termination command:

X601 A/S stops,HV 3619 A/S closes

HV 3608 closes, KV 3602 closes

HV 3603 and HV 3605 changes position.

X601 A/S starts,HV 3619 A/S opens

Meanwhile HV 3602 goes on opening and closing to take care of pressure imbalances.

HS 3607 start button:

HV 3620 A/S opens.

X601 A/S starts.

HV 3619 A/S opens.

LIST OF ALARMS WITH VALUES

B602

PSH 3614A 0.75 Kg/cm2g

PSH 3614S 0.75 Kg/cm2g

PSLL 3610 20 MMWC

SI 601A

LALL 3601A Conical portion

LAHH 3602 A 85%

Additional five point level alarms are there at 0%, 20%, 40%, 60% and 80%.

SI 601B

LALL 3601B Conical portion

LAHH 3602B 85%

Additional five point level alarm are there at 0%, 20%, 40%, 60% and 80%.

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# ADDITIVE METERING AND EXTRUSION

ADDITIVE METERING DESCRIPTION:

The powder is continuously discharged from silo bottom to the weighted hopper of metering unit PK 601. The powder flow rate by weight is kept constant acting automatically on the number of revolutions of extractor feeding the polymer to the continuous mixer WM 602.

A portion of powder is periodically diverted to cyclone WC 601, to prepare in the downstream chain the additive polymer mixture.

The separated nitrogen is recycled through diverter valves HV 3604 and HV 3605 to storage silos and then, after filteration in F601 A/B, to fan B 601A/S.

The powder is fed to mixer WM 601 by slide valve HV 3608 and rotary feeder X 603. The quantity is controlled by the balance WT 3602 which interrupts the feed when the required quantity is achieved and controls the closing of slide valve and the stopping of rotary feeder.

The solid additives in bags are fed to mixer WM 601, entire number of bags is loaded and weighing of the missing fraction of bag is made with platform scale WW 602.

The mixing with PP powder has the purpose to dilute the quantity of additives to guarantee uniformity and flowability of mixtures necessary to obtain very accurate proportions.

The mixer runs in discontinuous by charging the ingredients in the established ratios. It is fitted with chilled water cooling jacket to cool the polymer powder which is hot from the pneumatic haulage and to keep some low melting additives under solid state.

After completion of homogenization, the polymer additives mixture is fed by gravity and by subsequent quantities discharged to the intermediate hopper T 603 provided with agitator and the hopper in its turn will fed the gravimetric proportioning system PK 602 working by weight difference.

Opening and closing of HV 3610 slide valve placed between hopper and proportioning systems is carried out by WSL and WSH 3603.

The proportioning systems PK 601 and PK 602 feed the PP powder and additives to mixer WM 602, mixing the two streams continuously.

All vents from blanketing system of the two chains of additivation up to extruder are sucked by fans B604 A/S and vented to atmosphere through bag filter F604, where the entrained solid is separated.

This filter is fitted with bag washing system with compressed air, alarm of P to warn any fouling (dPAH 3620) and high level alarm system on bottom (LAH 3607).

B. EXTRUSION DESCRIPTION:

The extruder PK 603 is a twin screen co-rotating closely intermeshing compounder. It is driven by a 3.4 KW, 11 KV motor and carries a gear unit for stepping down rotational speed to two levels of 226 rpm through gear step I and gear step II lower speed to 181 rpm.

There are mainly three zones in the extruder, viz: (a) Compaction zone, (b) degassing zone, (c) metering zone.

Each zone is made up of multiple screw barrels with internal bores to accommodate heating coils and coolant flow, required for maintaining uniform temperature in the different zones. The barrel internal bore has a shape of a figure of “8”.

The twin screws of the extruder have a changing profile and are mounted with staggered kneading discs at specified points. The pitch of the screw also changes from zone to zone and in the zones themselves to do the different actions required within.

In the compaction zone the pitch of the screw is much less than the same for the other zones and the screw is also given a sealing profile thus effecting (a) high shear of polymer (b) narrow residence spectrum, (c) no over working of individual particles of the product, and (d) self cleaning of the screws.

In the degassing zone the pitch of the screw increases again and the diameter also increases restoring the sealing effect and prevailing any backflow of polymer melt. The angle of inclination of the screw flight with the hub, i.e. the root angle of the flights decreases and ensures a smooth unbroken melt flow with a steady pressure gradient, This is the metering zone.

In between the degassing and the metering zone there are a few rounded triangle shaped kneading disc mounted in staggered fashion on the screw. This ensures that the additives are mixed well in the polymer melt and a good homogeneity of the melt with respect to properties at different points of the same is achieved.

PK603

PAH 3728.1/2

SUV

SPC

DIE

M

M

M

L

P

P

T

T

F

M

M

M

OIL HEATING UNIT

SPC UNIT

FAL3725

TAH3735.2/3

SUV UNIT

LAL3725

PK604

SAL

3701

E602A/S

OVERSIZE

T 604

LALL3702

WS601

TAH 3701

TAL 3701

FAL 3703

WW601

TO SILOS

P601 A/S

F 607 A/S

PDAH 3704

PK603 EXTRUDER IN PP

SI 601A

SI 601B

SC 601A

SC 601B

H 601

PK601

PK602

WM602

WM601

T603/A601

TO PK 603

**POWDER AND ADDITIVE METERING BLOCK DIAGRAM**

The polymer additives mixture enters the extruder PK 603. This item of equipment provides for the melting, the homogenization and the transformation of the fed mixture into pellets.

The pellets as well as the carried and cooling water are fed to the separator/drier PK 604, equipped with an agglomerates catcher and an air suction fan. Here, the water is separated and sent back to the T 604 for recycle, where as the pellets are screened through screener WS 601 for the separation of the coarse pellets. The satisfactorily sized product is weighted by the scale WW 601, then it falls into the hopper T 605, wherefrom it is fed to the pneumatic haulage PK 606, served by the compressor B 603A (or B603 S), through the rotary feeders X 602 A/S.

In B 603 A/S, sucked air is filtered by F 606 A/S; delivered air is cooled in the finned tube, water cooled exchanger E 603.

The water separated by the drier PK 604 returns to the collection basin T 604, wherefrom it is recycled through pumps P 601A/S.

Before entering T 604, DM water is filtered in F 609.

The water temperature is controlled through TIC 3701 that operates the valves TV 3701.1/2 by diverting a certain water amount to the cooler E 602 A/S.

The water flow rate is controlled through FI 3703. This circuit has a pair of filters on the pump discharge (F 607 A/S) to capture any fines.

C. SCREEN PACK CHANGER, TYPE SWZ (OVAL) DESCRIPTION:

The SWZ is used for filtering thermoplastic melts in compounding plants, mainly for polyolefins and polystyrene with high throughputs.

Description:

The SWZ screen pack changer (with cylindrical filter elements) consists of the housing and the slide plate installed in its across the melt flow. This plate has 2 bores to take up the support plates with the filter elements. Cooling plates connected to a cooling circuit are installed on both sides of the slide plate.

The slide plate is driven by a hydraulic cylinders installed on the side of the housing and controlled by a valve. The hydraulic unit is in compact design. It is installed next to the machine and is connected to the hydraulic cylinder by high pressure hoses. The unit consists of the hydraulic pump with drivemotor, the pressure accumulator, the overflow valve, the pressure switch and the pressure gauge.

The housing and slide plate can be heated intensively with steam or oil.

The new SWZ oval screen pack changer has as its distinctive characteristic a slide plate with an oval cross section which is tightly guided on all sides in the housing.

The melt is sealed by product solidified by cooling in a sealing gap running among the entire circumference of the slide plate guide (thermal sealing).

This screen pack changer permits the filter to be changed without any interruption in production. In less than 1 sec, the slide plate is pushed out of the working position into the other so that the filter elements loaded with filtrate can be removed from the melt flow and fresh elements installed.

Exchangeable cylindrical filter element are held in the bores of a support plate. Each element consists of a support basket and a wire mesh filter insert. In the seamless support baskets, the perforations at an optimum distance from each other are in a uniform geometrical design. Instead of the relatively thickwalled support plate of the plate type unit, the walls of the support basket are only a few mm thick. The pressure build in the screen pack changer is therefore considerably reduced.

The filter inserts are usually in two layers and are suppliable for the usual filter mesh gauges.

In comparison with the plate type filter, the cylindrical filter is smaller but has the same filter area. Sealing diameters are therefore smaller, and a better sealing effect is achieved.

Attention:

The filter changing operation must never be carried out while the unit is cold or if the machine is at a standstill, but only while production is being carried out.

When the 4/3 way valve is operated, it must be ensure that the lever is moved out of the zero position to the right or left hand final position quickly. Slow movements cause the hydraulic liquid to lose pressure. After the filter change, return the lever back to the neutral zero position.

Switch off the hydraulic unit and make it pressure less by opening the accumulator drain cock. Observe pressure drop on the pressure gauge.

Remove the filter element support plate with the elements, which has been retracted from the product flow, the slide plate, using asbestos gloves. Remove any remaining melt from the slide plate with a spatula.

Clean the support plate and the elements completely.

Install the clean support plate and the elements about 2 hours before the change is planned. Clean the slide plate surfaces very thoroughly and apply MOLYKOTE (white) to the sliding surface. Charred polymer remaining on the sliding surface can lead to impurities in the melt.

Stopping the Unit:

Both the filter chambers of the slide plate must be empty before the machine is stopped. When the filter chambers are full, it takes much longer to heat the machine up when it is started up again.

Filter dismantling the nozzle plate and cleaning the inside surface of the pelletizer head housing the filter element support plate must be removed.

Filter cleaning intervals:

The filter cleaning intervals generally depend on the specific throughput (throughput per unit area) degree of contamination of the product, mesh-width of the gauge, kind of gauge (rectangular mesh or lace type gauge, the arrangement (layers of gauge), the design of the gauge support.

The intervals do not depend on the shape of the filter body (plate, conical or cylindrical shape).

D. DETAILED START UP LOGIC

Gear indication

When gear I or gear II is manually engaged for respective position, gear I or gear II light (limit switch) indication appears on mimic panel which energizes respective Torque limitation systems. This is one of the condition for extruder start up.

On gear system I extruder will turn at 226 rpm and on gear system II it will run at 181 rpm. Gear operating lever manual change over should be operated only during extruder stopped condition.

Friction coupling pneumatic system for gear.

One of the condition for extruder start up is Desch coupling engagement. Friction coupling will be engaged after 10 sec. of solenoid valves being energized for gear system II. Solenoid valve for gear system I or gear system II will be energized if following conditions are satisfied.

Gear system I or II operating manual lever is put in right position(Limit switch indication.

There is no rpm difference (more than 4 rev/two min) between motor shaft rpm and gear input shaft.

Desch coupling operating switch on extruder control roompanel is pressed manually.

In this case Desch coupling on (red light indication) will appear on extruder C/R panel.

d. Whenever there is high air pressure in gear system I or II Desch coupling will disengage and light indication appears on extruder control room panel with alarm and at the same time following equipments are stopped immediately.

PK 601, PK 602, WM 602 feeding extruder, WS 601.

Extruder main drive or auxiliary drive (whatsoever is running).

Clutch is disengaged.

Gear oil system:

If control voltage is available, press oil pump start switch, red light indication will appear. When pump starts running, and oil pressure is more than 2 kg/cm2g, one of the condition for extruder start up gets fulfilled.

If oil filter gets choked, oil filter alarm appears in extruder control room panel.

If oil pump fails or oil pressure below 1.0 kg/cm2 or oil temp is more than 65 **o**C alarm appears in extruder control room panel.

In case oil pump fails or oil pressure falls below 1 kg/cm2g, PK 601, PK 602, WM 602 and extruder main drive or auxiliary drive stops immediately. In case oil temp does not come down below 65 **o**C within 4 mins of high temp alarm (TAH) : PK 601, PK 602, WM 602 will be stopped.

Heating and Cooling System:

Heating system: After establishing proper oil circulation,start oil heating and with steps of 20 **o**C every 10 mins raise the oil temp to 270 **o**C. Simultaneously start electric heaters for zone I to V.

After temp attains the set values a timer starts which on expiry of two hours, will give “Extruder pre heated’ signal on extruder control room panel. In case it is assured that the barrel and screw have attained the desired temp, then waiting for timer is not essential. “Pre heating timer” bypass switch can be engaged to by pass position (This is to be done only for shutdown-start ups within ½ an hour of each other.

Cooling System : For starting cooling unit press “Cooling Unit 1 or 2” switch, cooling water pump will start resulting in red light indication on “cooling unit” on switch.

If thermo couples are OK, cooling unit is running and extruder preheated light indication available or pre heating timer by pass switch is operated, one of the condition for extruder start up gets fulfilled.

If heating system or cooling unit fails or barrel temp goes above 290 **o**C (breakage thermo couples) or barrel temp goes below 275 **o**C (low temp) alarms sound in extruder control room panel.

Screen Pack Changer Hydraulic Unit: When safety guards over screen pack changer, screen I or II are put in position, automatic valve on accumulation closes, at the same time pump for screen pack changer ready to start light appears (ensure accumulator automatic valve bypass hand operated valve is in close position). The pump can be started by pressing screen pack-changer start switch on Ext. local panel. In case there is no pressure indication in hydraulic unit P.G. the pump will automatically start and run.

Until the hydraulic unit pressure reaches 180 bars. Subsequently, if the pressure drops below 130 bars the pump will start automatically.

The pump will also gets stopped if screen pack changer guards not in position or “Vessel pr. Less” switch is operated on ext local panel.

Barrel Pressure: Whenever screen changer body upstream pressure goes to 100 bar an alarm of “Excessive melt Pressure” sounds in extruder panel. If this pressure goes above 180 bars PK 601, PK 602 WM 602 and ext. main drive/aux. Drive stops immediately and clutch is disengaged.

Die Head Pressure:

Whenever Die Head Pressure goes above 100 bars an alarm of “excessive melt pressure sound in extruder control room panel and at 180 bars it activates PK 601, PK 602, WM 602, ext main drive /aux.drive stoppage and clutch is disengaged.

P Across Screen Pack Changer:

Whenever P across screen pack changer increases 100 bars an alarm of “melt pressure difference” sounds at extruder control room panel. If this pressure difference goes beyond 150 bars PK 601, PK 602, WM 602 main drive/auxiliary drive stop immediately and clutch gets disengaged. Normally screen pack changer pump is actuated when P = 80 bars.

Classifying Screen:

If control voltage is available and B 603 A/S is running classifying screen start switch is pressed in extruder control room, the screen motor starts red light indication appears in stat switch. Running of classifying screen is one of the conditions for extruder start up.

If classifying screen fails, an alarm comes in extruder control room panel, if T 605 high level appears an alarm sounds in extruder control room. In both the cases diverter valve on dryer d/s gets diverted towards ground.

Centrifugal Dryer with suction fan:

If control voltage is available, press suction fan start switch, suction fan running light will glow in start switch. If suction fan is running, press centrifugal dryer running light will glow in start switch. Running of centrifugal dryer is one of the conditions for extruder start up.

If suction fan fails an alarm sounds in extruder control room. If centrifugal dryer fails or its speed sensor switch sends low speed signals an alarm of centrifugal dryer failed sounds in extruder control room followed by PK 601, PK 602, WM 602 ext main drive stoppage.

Slide Gate of Agglomate Catcher:

If control voltage is available, slide gate of agglomerates catcher can be opened or closed from extruder control room switch or local switch.

Diverter valve at downstream of dryer:

If control voltage is available diverter valve can be operated towards ground or towards classifying screen, provided screen is running, pressing switches in ext. control room or from local switch.

Start up valve:

Start up valve can be diverted towards ground provided that following conditions are satisfied.

Control supply is available.

Die head pressure is below 85 bars.

Pelletising unit by pass switch is in bypass position in local panel.

Diverter valve towards ground switch is pressed on local panel.

When above conditions are fulfilled Hydraulic Unit Pump starts (which maintains oil pressure between 150-180 bar) start up valve gets diverted towards ground, and after 3 secs hydraulic pump stops. Start up valve towards ground indication glows in the local panel switch. Positioning of diverter valve towards ground is one of the conditions for ex. Start up provided pelletizing unit bypass switch is not kept in by pass position.

Whenever start up valve switch towards ground is operated, if start up valve final position is not reached within 5 sec, an alarm of “SUV Final position not reached” sounds in ext. control room panel followed by hydraulic pump stoppage and PK 601, PK 602, WM 602 and extruder main drive/auxiliary drive stoppage. If there is problem in hydraulic pump alarm will would in Ext. Control Room for hydraulic unit SUV.

SUV is not to be operated in extruder cold condition.

Under Water Pelletizing cutting water pump:

For starting cutting water pump the following conditions to be fulfilled:

Control voltage is available.

There is sufficient water level in T 604 pellet water tank

When above conditions are fulfilled press pump I or pump II start P.B. from Ext. C.R. (The pump suction/discharge valves opening must be ensured)

Cutting water circuit bypass is in open position and the diverter valve towards

extruder is in close position.

b. Cutting water flow is more than 80%. It is to be adjusted around 90-95% by

adjusting P601A / P601S discharge valve.

c. Prior to pump running LP steam to be opened in the tank and temp controller in ext. Control room is to be set at 50 **o**C. In case the pump stops running on T 604 gets empty, alarm immediately extruder feeding system. PK 601, PK 602, WM 602 stops with main drive stoppage/auxiliary drive (Stoppage when pellet cutter motors is in boxed up condition). In case cutting water temp goes below 50 **o**C or above 70 **o**C or bypass valve final position is not reached alarms of pellet water temp min., pellet water temp maxi, final position of bypass not reached sound respectively in Ext. C/R. Whenever pellet water circuit press at die head is less than 1.5 kg/cm2 an alarm of pellet water press min sound in Ext C/R followed by Ext/Auxiliary drive stoppage and feeding unit PK 602 WM 602 stoppage. Whenever start up valve switch it is pressed towards die, cutting water is directed towards die plate. If within 5 sec the cutting water pressure does not exceed 0.7 kg/cm2 ,an alarm of pellet water pressure min sound in ext. C/R followed by extruder and feeding unit stoppage immediately.

If cutting water flow comes below 80% an alarm of pellet water flow min sound in C/R followed by extruder and feeding system stoppage immediately.

Note : Only one pump of P 601A/S can be run at a given time.

Pelletizer Drive:

If thyristor ready to start light is available and pelletizer trolley limit switch is in pressed condition. Press thyristor unit start PB on local panel. On pressing this switch excitation on thyristor will start. At this moment pelletizer ready to start light will appear on local panel. Press pelletizer motor start PB pelletizer will start running within 10 sec increase pelletizer RPM 400, otherwise pelletizer motor will be stopped. If pelletizer motor starts running and start up valve button towards die is operated, after 1 sec the pelletizser shaft will move in forward direction by operation of solenoid valve.

Under water pelletizing with knife adjustment:

If oil level at the oil cylinder is low an alarm of knife adjustment, oil level low will appear on extruder control room panel, once pelletizer is started within 10 sec pelletizer speed is to be increased above 400 rpm (alarm of speed knife cutter min will appear in Ext C/R panel).

Whenever during running,if the speed comes below 400 rpm Ext. stops immediately with powder of additive feeding under PK 601, PK, WM 602 .If cutter torque goes above 70% setting,an alarm of pelletizer overload appears in Ext. C/R with immediate stoppage of Ext along with powder and additive feeding units. If cutter motor fail or thyristor fails an alarm of “thyristor main fuse” alarm sounds at ext. control room along with stoppage of extruder and feeding units. In case pelletizer top hood limit switch is not in pressed position Ext. and feeding unit will stop immediately. In this case pelletizer motor will stop and knife will retreat to its backward position.

Auxiliary Drive/Main Ext. Start up:

For running ext and auxiliary drive following conditions are to be fulfilled.

Main power supply is available, switch on master switch light of control voltage will show on Ext. C/R Panel.

Ext. oil pump is running.

Ext. heating and cooling circuit has been commissioned and temp of barrel has been steady at set values for more than two hours.

Press clutch in extruder C/R, this will engage clutch.

Switch for selector Ext low or high speed.

Switch S1 is in bypass position, when cutter motor down stream equipment are not running. Cutter motor is fixed in position. Start up valve is towards ground. Classifying screen a running pellet conveying circuit is in operation.

Once above conditions are satisfied auxiliary drive ready to start appear on extruder local panel, press auxiliary drive start switch on local panel.

Auxiliary motor will start running. Torque indication will go to max and it will gradually come down. Once it comes below 30% Torque and remains below this value for more than 30 sec. Ext. main drive ready to start light will appear on extruder local panel.

The pellets transfer system should always have an empty silo or a silo being emptied, the amount contained in each of them being continuously controlled to avoid full silos. Now start the main drive.

The various groups forming part of this section will have to be checked for during the operation viz.

Powder pneumatic haulage PK 605.

Powder and additives metering systems to the extrusion unit (PK 601 and PK 602)

Continuous mixer W 602.

Extrusion unit PK 603.

Pellets transfer system to the storage/analysis silos.

This is required to ensure that the operating parameters are within the tolerances specified and to prevent any failures that might cause sudden shut downs.

E. OPERATION PROCEDURE:

Switch on main switch.

Charge all panels and PLC.

Release emergency stop.

Switch on hot oil unit pump I or II after checking oil level in tank.

Establish a flow at 20 m3 /hr (corresponding to 70.0 m bar)

Switch on oil heater and gradually increase temp to 270 **o**C at 20 **o**C steps every 10 minutes. (Initially due to low temp., FSL 3735 may be in actuated condition and hence it can be taken in bypass for heating to start, later key is to be taken in line).

Start lube oil pump and establish pressure.

Start pellet water pump under circulation.

After establishing temp in barrel start cooling pump with a setting of solenoid valve at position III.

Start centrifugal dryer suction fan and then start centrifugal dryer.

Start vibrating screen.

Start belt weigher(if its working else keep its bypass in line)

F. SHUT DOWN OF THE GRANULATION SECTION:

Stop the main drive.

Drain the cutting water hold up through the drain valve after diversion of HV3701 towards T604.

Disconnect pelletizer.

The other equipment being stopped are the metering systems, the pellets transfer to the storage analysis silos and then the powder pneumatic haulage.

Should the shut down be less than two hours, it is advisable to keep the auxiliary circuit operating, so that everything is ready for the restart up.

In case of longer shutdowns, the extruder temperatures should be lowered down (100 **o**C tentatively) to avoid the degrading of the polymer inside the extruder.

G. DESCRIPTION OF STARTING CONDITIONS AND INTERLOCK FOR PELLETIZING PACKAGE.

Starting conditions.

General starting conditions. Power supply and control voltage OK.

Preparing ZSK and auxiliary units:

Starting of hot oil unit. Starting of hot oil pump. Provided : Oil level is OK (LAL 3735) (I 3771)

Switch on oil heaters. Provided: Oil level is OK (LAL 3735) (I 3771), Pump P603A or pump P 603S is running (I 3772) (I 3773). Oil flow OK (FAL 3735) (I 3774), or FSL 3735 is on bypass. Oil temperature OK (TAHH 3735.2) (I 3770).

Starting heating procedure for barrels.

Starting of barrel cooling unit. Starting of cooling water circulation pump P602A or P602S.

Temperature supervision. Provided – Thermocouples are OK(TSH 3728.1-10) (TSH 3735.1) (I 3750).

Starting of lube oil system – Starting of lube oil pump P604A or P604S (I 3740)

Switch gear interlock. Choose gear I I (226 RPM) or gear 2 (181 RPM) (ZS 3724.1) (ZS 3724.2). Provided – Speed is zero (SSL 3724).

Engaging and interlock of coupling.

Provided: Gear 1 or gear 2 is engaged (ZS 3724.1) (ZS 3724.2)(I 3726). No coupling trouble which means :- Instrument air pressure is OK – Self supervision of control unit to desch coupling is OK – No speed difference (SDSH 3723) (I 3725)

Starting of pelletizing system:

Before starting the pelletizer the following preparation is to be done.

Units for pellet water circuit OK which means:

Filling of pellet water tank T 604. Water level equal or higher (LSH 3702) equal or lower (LSH 3702)

Heating of pellet water.

Water diverter valve direction bypass (SZL 3701 A) ZSH 3701 B) (I 3731).

Starting of pellet water pump P 601 A or P 601 S. Provided : Valves for selected pump are open water in bypass (SSL 3701 A) (ZSH 3701 B) (I 3731). Water level in tank T 604 OK (LSLL 3701) ( I 3734)

Supervision of pellet water filter F 607. Provided: Differential pressure (PDISH 3704) lower max.

Supervision of water flow rate. Provided : Water flow higher min (FSL 3703) (I 3732).

Unit for pellets treatment OK which means.

Starting pellet conveying system.

Starting weighing scale WW 601.

Diverter valve (HV 3704) direction weighing scale(HS 3704). Provided: pellet level in inlet chute of weighing scale (LSH 3704) lower max weighing scale is running. Else keep it in bypass.

Starting classifying screen WS 601.

Diverter valve (HV 3703) direction ground (HS 3703) direction HS 3703 until pellets are OK then direction to classifying screen (WS 601) by hand switch (HS 3703).

Provided: Pellet level in hopper T 605 (LASH 3703) lower max classifying screen (WS 601) is running (I 3706).

Starting exhaust fan for dryer

Starting centrifugal dryer PK 604.

Provided: Exhaust fan is running (I 3704).

Open slide gate for agglomerates open to ground (HS 3702.1), (HS 3702.2) until pellets are OK then close slide gate by hand switch (HS 3702.2).

Opening slide gate by hand switches (HS 3702.1) (HS 3702.2) from time to time for discharging of agglomerates.

When all these conditions from point 1.1 to point 1.3 are fulfilled and start up valve AV is directed to ground the ZSK (PK 603) is ready for start.

Starting of ZSK (PK 603)

The ZSK (PK 603) is started by the auxiliary drive.

Provided: Readyness for start (Point 1.1 to 1.3). No oil lube trouble ZSK (I 3740). Oil lube temperature is OK (TSH 3722) (I 3742). No trouble at coupling (SDSH 3723) (I 3725). Melt pressure in transition piece lower max. (PSHH 3728.1) (I 3754) Melt pressure in pelletizer head lower max (PSHH 3728.2) (I 3756). Torque max (XSHL 3725) (I 3727).

Starting of ZSK main drive.

Provided: 30 Sec delay expired after start of auxiliary drive. Torque lower min (SHL 3725) (I 3727) – Readyness for start (Point 1.1 to 1.3). still OK – 30 sec, after start of main drive the auxiliary drive is switched off automatically.

Starting of feed system WM 602.

Provided: Main motor is running.

Diversion of melt by start up valve AV direction die plate (ZSK 3730.2).

Diversion of melt by start up valve AV direction ground (ZS 3730.1). Provided: Product which leaves die plate is in a proper condition. Now there are two versions for continuing the start up procedure.

Version A : Fast start of pelletizer (See 2.6.A)

Version B : Interrupted start of pelletizer (See 2.6.B)

a)In case of fast start of pelletizer while ZSK is running and product goes to ground following steps have to be carried out:

Cleaning of die plate – mounting of pelletizer, starting of pelletizer. Provided: Thyristor auxiliaries on pelletizer hood closed (ZS 3732.1) (I 3758).

Diversion of melt by start up valve AV direction die plate (details see point 3).

b)In case of interrupted start of pelletizer following steps have to be carried out:

Switching off feed system WM 602.

Switching off ZSK main drive.

Cleaning of die plate.

Mounting of pelletizer.Provided Thyristor auxiliaries on

Pelletizer hood closed (ZS 3732.1) (I 3758).

Starting of ZSK as described above.

Starting of feed system WM 602.

Product which leaves the start up valve AV direction to ground is ok

Diversion of melt by start up valve AV direction die plate (Details see point 3).

Description of diversion procedure:

When actuating the push button “diversion” the following sequence is started: After some delay, the solenoid valve for knife adjustment (YV 3733) is actuated. After some delay the start up valve is diverted to die plate(ZS 3730.2). After some delay the pellet water diverter valves HV 3701A and HV 3701 B are diverted to die plate (SSH 3701 A) (ZSK 3701 B) (I 3731).

Description of screen pack change: When the pressure difference PDSH 3728 at the screen pack changer has reached a certain point 80 bar the screen has to be changed as follows:

Closing of safety guards (ZS 3731.1) (ZS 3731.2) (I 3752), - Starting of hydraulic unit. The hydraulic pump P 606 charge the accumulator until a certain pressure is reached (PSLH 3731) (I 3753) 150 bar, Reducing feed rate WM 602, Actuating of hydraulic valve, Increasing of feed rate WM 602.Provided : Slide plate has reached the end position.

**Interlocks**:

Feeding system WM 602 stops if:

Level in feed chute (LSH 3701) (I 3607) is higher max.

Main drive stops (I 3720).

Main drive PK 603 stops if there is:

Dryer drive failure (SSL 3701) (I 3705).

Classifying screen drive failure (I 3706).

Pellet water pressure lower min, higher max (PSL 3705), (PSL 3705), (I 3730)

End position of pellet water diverter valves not reached (ZSL 3701A) (ZSH 3701B) (I 3731).

Pellet water flow lower min (FSL 3703) (I 3732)

Pellet water pump drive P 601 a or P 601 S failure (I 3733).

Main drive temperature high max (TSH 3721.1-8) (I 3721)

Main drive torque lower min idle running (JSL 3721) (I 3722).

Main drive torque higher max (JSH 3721), (JSHH 3721) (I 3723) (I 3725).

Lube oil pump drive failure (I 3740)

Lube oil pressure lower min (PSL 3722) (I 3741).

Lube oil temperature higher max (TSH 3722) (I 3751).

Start up valve AV trouble.

End position not reached (ZS 3730.1) (ZS 3730.1) (I 3751).

Melt pressure in transition piece higher max (PSHH 3728.1) (I 3754).

Melt pressure in pelletizer head higher max (PSHH 3728.2) (I 3756)

Differential melt pressure at screen pack changer higher max (PDSH 3728) (I 3755)

Pelletizer torque higher max (ZSH 3732) (I 3760)

Pelletizer speed lower min (SSL 3732) (I 3759)

Pelletizer drive failure (I 3762)

Pellet treatment trouble.

Auxiliary drive PK 603 stops if there is:

Trouble at desch coupling (SDAH 3723) (I 3725).

Auxiliary drive torque higher max (ZSHL 3725) (I 3727).

Lube oil pump drive failure (I 3740).

Lube oil pressure lower min (PSL 3722) (I 3742)

Melt pressure in transition piece higher max (PSHH 3728.1)(I 3754).

Melt pressure in pelletizer head higher max (PSHH 3728.2) (I 3756)

Main drive failure during start up (I 3720)

Desch coupling opens if there is:

Main drive torque higher max (JSHH 3721) (I 3724).

Speed difference at desch coupling (SDAH 3723) (I 3725).

Melt pressure in transition piece higher max (PSHH 3728.1 (I 3754)

Air press 1 higher max (PSH 3723.1)

Air pressure 2 higher max (PSH 3723.2)

Self supervision actuated (system trouble).

Melt pressure in pelletizer head higher max (PSHH 3728.2)(I 3756).

Start up valve to ground if there is:

Pellet water flow lower min (FSL 3703) (I 3732).

End position is not reached (ZS 3730.2) (I 3751).

Pelletizer stops if there is:

Pelletizer hood open (ZS 3732) (I 3732)

Main drive failure (I 3720).

Oil heating unit:

Heaters are switched off if there is

Oil temperature higher max (TSHH 3735.2) (I 3770)

Oil level lower min (LSL 3735) (I 3771)

Neither pump P 603 A nor pump P 603 S is running (I 3771) (I 3773).

Oil flow lower min (FSL 3735) (I 3774).

Diverter valve HV 3703 to ground if there is:

Pellet level in conveying system T 605 higher max.

Classifying screen drive failure (I 3706).

Diverter valve HV 3704 by passing weighing scale WW 601 if there is:

Level in inlet chute of weighing scale higher max (LSH 3704)(I 3707).

Weighing scale drive failure (I 3707).

Pellet water pump P 601 A or P 601S stops if there is:

Level in water tank T 604 lower min (LSLL 3702) (I 3734).

End positions in water diverter valves not reached HV 3701 A,HV 3701 (ZSL 3701 A) ( ZSH 3701 A) (ZSL 3701 B) (ZSH 3701 B) (I 3731).

Pump P 601A and P 601 S running.

Pellet water diverter valves in by pass if there is:

Pelletizer hood open(ZS 3732.1) (I 3758).

H. OPERATING PARAMETERS:

Heating barrels:

1. Supervision zone 0 100 0C

2. Heating zone 1 250 0C

2 250 0C

3 250 0C

4 250 0C

3. supervision zone 5 250 0C

6 250 0C

7 250 0C

8 260 0C

9 230 0C

4. Oil heating unit 280-290 0C

5. Melt temperature 240 0C

6. Melt pressure SPC 60-135 bar

7. Melt pressure die plate 60-135 bar

8. Differential pressure 20-60 bar

b. Cooling unit:

1. Barrel cooling water pressure at barrel inlet 9-10 kg/cm2g.

2. Barrel cooling water in-flow temp 60-80 0C

3. Temp diff between inlet/outlet 13.4 0C max

c. Extruder capacity.

0.2 to 0.4 MFI 8.5 Tn/hr

0.6 to 0.9 MFI 9.0 Tn/hr

1.5 to 10 MFI 10.0 Tn/hr

12.0 to 18 MFI 11.5 Tn/hr

LIST OF ALARMS:

SSL 3701 Centrifugal dryer drive failure. Main drive stops.

LSL 3702 T604 pellet water level low.Alarm in control room and make up valve open.

LSH 3702 T604 pellet water level high. Alarm in control room and make up valve closes.

FSL 3703 Low flow of pellet water below 80% pelletizer and main drive stops.

PSL 3705 Pellet water pressure lower than 1 kg/cm2g.

PSH 3705 Pellet water pressure higher than 4 kg/cm2.

TSH 3721.1-8 Winding and bearing temp of main motor. Alarm at 90 0C

And trip at 95 0C

JSL 3721 Main drive running idle at 25% or below torque. Main

Drive trips after a delay of 6 mins.

JSH 3721 Main drive torque higher than 105% main drive.

JSHH 3721 Stops.

PSL 3722 Lube oil pressure lower than 1 kg/cm2g.

TSH 3722 Lube oil temperature higher than 65 0C.

SDSH 3723 Friction coupling slippage more than 4 rev. in 2 min.

SDAH 3723 Main drive stops.

PDSH 3728 Differential pressure across screen pack changer high. Alarm at 100 bar and main drive trips at 150 bar.

PSHH 3728.1 Melt pressure at upstream of SUV high. Alarm at 150 bar and main drive trips at 180 bar.

PSHH 3728.2 Melt pressure at die plate high alarm at 150 bar and main drive trips at 180 bar.

TSH 3728.1-10 High temperature at extruder barrels.

SSL 3732 Pelletizer speed lower than 400 rpm.

XSH 3732 Pelletizer torque higher than 120 %

LAL 3735 Low level in hot oil tank. Heaters are switched off.

FAL 3735 Low flow of oil in hot oil circuit. Heaters are switched off.

TSHH 3735.1 High melt temperature main drive trips at 300 0C.

TAHH3735.3 High temperature in oil heating unit. Alarm at 285 0C when heaters are switched off.

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**CHAPTER - II G TO N**

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# PELLETS CONVEYING, HOMOGENISATION/STORAGE

PROCESS DESCRIPTION:

This unit includes:

Pellets analysis and storage silos SI 701 A thru D.

Homogenisation silo SI 702.

PP pellets transport to homogenization silo, bagging machine silo and off grade silo, PK 702, including:

Pneumatic haulage blowers B701 A/S.

Intake air filters F 701 A/S

Delivery air cooler E 701.

Delivery air filter F 702.

Rotary feeders X 701 A thru D.

Rotary feeder X 702

The polymer pellets are transferred by the air pneumatic haulage PK 606 to various destination, namely : the four silos SI 701 A thru D, 150 m3 each for storage: The distribution to various silos is carried out by the diverter valves HV 3801, 3802, 3803 and 3804.

Each silo is fitted with high and low level alarm system and very high level switches which cut off the feed to the pneumatic haulage (stopping the rotary feeders X 602 A/S) if the operator has not diverted the product to another silo.

Each individual silo receives the pellets, segregated based on hourly lab analysis from extruder, as per grade requirement. After the lot is complete, which is normally of 75 MT, is then transferred to SI 702

The transfer is carried out with PK 702 air pneumatic haulage. The sucked air is filtered, compressed by blowers B 701A/S, cooled with water in the finned tube cooler E 701 before coming in contact with polymer to be transferred. This is discharged from the silo by the rotary valves (X701A thru D) and sent to destination. Normally in homogenization, 2 cycles are given i.e. for 2 hr at its normal conveying rate of 40 MT/hr. After homogenization a sample is given for lot analysis. The lot is then transferred to SI 703 / SI 704.

Conveying system

System I

Operating procedure

Take all instruments in line. Field switches of blowers and rotary valve should be kept on auto and stop push button.

Open the disch valve of the blower to the selected for conveying.

Ensure cw inlet/outlet valves of E 603 are open.

T 605 bottom valve to rotary feeder (X 602A/S) and the d/s valve of the rotary feeder should be opened.

With the 3708 select the blower to be taken in line..

With the help of selector switch HS 3810, select the silo to be loaded.

(SI 701 A,B,C,D and SI 704).

Press the start push button HS 3814, and check the correct diversion of the diverter valve (Green LED shows the position of the diverter).

Start the blower with the help of HS 3707 A and check the disch pressure, on panel (when disch silo in empty condition the blower disch press ranged from 65 m bar (SI701A) to 95 m bar (SI 704). There should not be dPAH alarm for filter F 605. Before starting the blower, there should not be PSH and PAH alarm, on panel.

Ensure that no LAHH alarm persists on the selected silo and see that the same silo is not selected for unloading.

Select the lined up rotary up valve (X 602A/S) with the help of selector switch and start the selected for unloading.

After starting the rotary valve check the disch pressure and proper conveying of the pellets. Speed of the rotary valve can be varied with the help of hand wheel mounted. On the rotary valve. The max conveying capacity is 15 T/ Hr.

Change over of silo

Following are the steps for change over.

Stop X 602A/S rotary valve with the help of HS 3058 wait for 20 sec and then select the required silo with HS 3810 and HS 3814. Before 20 sec silo can not be selected as 20 sec time is given for line cleaning. After selecting the silo pressure check the correct line up of diverter valve (Green LED) when silo selection is over again start the rotary valve and X 602 A/S.

System –2

Conveying system from daily silos (701 A/B/C/D) to Homogenization silo (SI 702) for Homogenization silo circulation and conveying to Bagging silos (SI 703 and SI 704).

Procedure

Take all instruments in line. Ensure that switches of blowers and rotary valves are on auto and stop push button released.

Open the disch Valve of the blower to be selected for conveying (B701A/S)

Check that C.W. inlet/outlet valves of E 701 (Blower disch cooler) are open.

With the help of selector switch HS 3709 select the blower (B 701A or B 701S) to be taken in line.

With the help of selector switch HS 3812 select the silo (SI 701a/B/C/D and SI 702) to be unloaded.

With the help of selector switch HS 3813 select the silo (SI 702, SI 703, SI 704) to be loaded and press the start push button HS 3815 and see the proper diversion with the help of green LED, check the proper diversion of HV 3806 and HV 3901.

Ensure that no LAHH alarm persists for the silos to be selected for loading (SI 702, SI 703, SI 704).

Before starting the blower, ensure that no TAH, PSH or dPAH (F702) persist on the panel.

Start the blower with the help of start push button switch HS 3707A. After starting the blower check the disch press (It should be approx in the range of 75 m bar to 90 m bar when line is empty.)

Check that the bottom isolation valve of the selected silo for unloading is in close condition.

Open the bottom valve (HV 3805 A/B/C/D or HV 3807) with the help of start push button switch. HS 3811 A and check the opening of the bottom valve by green LED and consequently see that the u/s Rotary valve (X701 A/B/C/D or X 702) start.

The speed of the rotary valve can be adjusted with the help of hand wheel provided on the rotary valve. Normally once fixed, it need not be changed.

After the rotary valve has started check the disch press of the blower and proper conveying of the pellets by opening the bottom valve of silo slowly.

If any of the PLC fails other PLC will take care and after rectifying the failed PLC again the push the required start push button (Although system is running) It is to feed data to rectified PLC.

3. B603 A/S change over procedure : Say B 603 is running (selector is on B 603 S).

Start B 603A on manual is field.

Stop B 603S from C/R

Press reset on panel in C/R

Select B 603A on panel and press reset.

Give start command for B603A, just to normalize the sequence.

Put B603A field AUTO/MAN switch on AUTO sequence to be followed for B603S if B603A is running.

List of Alarms Pneumatic Conveying of Pellets:

PI 3709 At 40 m bar or below, pressure, B603 and X 602 trips leading to drive trip.

At 750 m bar or above pressure X602 stops. Rotary valve restarts once pressure falls.

PI 3803 At 30 m bar pressure B701 and X701 A-D stops.

At 750 m bar or above pressure X701 A-D stops rotary valve restarts once pressure comes down.

LAH on silos Only alarm.

LAL on silos Only alarm.

LAHH on On alarm of very high level in silos SI 701 A-D, SI 702

Silos SI 703 and SI 704, rotary valves on unloading silos stops

and rotary valve will start automatically if LAHH disappear.

# BAGGING

DESCRIPTION OF THE FULLY AUTOMATIC VALVE BAG FILLING STATION:

The product is fed into the valve bag filling station via two storage silos. When the respective hand operated slide valves are opened, the product is directed through the inserted pneumatic shutter box and pipe conduit into the connecting hopper. The connecting hopper is equipped with level indicators for minimum, maximum level.

From the bottom part of the hopper, the product is fed into the net weigher over a pressure relief. The shutter proportioning system(working in course flow and dribble feed) doses the preselected weight in the weighers.

The weighers load buckets empty as soon as the weighing process signaled to be completed and valve bag have been placed in to the spouts of the centrifugal belt filling unit.

The product reaches the weigher dumping hoppers, is directed into the gravity tubes, and is filled into the bags from the centrifugal belts.An automatic bag placer serves to place the valve bags into the filling spouts. In case it is not operable, bags are place manually and button near packer is pressed to start filling.

Alter filling, the pusher pushes the bag into its sealing position. A heat sealing unit moves into working position and the valve is automatically sealed. Presently automatic sealing operation is not in use.

Thus, the filled bags are dropped on to belt conveyor by an automatically operated bag carrier and finally reach the pelletizer.

FUNCTIONAL DESCRIPTION OF CONVEYOR SYSTEM.

At the automatic operation the bags move from the bagging conveyor via the bag flattener,metal detector, checkweigher etc. If the bags containing metal is passing through the metal detector,it senses it immediately and rejects it outside on rejection conveyor by means of activating a pusher.In case of metal detector sensing a metal, it gives an audible alarm in the field and an alarm in control room. Similarly if the gross weight of the bag passing through is beyond minimum weight(25.20 Kg) and maximum weight(25.40 Kg), then it gets rejected by means of the pusher. Only okay to pass bags are sent to inclined conveyor. On this conveyor manual sealing is performed.

FUNCTION DESCRIPTION OF THE PALLETIZER:

On turning grate roller conveyor the bag stop as soon as it reach it and are turned by 900. The turning grate is lifted by means of pneumatic cylinders, turned by 900 by motor and then lowered again. Reaching the lowest position of the turning grate, the turning grate roller conveyor is restarted and the bag is transported on the infeed roller conveyor. Three such bags are stored on infeed conveyor and then layer feeder pushes these bags on loading plate. Next two bags go to

**WEIGHERS**

BAG REJECTION

FOR METAL

**A B PACKERS**

DISCHARGE CONVEYOR TURNING

GRATE

PALLETIZER INCLINED CHECKWEIGHER METAL

CONVEYOR DETECTOR BAG

FLATTENER

BAG REJECTION

FOR OVER WT/

UNDER WT

**FLOW DIAGRAM OF PP BAGGING : PK 701 A/B**

activated and side plates press these and loading plate opens to feed these bags on pallets.

The layer feeder plate raises when reaching the final positions in order to enable the forming of a new layer and the layer feeder returns into its initial position. Reaching its initial position the layer feeder plate is lowered again and thus ready for the next loading process.

The loading plate only opens if any empty pallet or a partially filled pallet in the distance of normal drop height is lying underneath the loading plate. As soon as the loading plate is open, the layer forming device returns into the initial position of the pressure plate lowers for a set time.

The pallet lift lowers (the pressure plate retracted) until the loading plate can be closed and then only raises upto the transfer position. This position is controlled by photocell underneath the loading plate occupied by the partial layer or empty pallet. Layer by layer the formation of the stack continues up to preset value of 8 to12 layers and each layer is made mirror imaged.

After reaching the preselected layer number the pallet lift moves down to the lowest position. The loaded pallet leaves the palletizer and automatically new empty pallet enters.

Approx 200 mm before empty wooden pallet has reached its final position on the loading conveyor, the pallet pusher actuates a proximity switch during its forward movement disconnecting the drive of the loading conveyor is achieved.

In its final front position the pallet pusher actuates a proximity switch stopping the forward movement, activating the automatic pallet change introducing the return of the pallet pusher. In its back initial position that pallet pusher is stopped by a proximity switch.

After this process a new pallet is released by the empty pallet magazine.

The pallet fork lower until the lowest position has been reached(confirmed by proximity switch) and the fork retracts. Now the fork lifts until the fork can penetrate into the second empty pallet. As soon as the fork has extended the fork again raises upto the upper position. Now the lowest pallet is free and is pushed by the pallet pusher towards the waiting position and waits there until the next pallet change is introduced.

After completion of the palletizing process the loaded pallet is transported on the downstream pallet discharge conveyors. When all conveyor are occupied, the FLT driver must remove the last pallet.

The electrical control system is equipped in such a way that the complete line can be switched on backwards, that means first of all the palletizer, then the transport conveyors and last the packing machine. Stopping the equipment is done in reverse order

In order to guarantee a faultless operation of the palletizing line, take care of the following.

Two bag must always be spaced continuously and with a certain distance to each other onto the transport conveyors.

The bag must be capable to be stacked and transported and must not be damaged.

Sufficient empty pallets must always be in the empty pallet magazine but not more than 10 . The refilling of the empty pallet magazine should be made when only 1-2 pallets are in the magazine (after the pallet change).

The loaded pallets must be removed.

VELOX – CENTRIFUGAL BELT:

The centrifugal belt is located underneath the gravity tube. From the gravity tube, the product is directed via the inlet spout to the filling spout for the filling of valve bags with either inside or outside valves. Open mouth bags can be filled by means of an additional bag spout which is clamped onto the filling tube.

It is recommended to place a collecting bin below the drain of packers to have

the dust/pellets (if belt is damaged) collected.

Drive is transmitted from the motor by means of V-belts to the driving pulley (check direction of rotation prior to start up).

The compressed air cylinder with rubber washer will clamp the valve bag onto the filling spout.

Maintenance and Servicing:

Tensioning the belt:

By turning the tensioning screw upward the belt is being tensioned over the tension lever with return pulley.

On detecting that the belt is slipping on the driving pulley retensioning is necessary.

Adjusting the belt:

Contamination between the belt and the pulley may cause the belt to side slip. Therefore, it is necessary to clean the unit frequently (depending on the dust development) and to remove contamination by suction.

However, if a belt continues to side slip even after carefully cleaning, re-align the belt auto center position of the pulley by trimming the pulley by means of pressure screws towards the bearing.

The belt usually side slips to the side on which the belt is less tensioned. However, fast running belt or slack ones may reach differently when started.

DESCRIPTION OF THE HEAT SEALING UNIT.

The bag clamp opens upon the expiry of the filling time of the centrifugal belt packer, and the bag is pushed off the filling spout by means of cylinder on bag carrier.

At the same time cylinder serves to spread the valve. When its end position is reached, cylinder has the heat sealing unit moving to the bag. When the end position is obtained, the sealing tongue is closed by cylinder and the valve is being heat sealed by an impulse unit.

During this process, cylinder moves the bag into the discharge position. When the bag is in discharge position, the next bag is being placed and filled.

Upon termination of the heat sealing process, cylinder has the bag dropped onto the belt conveyor, and the closing process is terminated.

Bagging is done as per lot wise and lot number changes with silo number for example:

001 06 89

001 Lot No

06 for month

89 year

For another silo lot no 001 will change.

TECHNICAL DATA SHEET:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Description | Equipment No | Weight of unit | Material of const | Manufacturer |
| Connecting hopper | PK701A/B | 37 kg | SS 1.4301 | Grief-werk |
| Weigher dumping hopper | PK701A/B | 53 kg | SS 1.4301 | Grief-werk |
| Electronic net weigher N50-KD-EM | PK701 A/B | 300 kg | SS 1.4301 | Grief-werk |
| Bag filling device | PK701A/B | 50 kg | SS 1.4301 | Grief-werk |
| Storage hopper | PK 701A/B | 650 kg | SS 1.4301 | Grief-werk |
| Cut of valve, Manually operated Piping system | PK 701 A/B | 650 kg | SS 1.4301 | Grief-werk |
| Valve bag closing and tilting stations | W 709 A/B | 430 kg | SS 1.4301 | Grief-werk |
| Valve bag Placer | BP701A/B | 1550 kg | Normal sheet | Grief werk |
| Operating platform | PK701A/B | 420 kg | Normal sheet | Grief werk |

# K301 A/S RECYCLE GAS COMPRESSOR

RECIPROCATING TWO STAGE COMPRESSOR

DATA SHEET:

A. Conditions Stage 1 Stage 2

1. Percentage full load 100 100

2. Intake pressure(kg/cm2g) 0.357 5.267

3. Intake temp ( 0C) 45 40

4. Discharge press. ( kg/cm2g) 5.607 20.417

5. Discharge temp (0C) 108.8 88.14

6. Capacity at inlet(m3/hr) 695

B. Total B.H.P. 134

C. R.P.M.

COMPRESSOR LUBRICATION SYSTEM:

GENERAL

The compressor is equipped with a self contained force feed lubrication system for the bearing and running surfaces of compressor frame and running gear. Parts lubricated by the frame lubrication system include the main crank shaft journal bearing, crankpin bearing, crosshead pin bushing and cross head. Oil is delivered to the cylinder parts in metered quantities by mechanical force feed lubricator.

Lubrication for rubbing surfaces is intended not only to reduce friction (and consequently wear between parts) but also to carry away any heat developed where high rubbing speeds and loads are encountered.

Frame and Running Gear Lubrication System.

The oil flow through the lubrication system is as follows:

The oil is drawn from the frame sump. Through a screen type strainer and into the crankshaft driven gear type oil pump. The pump forces the oil through cooler and then through a filter. The cooled and filtered oil then flows under pressure to the main crankshaft journal bearing located at the oil ump end of the frame and from there through drilled passages in the crankshaft to the crankpin bearing and drive and main bearing. A rifle drilled hole through each connecting rod conducts the oil from the crankpin to the crosshead pin bushing located in the small (eye) end of the rod. The oil then enters the hollow crosshead pin from where it is distributed to the pin surfaces and the crosshead shoes. After passing through and lubricating the various parts, the oil drains back into frame sump.

There is a minimum amount of oil piping in the standard frame lubrication system. Most of the oil flow is through internal passages in the compressor parts. External piping delivers oil from the pump discharge to the cooler and from cooler to the filter. The short tubing line conveys oil under pressure from the drive and main bearing to the oil pressure gauge and also to the low oil pressure shut down switch. The tubing runs between the oil sump strainer and the oil pump suction connection is the only internal piping used in the system.

A spring loaded ball check type relief valve protects the lubrication system from excessive oil pressure resulting from:

Low ambient starting temp.

Clogging of oil filters.

C. Frame oil pump:

The frame mounted oil pump is a gear pump with two rotating gears, it is driven directly off the end of the compressor crankshaft.

The oil pump covers pump spacers and the main bearing housing incorporate drilled passages which direct oil flow to and from the pump. The pump shaft rotates in flushing which are lubricated by pump leakage. The pump shaft extends through the cover and is used to drive the mechanical cylinder lubricator and applicable units. An oil seal is installed around the pump shaft to prevent oil leakage at this point.

D. Motor driven auxiliary pump:

This pump is used as priming pump and can be used as back up pump for the main frame oil pump. This pump has built in relief valve to prevent excessive discharge pressure.

E. Low oil pressure protection:

The compressor is equipped with an automatic safety shut down device which monitors the lubricating oil pressure at the drive end main bearing and initiates stopping the unit when the oil pressure drops below the set point. The device is a snap action electrical switch which trips to shut down the machine at the decreasing oil pressure. An oil pressure gauge is fitted to the shutdown switch to indicate the pressure at switch.

It is necessary to keep this protective device inoperative during the starting period to permit the frame oil pressure to build above the rising pressure setting of the switch.

COMPRESSOR COOLING SYSTEM

Compressor, cooling can be done by three methods namely, circulated cooling water, static cooling and thermosyphon cooling. In this compressor cooling is done by circulating water.

Circulating cooling water:

Cooling water removes some of the heat from compression and frictional heat from the cylinders. While filling the cooling system prior to starting the unit, it is important that all air is removed from the cylinder passages and jackets to assure complete and uniform cooling of cylinder during operation.

If the water inlet temperature is above the gas inlet temperature to the cylinder no condensate will form in most of the cases.

Should condensate form on the cylinder walls and gas passage, it will tend to break down the lubrication qualities of oil and cause excessive wear to the cylinder piston rings and valves and possibly result in valve breakage.

Should the compressor be started without turning on the cooling water, shut the unit down immediately. Do not turn the cooling water on until the cylinder walls have had chance to cool, otherwise a cracked cylinder wall may result where the compressor is to be shut down for more than the minute, do not leave the water circulating in jacket or it can cause condensate to form an cylinder wall.

REGULATION:

Two basic method for capacity control are commonly used:

Inlet valve unloading.

Clearance pocket unloading.

Inlet valve unloading:

If the channels or plates in a cylinder inlet valve are forcibly held open by some mechanical means, the gas can not be compressed. The gas which enters the cylinder on the suction stroke is pushed back into the inlet passage of the cylinder, passing freely back through the open inlet valve, during the discharge stroke without being compressed. This unloads the end of the cylinder containing the unloader device.

Clearance pocket unloading:

A clearance pocket is normally cast as an integral part of the cylinder outer head. The amount of capacity change from adding clearance volume to the cylinder is function of the type of gas being compressed, the amount of clearance volume added and the compressor ratio.

By adding additional clearance volume to a cylinder end, a reduced quantity of gas is delivered during the compression portion of the stroke because part of the gas passes into added clearance volume instead of out the discharge valve. On the suction portion of the stroke, the gas in the added clearance volume extends into cylinder end, transferring energy to the piston and delaying the opening of inlet valve. Therefore NO ENERGY IS WASTED BY CLEARANCE CONTROL.

INITIAL START UP

Following are the procedures for initial start up compressor.

Check that the filter (strainer) has been installed in propylene inlet line to compressor. Also check to see that all blinds have been removed from piping and that no pipe strains have been introduced during erection and hook up of the process piping.

Check as far as possible into the inlet and discharge line for foreign objects. Check all lines and compressor valves for proper location flow, direction and position.

The compressor must be completely unloaded for its initial start.

Check oil level in frame sump and force feed lubricator.

Manually operate each lubricator pumping unit by pushing down the plunger cap to ensure lubricating oil is available to cylinder bore and piston rod packing rings.

Manually turn the compressor through several revolutions in the direction shown by the arrow located above the frame oil pump to make certain that moving parts are clear and more freely without blinding.

Turn on the cooling circulating water in the circuit.

It is necessary to “lock out” the frame oil system pressure shut down switch to permit the machine to be started.

Start and then immediately stop the driver/motor driven units only to determine the direction of motor and compressor rotation.

Run the compressor for five minutes. While operating check the frame sump oil level shown on the gauge glass located at the oil pump end of the unit; add oil if necessary to bring the operating oil level to the line on the gauge glass. Also check the frame oil pressure gauge. Check the cooling water flow and temperature, watch for signs of excessive heating, unusual noises or other abnormal conditions.

Shut down the unit, immediately, without giving the part time to cool, remove the frame and crosshead inspection covers, feel the main crankpin bearing, crosshead pin bushing and cross head running surfaces to see if any parts are overheated. Investigate any overheating and eleminate the conditions causing it. Reinstall inspection covers.

If everything appears to be normal, restart the compressor and operate it continuously for one hour at no load. Stop the machine and once again check running parts for excessive heating. The compressor cylinder must also be examined as follows:

On lubricated cylinders, examine the cylinder bore for satisfactory lubrication. Also check the piston rod and packings for adequate lubrication and normal temperatures.

The compressor is now ready to start, purge and load as per the operation and service.

ROUTINE STARTING:

Check the oil level in the frame sump and refill as required to bring the operating oil level to the level in gauge glass. Do not overfill, as rotating parts may strike the oil surface which can cause the oil to foam and restrict in the drop of oil pressure.

Refill the lubricaor oil reservoir. Leave the pumping unit feeds at same setting.

If starting after several days priming of oil pump may be required.

Manually operate each lubricator pumping unit, by pushing down the plunger cap several times, to ensure an initial supply of oil to the cylinder bore and piston rod packing.

Manually turn the compressor through atleast one complete rotation to be sure that all moving parts are clear.

Unload the compressor.

Turn on the cooling water supply and check to be sure the cooling water system is operative.

Run the compressor with no load for few minutes to warm up the unit. Listen to unusual noises during the warm up period.

Check the oil pressure in the frame lubrication system; check each feed of the force feed lubricator for oil flow. Check cooling water flow and temperature.

When the unit is warmed and running satisfactorily, the compressor may be loaded.

ROUTINE STOPPING

Unload the unit, step by step.

Press the stop button and stop the driver.

Shut off the cooling water supply after some time if the compressor is to be STOPPED FOR LARGER PERIOD.

Prepare the unit so that it can be started on short notice.

Manually turn the compressor through atleast one complete rotation to be sure that all moving parts are clear.

Unload the compressor.

Turn on the cooling water supply and check to be sure the cooling water system is operative.

Run the compressor with no load for few minutes to warm up the unit. Listen to unusual noises during the warm up period.

Check the oil pressure in the flame lubrication system; check each feed of the force feed lubricator for oil flow. Checking cooling water flow and temperatures.

When the unit is warmed and running satisfactorily, the compressor may be loaded.

ROUTINE STOPPING:

Unload the unit, step by step.

Press the stop button and stop the driver.

Shut off the cooling water supply after some time if the compressor is to be

Prepare the unit so that it can be started on short notice.

EMERGENCY OF NON SCHEDULE SHUT DOWN

In case of emergency the unit can be shut down even at load.

In event of automatic shut down first relieve the system of pressure if the cause is not detected immediately. Then look for the cause of shut down and take proper action for the same.

The complete list of possible troubles with their causes and corrections is impractical, but the following list of the more frequently encountered troubles (with their probable causes and suggested remedies) is offered as a guide.

NOTE: When trouble are countered involving the compressor cylinder valves, refer to the instruction from entitled “General instructions for Compressor valves” for comprehensive trouble shooting recommendations.

Suggested remedies for correcting the trouble are listed in the right hand column of the trouble shooting chart. Disregard those solutions that do not apply to your particular unit. When making a repair or adjustment, refer to the applicable maintenance procedures contained in CHAPTER IV , MAINTENANCE.

COMPRESSOR TROUBLE SHOOTING CHART

|  |  |  |
| --- | --- | --- |
| TROUBLE | PROBABLE CAUSE(S) | REMEDIES |
| Compressor will not start | Power supply failure.  Switchgear or starting panel malfunction.  Low oil pressure shutdown switch.  Control panel problems | Control voltage or power supply.  Check circuitry, interlocks, relays, etc see manufacture’s literature.  Check switch setting. Install momentary bypass or on delay for start up.  Check connections and settings of all devices. |
| Motor will not  Synchronize on applicable units | Low Voltage.  Excessive starting torque.  Incorrect power factor.  Excitation voltage failure | Correct voltage supply.  Unload compressor during starting.  Adjust excitor field rheostat.  Check field excitation system. |
| Low oil  Pressure | Oil pump failure.  Oil foaming from counterweights striking oil surface.  Cold oil.  Dirty oil filter.  Oil leaks.  Excessive leakage at bearings.  Improper low oil pressure switch setting.  Malfunctioning oil valve.  Defective pressure gauge.  Plugged oil sump strainer.  Clogged oil cooler. | Repair oil pump.  Reduce oil level.  Heat oil before starting.  Replace filter cartridge.  Check oil piping.  Replace bearing to remedy excessive running clearance.  Reset as per switch manufacturers instruction.  Service valve; replace defective parts; reset.  Replace gauge.  Clean strainer.  Clean cooler tubes. |
| Packing overheating | Lubrication failure  Improper lube oil and/or insufficient lube rate.  Insufficient cooling  4. (water cooled packing cases) | Replace lubricator check  valve/lubricator pumping unit.  Use correct lube oil and increase lube oil.  4 Clean coolant passages/install water filter/increase supply pressure. Reduce coolant inlet temperature. |

PRESSURE GAUGE

FRAME MOUNTED

OIL FILTER

WATER COOLED

OIL COOLER

(FRAME MOUNTED)

MAIN

BEARING

CRANK PIN

BEARING PIN

BUSHING

CROSS HEAD

MAIN

BEARING

SUMP SUMP

LOW OIL PRESS SWITCH

SIGHT GLASS

STRAINER

DRAIN

BLOCK DIAGRAM OF OIL FLOW IN FRAME LUBRICATION SYSTEM

I

STAGE

I STAGE DISCH

DAMPNER

I STAGE SUCTION

DAMPNER

TE

PG

PSL

INTERCOOLER

II

STAGE

II STAGE DISCH

DAMPNER

II STAGE SUCTION

DAMPNER

TE

PG

PSL

TO FLARE

DP

TO FLARE

GAS INLET

GAS TO C301

I STG KOD

II SATGE KOD

**RECYCLE GAS COMPRESSOR(GAS FLOW SCHEMATIC)**

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# CHILLER UNIT

Design basis:

Total Refrigeration Capacity 2,00,000 Kcal/hr

Evaporating Temperature -3 0C

Condensing Temperature 42 0C

Refrigerant used R22 (Freon 22)

Condenser water flow 6.15 m3/hr

Brine inlet temperature to chiller 7 0C

Brine outlet temperature from chiller 2 0C

Brine flow 39.4 m3/hr

Major Equipments:

Compressor

Condenser

Chiller

Oil cooler

Oil tank/separator

Oil pump

DESCRIPTION OF BRINE CHILLING UNIT OPERATION:

The basic process of refrigeration occurs by a cycle consisting compression condensation expansion and chilling. The refrigerating media is Freon-22 (R22). The expansion of Freon-22 results in the refrigeration effect.

Compression:

The compression action of the Freon is accomplished in the Howden make screw compressor. The suction of vapour occurs from two places i.e. one from the Dx chiller in the main suction port and another from the superfeed vessel in the superfeed port. The compression of the gas occurs along with oil in the screw compressor and the compressed gas at a higher pressure and temperature from the screw compressor is discharged to the oil tank/separator. The oil from the discharge gas is separated in the demister pad and collected in the oil tank.

Condensation:

The discharge gas from oil tank separator is at high pressure and temperature. This is condensed to high pressure liquid at the shell side of the condenser with the cooling water as cooling media in the tube side.

Expansion and Refrigeration:

One small fraction of the high pressure liquid is expanded and passed through the tubes. The expansion of this small fraction of freon brings in the chilling effect. The major fraction of the refrigerant is subcooled by evaporation of the small fraction in the tube side. Thus, the high pressure liquid is subcooled and passes through the thermostatic expansion valve to the Dx chiller. Due to expansion this liquid changes to low temperature and low pressure liquid with some flash gas. This liquid flows through the tubes of the chiller and absorbs heat from the brine on the shell side. This way, the brine is chilled to the desired temperature. The refrigerant vapour from the chiller outlet and the vapour from the superfeed vssel outlet are sucked by the screw compressor and the cycle repeats.

Oil from the oil tank/separator is drawn by the oil pump and delivered at a higher pressure. This oil is then cooled in the oil cooler and then injected into the compressor. One part of the oil is used to vary the loading factor of the compressor. This helps in the movement of slide valve for increase/decrease of compressor loading.

Capacity control:

The capacity control of the screw compressor is done by means of an integral slide valve. The slide valve moves parallel to the rotor axis and achieves capacity control by altering the effective length of rotors used for compressor.

The action of the slide valve is to release the gas drawn into the compressor and trapped between the rotors and casing before the compression process starts. In this way, the released gas is recycled back to suction again.

The slide valve is actuated in either direction by feeding oil to the one or the other side of the double acting hydraulic cylinder, integral with the compressor. The slide valve is connected to the piston in the hydraulic cylinder. Oil flow is controlled by solenoid valves.

Temperature control:

The temperature transmitter fitted at the brine outlet from the chiller gives signal to the capacity controller located in the control panel. If the brine outlet temperature deviate from the set temperature, the controller operates the appropriate solenoid valve to apply oil pressure to the piston to move in the required direction to increase or decrease the compressor capacity. The signal to the solenoid valves is continued to be given until the compressor capacity matches the system requirement.

STARTING PROCEDURE:

Establish the condenser cooling water flow.

Establish the cooling water flow to the oil cooler.

Check the power supply and control supply.

Check the level of the oil in the oil tank/separator.

Open the compressor discharge valve.

Open the suction valve and super feed suction valve.

Open the valve after the oil tank/separator, condenser inlet valve, valves from the condenser outlet to the super feed vessel and valves before and after the filter drier and valves in the oil lines.

Check purge and drain valves closed.

Establish brine flow through the chiller.

Start the lubricating oil pump. Check that the differential pressure o/c oil and discharge line is developed.

Ensure that the slide valve is in the fully unloaded position.

Start the compressor motor, after about 5 to 10 minutes.

STOPPING PROCEDURE:

Stop the compressor motor.

After stopping the compressor, check that the slide valve is brought to the fully unloaded position.

After the compressor stops rotating, stop the lubricating oil pump motor after approximately 15 minutes.

Close all water and gas valves.

TROUBLE SHOOTING:

High discharge pressure : may be caused due to

Sealed condenser tubes: Inpurities separating out from water deposit on the condenser tube surface thereby reducing the effective heat transfer from refrigerant to water.

Refrigerant surcharge: In an overcharged system, bottom rows of condenser tubes are covered with refrigerant, thereby reducing the effective heat transfer area.

Non-condensibles.

Chiller : The following symptoms show refrigerant shortage to chiller.

Low suction pressure.

Bubble in sight glass.

High expansion valve superheat.

Temperature drop in the liquid line (due to restriction).

If refrigerant shortage is the difficulty, charging of additional refrigerant should raise suction pressure and clear the sight glass.

The above symptoms may be caused by:

Actual shortage of refrigerant.

Plugged drier.

Line restriction.

Faulty expansion valve.

OPERATING PARAMETERS:

Brine specification:

Demineralised water + 10% Ethylene Glycol.

Freezing point – minus 3.50 C

Brine flow rate – 39.4 m3/hr

Condenser water flow rate – 6.0 m3/hr.

Oil cooler cooling water flow rate – 6.0 m3/hr.

Compressor suction pressure (PG 4105 A) 3.5 kg/cm2g.

Compressor suction temperature (TG 4104 A) – 2 0C

Compressor discharge pressure (PG 4109 A) – 15.5 kg/cm2

Compressor discharge temperature (TG 4107 A) – 66 0C

Brine inlet temperature TG 4111 A 7 0C

Brine solution out let temperature 2 0C

The compressor is tripped if any of the following switch is activated:

1) PSHH 4110 A /S High discharge pressure,16 kg/cm2

2) PSLL 4106 A/S Low suction pressure,2.5 kg/cm2

3) TSHH 4105 A /S High compressor discharge temperature, 90 0C

4) TISL 4117 A/S Low chilled brine temperature.

5) LSL 4103 A/S Low lubricating oil level in the oil tank/separator.

6) DPSL 4108 A/S Low differential pressure between oil and disch gas.

1.8 kg/cm2

7) FSL 4103 A/S Low flow rate of brine. 80%

8) FSL 4102 A/S Low cooling water flow rate to the condenser. 75%

9) FSL 4104 A/S Low cooling water flow rate to the oil cooler. 65%

LIST OF ALARMS IN CHILLER UNIT.

PSL 4105 Alarm 3 kg/cm2 low suction pr.

PSH 4109 15 kg/cm2 (Alarm) compr. Discharge Pr. High.

TSH 4105 76 0C (Alarm) discharge temp high.

Anti Freeze 2 0C (Trip)

**K. BLOW DOWN SYSTEM**

In case of emergency or a planned shut down, the polymer and the monomer from the plant is discharged to this section which primarily consists of four vessels V 801, V801A, V802 and V 804. V801 and V801A are high pressure blwodown vessel in series, whereas V 802 and V 804 are low pressure blow down vessel. The monomer is recovered from V801 and recycled in plant through K 301 while powder is discharged from bottom. The entire flare system of the plant is connected with blow down, from where the gases are routed to main flare.

TYPE OF EMERGENCIES BLOW DOWN:

There are two types of emergencies. Type A and Type B.

Type A : When reactors are to be emptied out which may be attributed to the failure of reactor pumps P 201 and P 202.

Type B : When the downstream units of reactor are disturbed. Say polymer feeding can not be routed to flash drum.

Actions in Type a Emergency:

Discharge R 201 to V 802.

Inject killer to R 202.

Lower R 202 jacket water temperature and set down at 20 C

Isolate R 202.

Open bottom emergency discharges to V 801 (HV 1905 1.2.3) for 3 minutes max at a time then close.

Verify the R 202 bottom temperature and pressure. If it increases open HV valves for another 3 minutes and close.

Actions in B type emergencies :

Switch R 202 discharge to secondary flash line and to V802/V801A (using HV 1904 and HV 2204).

Stop the catalyst feed to reactor but keep Teal and Donor on.

Verify that if the cause that has led to the emergency be removed in a short time.

If the normal operation can not be restored in about 15 mins, after R 202 discharge switching to V 802, do the following.

Inject emergency killer or service killer.

Put primary propylene feed to R 202 (FIC 1702) minimum keep flushing propylene to prepoly slurry pump, and poly pump.

Keep V 802 level under control during the whole reactor progressive dilution stage, should the V 802 level reach such values that can be considered as dangerous, direct the discharge to V801A by means of HV 4004 and lower down the setting of PIC 4001 to 5 kg/cm2g.

VESSELS SPECIFICATION

V801 : Volume 47.8m3

Input flow: reaction discharge and safety valves discharge containing large quantities of propylene.

Heating of vessel: At the bottom of the vessel, a half tube is provided through which LP steam passes to evaporate the propylene.

V801A : Volume 64 m3

Input from V 801 and occasionally from HV 4004.

Heating of vessel : It is jacketed at the bottom conical and LP steam is used.

V 802 : Volume 47.8 m3

Input from : All the gaseous discharges from vessels containing small quantities of propylene solid discharges from V801/V801A.

Heating of vessel : LP steam to extension half tube and all through four line inside the vessel from bottom to evaporate the liquid present.

Instruments:

1. TI 4001 Senses the temperature of V 801 bottom.

2. TI 4002 Senses the temperature of V 802 bottom.

3. TI 4003 Senses the temperature of V801A bottom(conical portion)

4. TI 4004 Senses the temperature of V801A bottom(conical portion)

5. LR 4002 An RF type of level recorder for V 801 (Not available).

6. LIAH 4003 Radioactive type of level indicator having sources and detector. The high alarm will come at 70 %.

7. LR 4004 An RF type level recorder for V 802. (Not available)

8. LIAH 4005 This is also a radioactive level indicator, high level alarm will come at 70 %.

9. LI 4007 Radioactive level indicator of V801A in cylindrical portion.

10. LAH 4009 High level in V801A

11. LAL 4008 Low level in V 801A.

12. LIAH 4006 Radioactive level indicator in V804 with high alarm setting.

13. HV 4001 This valve is used to send the propylene removed from the V801 to guard filter F 302 for recompression.

14. HV 4002 The valve at the bottom of V 802 can be used to drain the powder when required.

15. HV 4003 This is at the bottom of V 804 to drain the polymer from V 804.

16. HV 4004 As described earlier in 2.2 (VI) this three way valve can be used to transfer the material going to either V 802 or V 801a in which case V801A will act as V 802.

17. PV 4001 This controls the pressure of V 801 should the pressure of V 801 increase beyond 12 kg/cm2 only. It will open to flare.

18. PV 4009 This controls the pressure of V 801A.

19. FICV 4001 This controls the continuous flow of N2 (10 kg/hr) in flare header to maintain the pressure.

OPERATION OF BLOW DOWN SYSTEM:

V801 and V 801A are connected in series to give a combined volume of about 112 m3. The polymer discharge to V 801 contains monomer which is vaporized by means of steam in coil. The vapour going out can be taken to F 302 via HV 4001 to recycle compressor for recovery. PV 4001 on the top of V 801 will release excess pressure to flare whereas V 801A will receive vapours from V 801. Powder in V 801/V801A is transferred to V 802 for draining purpose through bottom valve. N2 which is connected tangentially to this transfer line is opened to provide carrier to this powder, even though the transfer takes place by pressure difference. The powder in V 802 contains Propylene ,Catalyst and Teal and hence deactivation of all these is must, this live steam is injected from four bottom nozzle. Outgoing gases from V 802 top may have some solids which are knocked in WC 801 to V 804 while gases go to flare. After steaming, N2 is put through V 802 from the same four bottom nozzle to dry the powder for easy flowability.

Normally V 802 is lined up for type ‘B’ emergency and when V 802 is to be drained, V 801 A can be taken in line as blow down vessel for type ‘B’ emergency using HV 4004.

Provision is also made to use V 801A as primary blow down vessel, only if V 801 is choked and can not be put into service, Y piece diversion at pipe rake are there with spectacle blinds which are to be reversed for this, V 802 is normally drained when powder in it is about 6-7 MT for better availability.

Procedure for powder draining from V 802.

Take V 801A in line.

Take V 802 bypass in line and isolate V 802 except its top outlet.

Start steaming from all the four bottom nozzle for about 1 ½ hrs minimum.

Stop steam and start N2 purging.

Check intermittently the gas from sample point at V 802 top. If the smell is not there and water droplets are not coming with gas, give a sample for HC content in gas.

Provide blinds on V 801 – V 802 transfer line, V 802 inlet isolation valve downstream, HV 4004 downstream line isolation valve down stream at V 802.

Sample is having hydrocarbon less than 0.2%, top outlet to be isolated under positive N2 flow to flare and then upstream of this isolation valve to be blinded.

Now vessel is ready for discharge from the bottom.Remove discharge blind and open the valve.

Since PP generate static charge when flowing, proper earthing must be ensured and powder draining is termed as hot work and therefore draining is to be started after proper Hot work permit is made ready.

After vessel is empty, normal line up of vessel to be done.

L. NITROGEN COMPRESSOR

DATA K801

GAS HANDLED NITROGEN

MOLT. WT. AT INTAKE 28

CP/CV (INTAKE) 1.4

SUCTION TEMP 30 0C

SUCTION PRESSURE 5.5 KG/CM2

DISCHARGE TEMP 106 0C

DISCAHRGE PRESSURE 12 KG/CM2

CAPACITY 330 KG/HR

|  |  |  |
| --- | --- | --- |
| Tag No | Description | Setting  Range |
| SF1  SF2 | Sight flow glass | - |
| PG1 | Pressure/kgcm2 gauge | 0-10 |
| PG2 | Pressure gauge kg/cm2 | 0-20 |
| T61 | Temp gauge 0C | 0-100 |
| T62 | Temp gauge 0C | 0-200 |
| T44 | Temp gauge 0C | 0-100 |
| T45 | Temp gauge 0C | 0-100 |
| SRV2 | Safety relief valve kg/cm2 | 5.25 |
| SRV1 | Safety relief valve kg/cm2 | 12.5 |
| LCW FS | Low CW flow switch alarm | 6 LPM |
| VHD TS | High gas disch temp switch | 125 0C |
| HDTS | High gas disch temp switch | 125 0C |
| IP | Inspection opening |  |
| V | Vent connection |  |
| D | Drain valve |  |

WATER IN

WATER OUT

DISCHARGE VOLUME

BOTTLE

4 ¼ ” GAS END

V

TG

PG

SG

PG

TG

V

SRV

D

TS

TSG

GAS OUTLET

SG

TG

D

GAS INLET

**NITROGEN COMPRESSOR K - 801**

**M. EXHAUST OIL RECOVERY**

The unit works discontinuously, with about a weekly frequency. When the analysis of the oil contained in the circuit of the scrubber C302 reveals a content of about 5% by weight of Teal. Oil is sent through pump P303 to the collection vessel V901 and replaced with fresh oil.

From time to time, the above vessel receives also the polluted oil coming from the washings of the lines transferring the concentrated Teal. Pump P102 transfer this oil to V901.

The vessel V901 is flushed continuously with nitrogen and blanketed directly with the flare network.

With a flowrate of about 100 kg/h, the exhaust oil if transferred by pump P901 to the treatment vessel V902.

Previously, DM water, equal to about the double of the oil to be treated and a quantity of caustic (20%) are charged in V902, said quantity being such as to bring the final pH to about 12.5 – 13 (after neutralizing all the aluminium – Alkyl present in the oil).

The treatment operation is carried out with boiling water: It is operated by time (duration: about 4 hours).

The water is directly sent a 100 0C, as condensate recovered from the plant, through the pumps P802A/S.If condensate is not available, DM water is taken directly from header.It is possible to supply heat also in the jacket by sending steam.

The tank is provided with stirrer to increase the contact among fluids. This is directly connected to the flare network since from the decomposition reaction of Teal hydrocarbons can arise. Once the reaction is over, the two phases are let to settle, the aqueous one containing the dissolved aluminates and the oily one being clarified.

Water is slowly drained from the bottom, cooling it in a water jacketed pipe before discharging it to the oily drain.

Once the water discharge is over, this ascertainable through the sight glass located on bottom discharge or even by visual inspection , the vessel V902 is put under vacuum, by closing the valve on gases to flare and by starting the steam ejector J 901. Drying of the oil is performed with the vessel agitator running and full steam pressure in the jacket.These drying conditions should be maintained atleast for 2 to 3 hrs duration.Then oil can be discharged to the dry oil collection tank T901.In case drying is not required,then it can be directly filled in barrels.

This tank, blanketed to the atmosphere, is continuously flushed with nitrogen, to avoid any water to enter.

Reaction-



(C2H5) 3 Al + Na OH + H2 O 3 C2 H6 + Na Al O2

1000C

Batch operation:

For Neutralisation of 500 kg. Of TEAL contaminated(Exhaust) Oil:

Take 1000 litres of DM water in V-902.

Add 20% Caustic Soda lye as per following formula:

where, X = TEAL concentration in % exhausted oil.

The factor 8 is arrived at by considering above equation, 20% lye

Density = 1.2 gm/cc and 10% excess alkali required to complete neutralization and attain final pH = 12.5 to 13.

Adjust minimum blanketing N2 during addition to avoid splash over due to escaping N2 from charging valve. Qty. of 20% Caustic Soda lye = 8 x litres.

Pump 500 kgs of oil from V-901 by running P-901 for 5 hrs, under agitation and maintaining 100 0C temp in V-902 by steam in jacket.

Complete neutralization by further agitation for two hours max. More agitation and heating can lead to loss of water by evaporation and settling of formed sodium aluminate(water soluble) causing V-902 bottom outlet choke.

Allow to settle for 2 hrs. confirm final PH 12.5 to 13 by pH paper and Drain water layer to OWS.

Transfer oil layer from V-902 to T-901 after vacuum drying if required.

All the operations are to be done as per process manual.

**N WASTE WATER PRIMARY TREATMENT**

Waste water comes from the following sources:

Process waste from the steamer and dryer scrubber, with a small continuous flowrate of about 3 m3/hr.

Process waste from exhaust oil recovery unit, batchwise discharge about once a week in the quantity of about 800 lts.

Paved areas washing water, with a desultory instantaneous design flowrate of about 15 m3/hr.

Rain water falling on paved areas, potentially polluted with oil and /or polymer powder.

A process oily sewers, collecting the above mentioned effluents a&b.

A rain water oily sewer, collecting the above mentioned effluents c&d.

The process oily water sewer is collected into an open RCC tank where floating powder is removed periodically. Water from this tank goes to second open tank, Baffle is provided at out let of this tank where remaining power separated and water goes to clean sewer for secondary treatment at centralized ETP.

The rain water oily sewer is collected into second tank directly and goes to clean sewer through baffle at a outlet. Floor washing from the areas potentially polluted with polymer pellets will be discharged into clean sewer. In these areas suitable screens will be provided for catching polymer pellets.

Floor washing water from potentially polluted with polymer powder will be sent to the rain oily sewer.

**CHAPTER-III,IV & V**

**III** [**START UP PROCEDURE/SEQUENCE OF OPERATION**](#SATRTUP)

**IV** [**SHUTDOWN PROCEDURE**](#SHUTDOWN)

**V** [**INTERLOCKS DESCRIPTION OF ENTIRE PLANT**](#INTERLOCKS)

CHAPTER III

START UP PROCEDURE/SEQUENCE OF OPERATION

N.B. Individual sections start ups are given in respective sections.

Chiller cooling water in all the exchangers.

Start chiller system and establish temperature and flow.

Start all the tracing and jacket steams in 100, 200, 500 and 800 areas.

Maintain V-304 pressure at 18.0 kg/cm2g. Start P301 A/S on close circulation maintaining the discharge pressure at 40-42 kg/cm2g.

Start jacket water in R-202 and V-201. Line up chilled water in E201.

Start P 107 A/S and keep it on auto mode.

Check and take P-201, P-202, A-201 and A-301 seal pressurization system in line.

Start hot nitrogen circulation in FB 502 alongwith C-502 in operation. Start all the flushing nitrogen in the instruments of dryer section.

Start all the steams in line in FB 501 and establish its temperature with C501 in operation.

Charge steam in E 203, LT 1801 A/B and LT 2301.

Take propylene vapour in V-202 from E 302 top upto 18.0 kg/cm2g. Line up LT 1801 A and B. Check the leakages.

Charge propylene header with F 201 A/S in line and check leaks.

Take propylene vapour in V-301 through FV 1803 upto 18.0 kg/cm2g and check leaks. Line up C 301 and E 301 top and raise the pressure upto 18.0 kg/cm2g. Check the leakages, check P 302 discharge sample for moisture. If the moisture is more than 5 ppm, then blow down P302 casing until the moisture comes down to 5 ppm. Then build up level in E301 and start P302 by sending reflux to C301.

(NB : The other way of pressurizing V-301 – C301 is to take propylene through FV 2201-E306)

Start A-301.

Line up hot water in E 303, and raise C301 bottom temperature gradually when level appears in C 301 bottom.

Stabilize C301 system lining up V304.

Start liquid feed through FV 2201 to V 301 and control pressure at 18.0 kg/cm2g taking PIC 2301 in line.

Start P304 A/S on circulation. Take propylene vapour in F 301-C302-K301 circuit through FV 2203 upto 0.4 kg/cm2g. Start K301 with PIC 2501 in line and establish the circuit. Before lining up K301 discharge to C301, check C 302 system propylene moisture to be less than 5 ppm.

Pressurize R201 and R 202 upto 18.0 kg/cm2g with vapour propylene from E 302 top and check the leakages.

Isolate E 302 top from V202 and isolate hand operated valves on the line connecting V 202, R 201 and R 202.

Start filling of reactors with the following flow rates:

FIC 1703 2000 kg/hr

FIC 1801 400 kg/hr

FIC 1702 10,000 kg/hr

FIC 1901 1200 kg/hr

Set PIC 1802.2 at 36 kg/cm2g on auto.

When LIC 1801A indicates 10% keep PIC 1802.1 on auto and gradually increase its set point till 30 kg/cm2g.

Once pressure reaches 30 kg/cm2g open top HIC of R-201 and R-202 by 15-20% and vent the inerts.

When R 201 and R 202 are full, open top HIC’s for a moment and close. Check the temperatures on TI/TAL 1803-1907-1908-1909. If the temperature of above TI’s indicates about 20 0C, then the reactor is full of liquid.

Keep LIC 1801 A on auto gradually at 40% and PIC 1802.1 at 33 kg/cm2g and simultaneously close FV 2201.

Full R 201 jacket with chilled water – start circulation maintain R 201 temperature at 20 0C using TRC 1801.

Start P 201 and P 202, if hot alignment of P 202 is needed then do following without starting P201/P202.

Set TIC 2001 in auto at 70 0C.

Bring R 202 temp to 70 0C taking J 201 in line and adjusting steam through HIC 1903 so that temp increases 3 to 4 0C at every 15 minutes.

When 700C is reached, operate HIC 1903 in such a way as to get TIC 2001

Regulated at 10 to 20%

Align P 202 at 70 0C.

Cool slowly to 45 0C.

Start P 201 and P 202.

Start pneumatic conveying system for PP powder with following sequences:

Start all flushing nitrogen for all the instruments in this section.

Line up B601 A/S with SI 601 A/B and maintain pressure at around 0.03 kg/cm2g with PIC 3604 on auto.

Check line up at B602 A/S.

Start B 601A/S and then B 602A/S and establish the system.

Check the following:

A201 flushing oil has already been started.

Check proper line up of V 203.

Start A 201.

Fill V 201 with oil along with H 1703 upto R 201 inlet ram valve and maintain V 201 pressure at 45 kg/cm2g and then close Vaseline oil supply valve to V 201.

Start P104 A/S at 0.6 kg/hr with FICA 1401 in auto. When pump discharge pressure reaches 50 kg/cm2g open the manual valve to introduce donor into V201.

Open, immediately after, the discharge from V 201 aligning it with H 1703 under operation.

Check donor flow rate.

Start P 101A/S immediate after Donor and maintain flow at 3.0 kgs/ hr with FIC 1302 on auto. When the pressure on the delivery of P101A/s reaches 50 kg/cm2g open the manual valve to introduce TEAL into V201. Check flow rate.

Set FIC 1401 and FIC 1302 in cascade with FIC 1702.

Start hydrogen to propylene after 1 ½ hrs of Teal/Donor injection and try to bring the required hydrogen concentration. Keep FIC 1701 in auto.

Start catalyst through P108 A/S with 20% output after 2 hrs of Teal/Donor injection.

Keep the V 301 discharge to blowdown until reactor density of 460 kg/cm2 is reached. Keep stocking LV 2201 0-100% deluge frequently to avoid choking during polymerization.

Divert HV 2201 to Bag filter.

CHAPTER IV.

SHUT DOWN PROCEDURE

Normal shut down:

(Shut down procedures for individual sections are given in their respective chapters)

Cut off catalyst feed by closing valve at V 201 and at the same time reduce P108 strokes to zero without line pressure over shoot.

Stop P 108 A or S

Decascade DRC – 1901 and FIC 1702.

After about 1 ½ hrs of catalyst, stop hydrogen to reaction.

After 2 hrs of catalyst cut off close Donor valve at V 201 and at the same time reduce P 104 strokes to zero without line pressure overshoot.

Stop P 104 A/S and isolate.

Then first open oil flushing valve to inline mixer, then close inline mixer u/s valve from V 201 and then close Teal line valve at V 201. All these three valves to be closed at the same time in the above order.

When Teal valve is closed, simultaneously stop P 101.

Then close R 201 inlet ram valve, FC 1703, manual i/v of propylene line in this order only.

Then immediately open blow down valve on C 3 line for a moment and close.

Then close oil flushing line valve after ensuring that the line d/s of inline mixer is full of oil.

All the time maintain reactor temp at 70 0C by injecting steam to jacket when required.

Close V101 bottom valve through HS 1302 and the LI 1305 bottom valve. Then line up T 104 – P102 – F 102 FI 1303 – P 101 suction – V201 and open V 201 bottom valve to T 103. Flush the Teal lines/pump for about ½ hr and stop P 101 and P 102.

Flush V 201 several time by pressurize/depressurizing with flushing oil from P 107 as it may still contain residues of Teal and Catalyst.

When reactor density comes to normal C3 density, then open R 201/R 202 top HIC for moment to check for plugging of HIC’s. Keep in mind that P201/P202 are running and HIC’s can not be opened for long.

Empty out all the equipments from powder in Degassing/steamer/dryer systems.

Keep C 301 system under running condition.

In case of emptying of reactors for long shut down.

Stop P 201 and P 202.

Stop all propylene flows i.e. FCV 1801, FIC 1901 and FCV 1702.

Take LCV 1801 on manual and keep fixed flow to flash drum.

Ensure secondary line is connected with flash drum and open HIC 1909 and HIC 1910. Make sure that the total flow from all reactor legs to flash drum is not more than 6 MT/hr.

Gradually reduce C 301 pressure to about 14.0 kg/cm2g.

Also gradually reduce the setting of PCV 1802.1 but keeping it always at 3-4 kg/cm2g higher than C 301 pressure.

When the reactor pressure is 18 kg/cm2g, close PCV 1802.1 completely.

Stop P 301.

After loosing level in V202 isolate V202 from R 202 and close PCV 1802.1. Then line up V 304 vapour to R 202 top and recover remaining liquid upto a reactor pressure of about 14 kg/cm2g.

When no more liquid goes from R 202 to V 301, take s/d of C 301.

Leave about 14 kg/cm2g vapour pressure in reactors/flash drum systems.

Stop K 301 when no more propylene is available from bag filter.

Then stop jacket water system.

If the shut down is for more than 2-3 days, send back catalyst from V 104 to V 103 and depressurize catalyst lines.

Then stop chilled unit.

Then take s/d of degassing and conveying systems equipments.

EMERGENCY SHUT DOWN:

Electrical Power Failure:

Such failures will involve:

The shut down of all plant machines, except the control systems consisting of DCS and PLC, which being fed by an inverter (UPS), remains active for atleast 30 minutes.

Following actions takes place automatically.

P201 pump shut down actuates the interlock I 1801. It will cause:

Block of the catalyst feeds.

Closing of the flushing propylene to P201.

Closing of the discharge from R 201 to R 202.

Opening of the emergency bottom discharge of R 201 to blowdown V802.

With a delay of 30”, the closing of propylene to R 201.

In this way, the prepoly without solid and liquid, will remain under the blowdown V802 pressure.

The P202 pump shutdown actuates the block I 1901 causing besides the shutdown of catalyst already actuated by I 1801, also that of hydrogen and ethylene. Also lack of propylene will occur, since the pump to the reaction P 301A/S stops. Moreover, the jacket cooling is lacking as well.

Then proceed quickly with the following actions:

Manually block in the closing position the reactor emergency discharge valve (HV 1804) and that connecting R 201 with R 202 (HV 1803).

N.B: I 1801 can be actuated from the panel also with HS 1806 A/B.

Then, proceed quickly with the following operations:

b. Introduce the emergency killer (1% CO) on all the reactor legs by following the procedures set forth in para. Interlock system (I 2002)

c. By means of the emergency bottom discharge controlled by HS 1905A/B, discharge the thicknened slurry to blow down V801 for ¾ minutes.

d. Check that the bottom temperatures of the reactor legs and the reactor pressure are kept constant. If they are increasing, re-inject the killer (1% CO) and again discharge from the bottom piston valves for other 3 minutes.

Intercept the R 202 discharge by LIC 1801.

Cut off the propylene to flash pipe by FIC 2201.

Put LIC 2201 in manual and empty V 301 discharging to blow down V802 by HS 2201 which from the panel controls the relevant 3 way valve.

Due to lack either of the bottom vapours (since the hot water feed to reboiler has been stopped ) or of reflux, the propylene scrubber C301, will have all the liquid collected on bottom and the bottom valve closed (see para above).

The propylene storage tank V 304 remains in the same situation in case of emergency.

The bag filter F 301 will be full with the operating quantity of polymer; in the scrubber C302 the oil is entirely collected in the bottom; the compressor K301 A/S stops.

Close the manual valve on the washing propylene to F 301 bags and that on the flushing to FT 2201.

Close the C301 bottom discharge by FIC 2203.

Manually block in closing position all the piston valves on the reactor namely:

3 nos of emergency discharge valve from R 202 bottom (HV 1905 1/2/3)

Nos of valves to inject the emergency killer into R 202.

In the steamer FB 501 it is necessary to stop the fluidization steam which would cause dangerous polymer temperature increases.

Close the stripping steam under the scrubber C501 feed, the water contained in the column is entirely bottom gathered compressor K501A/S stops.

In the system a natural cooling will occur which causes a diminishing in pressure. In case of vacuum, PSV 2912 vacuum breaker will call nitrogen from the dryer circuit.

In this latter, the motor shut down makes the fludization nitrogen to drier FB 502 and washing water to scrubber C 502 slack.

To avoid any vacuum risks due to natural cooling, let PIC 3106 connected to the nitrogen circuit.

b. Steam failure:

This failure will involve:

Lack of propylene vapourization in flash pipe.

Pressure reduction in reaction system.

Pressure reduction in propylene storage tank V 304.

No fludization in steamer FB 501.

No heating of FB 502 dryer fluidization nitrogen.

Absence of propylene vapourization discharged from C301 scrubber bottom and that of flushing of FT 2201.

No heating of tanks and suction and delivery lines of additive pumps P504A/S.

Avoid that liquid propylene through flash drum V 301 and filter F 301 reaches steamer and drier.

If the off service is foreseen to be short (some minutes only) the plant can be kept under run, but carrying out some interventions:

CASE A (short time steam failure)

Divert reactor discharge to blowdown V 802 acting o 3 way valves HV 1904 and HV 2204.

Intercept propylene to E 203, those of flushing to FT 2201 and to primary flash by FIC 2201 and bottom discharge from C 301.

Close the V 202 top vent to secondary flash (FIC 1803).

Cut off catalyst feed, closing manual valve upstream of V 201 and stopping pump P 108 A/S.

Remove the polymer from flash drum V 301 diverting the bottom discharge to blow down V802 through HV 2201 and acting on LIC 2201.

Close the manual valve on washing propylene to F 301 filter.

The downstream equipment containing polymer will remain full at standard levels. Lacking the fluidization steam in steamer FB 501, the powder will deposit on the bottom.

The scrubbers will recirculate around themselves and, particularly, scrubber C 301 can still work for a limited time taking advantage from the reboiler vapours, which heat is supplied by the sensible heat of condensate contained into scrubber C 501. If flowrate of pumps P302 A/S decreases below the minimum flowrate value, it is necessary to put the pump on recycle on heat exchangers E 301.

The two compressor K301 and K 501 A/S shall circulate on themselves in bypass.

If, vice versa, the off-service period is expected to be longer, in that case it is necessary to take more drastic measures, operating as follows:

CASE B (long time steam failure)

Immediately introduce the emergency killer (1% CO) into reactors keeping circulating pumps always in operation.

Cut off catalyst feed, closing manual valve upsteam of V 201 and stopping pumps P 108A/S.

Divert reactor discharge to blow down V802 acting on 3 way valves HV 1904 and HV 2204.

Intercept propylene to E 203, those of flushing to FT 2201 and to primary flash by FIC 2201 and bottom discharge from C 301.

Close the V 202 top vent to secondary flash (FIC 1803).

Remove the polymer from flash drum V 301 diverting the bottom discharge to blow down V802 through HV 2201 and acting on LIC 2201.

Interrupt additive feeding, stopping pump P 504 A/S.

Close the manual valve on washing propylene to F 301 filter.

Cut off Teal and Donor feeds by stopping pumps P 101 A/S and P 104A/S.

Cut off all the propylene feeds to reaction except the flushings to pumps P 201 and P202 (FIC 1801 and FIC 1901).

Completely empty steamer FB 501 acting on LIC 2901.

At the same time, carry out the following controls and/or isolations:

Until reaction temperature is of 70 0C, the pressure in V 202 (PIC 1802.1) must not decrease below 32 kg/cm2g.

When the killer is introduced, the temperature decreases deriving, in consequence, a volume contraction in the reactor which closes the discharging valve (LV 1801)

Below 32 kg/cm2g, formation of bubbles on the upper bends of reactors can takes place which could put the pump P 202 under troubles. Formation of a dangerous gas phase on the upper bends of reactors is warned by an irregular signal of the reactor density meter.

In such a case, stop pump P 202.

Keep pressure under control in the propylene storage tank V 304 by PIC 2401; if suction temperature of pumps P 301A/S (TI 2401 A/S) becomes equal to that of equilibrium with the tank pressure the pumps could cavitate, therefore, it is necessary to stop them.

But, in this event, it is necessary to stop firstly the circulation pumps in the reactors in order to avoid that they should remain without propylene flushing.

The beginning of the caviation of propylene pumps is warned by the reduction of flushing flowrate to reactors pumps by alarms FAL 1801 and FAL 1901.

c. Cooling Water Failure:

Such a failure will involve the lacking of:

Reactor jacket cooling (E 202).

Propylene condensation in E 301.

Cooling of P 301 A/S recycle in E 305.

Cooling in E 304 of propylene recovered from E 301.

K301 A/S interstage cooling.

K301 A/S oil cooling.

Steaming steam condensation in E 501.

Liquid ring circuit cooling in K 501 A/S.

FB 502 nitrogen cooling in E 502.

P 201, P 202, A 301, P 301 A/S seal oil cooling.

P 202 bearing oil cooling.

PK 605 nitrogen cooling in E 601 and E 604.

Cooling of cutting water to extruder in E 602.

PK 606 air cooling in E 603.

PK 602 air cooling in E 701.

Condenser cooling in PK 801 A/S

Oil cooling in PK 801 A/S

Steam fumes condensation above T 802.

K 801 compressor cooling.

Propylene condensation in E 301 and holding of reactor temperature is no more possible.

The following operations will be immediately required:

By HS 1904 and HS 2204 divert the standard discharge of R 202 to V 802.

Introduce the service killer (30% CO) into the main propylene line to reaction.

Interrupt catalyst feed to reaction bringing to ‘zero’ the stroke of P 108A/S.

Stop compressor K301 A/S.

Remove completely the polymer from V 301, diverting the discharge to blow down V 802.

Cut off fluidization steam to steamer FB 501.

Close heating steam to E 503A/S by TRC 3106, keep drier (FB 502) temperature under control to avoid it from increasing too much in consequence of heat introduced into circuit by blowers B 501A/S. Close also the steam to J 502.

Stop compressor K 501 A/S.

Close also stripping steam to C 501 bottom and that to ejector J 501.

Close condensate to E 303 to avoid the safety valve release on C 301 and stop pump P 302A/S since liquid to be pumped is failing.

Keep the propylene feed to R 202 within standard values to proceed with the quick dilution upto 50 gr/lt in reactor.

Should be the failure time extended, once the reactor has been diluted.

Close all propylene feeds to reactors. Stop pump P 301.

Stop P 101 Teal pump and P 104 Donor, stop P 201 and P 202.

Close washing propylene of FT 2201 (manual valve) as well as delete flushing propylene by FIC 2201.

Manually close the washing of F 301 bags.

d. Nitrogen failure:

Such a failure will involve:

Possible shutdown of blower B 501 A/S for nitrogen recirculation to FB 502, due to nitrogen leakages towards the pneumatic haulage beneath it and subsequent intervention of PSL 3105.

Possible shutdown of blowers B 602 A/S in the pneumatic haulage for powder PK 605, due to nitrogen leakages through the rotary feeders or towards the downstream system.

Lack of nitrogen to transfer Teal from cylinder into surge drum V101 and for blanketing of Teal washing oil area.

Lack of Donor tanks (T 101 A/B) blanketing.

Lack of oil grease tank (T105) and catalyst paste preparation tank (V103) blanketing.

Problems in transferring catalytic paste to the proportioning syringes.

Lack of flushing to oil tanks T 106 and T 107.

Pressurization of V307 A/S.

Lack of blanketing to additive tanks T 501 and T 502.

Lack of flushing to instrumentation taps and rotary feeders seals as well as other rotary devices.

Absence of washing of filter bags F 601 A/B, F 603.

Case – (Short Time Failure)

Align V 301 discharge with blowdown V 802 through HV 2201.

Suspend catalyst feed by cutting off the line upstream V 201 and stopping pumps p 108 A/S.

In case of prolonged interruption, the following operations are to be carried out in addition to those mentioned above.

Case B – (Long term failure)

Introduce the service killer (30% CO) into the reactors.

Stop feeding of PP beads to conveying lines by closing LV 3101 and stopping X601 A/S.

Stop, in consequence of the above, the whole section for feeding of powder and additive to the extrusion.

Open oil flushing to inline mixer.

Stop Teal/Donor after isolating V 201 overflow lne to inline mixer.

Actuate I 1801.

Isolate R 201 – R 202 and the actute/reset I 1801 for 3-4 times to around R 201 – R 202 line from choking due to stagnancy.

Close the bypass of V 201 and stop P 101 and P 104 by keeping the oil to H1703 opened.

Close Ram valve on prepoly and FC 1703, main i/valve after ensuring line filled with oil, stop oil to I/mixer.

Flush V 201 throughly with oil and keep 25-30 kg/cm2g pressure.

Cut off all propylene feed to reactors, except flushing to pump P 202.

Stop all the powder and additive transfers among the various equipment, which – due to blanketing lack – could be put under vacuum and dangerously collect air from outside.

Keep the extruder hot and ready for its restarting.

No problem will occur to the pellets homogenization section for nitrogen absence, because all the operations are conducted using air. Therefore, the section can run without, interruptions and troubles.

e. Chilled water failure:

Being the plant provided with a standby refrigerating unit, the risk of the chilled water failure only in very distant. Generally, the emergency will be accompanied by the electrical power failure or lack of cooling water.

Such an inefficiency will involve:

Lack of cooling in the tank jacket for preparation to catalyst paste V 103.

Lack of cooling in the catalytic paste transfer lines to reaction and in V 104 A/B syringe jackets.

Lack of cooling in E 201 of propylene sent to R 201 propolymerizer.

Lack of cold-thermostating of the precontacting pot V 201.

Lack of R 201 propolymerizer cooling.

Lack of cooling in E 504 of off gas sent to B.L.

Lack of cooling in the mixer jacket WM 601.

No consequences are expected for item(1). When chilled water is available, restart with the cooling before carrying out other catalytic paste transfers. Similarly for item 6 and 7, significance is not much.

For items 2,3 and 4 it is necessary to interrupt the feeding of catalyst to reaction.

The item 5 requires the following operation:

Stop the catalyst.

Bring to maximum the propylene flowrate to 201 to speed up the removal of the catalyst.

f. Instrument Air Failure:

It is necessary to remember that the instrument air network is provided – outside the B.L. – with an intermediate tank capable of granting the operation of all the instruments for 20’ at least. This time is sufficient to put the plant under security conditions. Therefore, it is necessary in case of low pressure alarm intervention at B.L. (PAL 1109), to make sure immediately with the supply department about the time required for the off service.

If the period is long, higher than the maximum period of the intermediate tank, after this time all the pneumatic valves will reach fail safe position in compliance with what provided by the project on the ground of the safety criteria.

It is highlighted that valves pneumatically operated with double acting piston will remain in the same position as at the moment of the off service in case of air failure.

Moreover, some valves are individually fitted with an air pot capable of ensuring two operations at least, in case of emergency. They consist of quick degassing valves on equipment of lines containing propylene, type FO (air failure open) and piston valves on reactors (including those of killer).

When a long time off service is foreseen, the following operations must be quickly carried out.

Prepolymerization and reaction:

Empty at R 201 as per procedure given earlier (1%).

Immediately introduce the emergency killer into reactors..

Close catalyst feeds by stopping immediately the catalytic paste pump and then those of Teal and Donor.

Proceed with the feeding of propylene to reactors at the maximum flowrate to dilute as much as possible their contents gradually lowring the set of DIC 1901 and compatibly with vaporization capacity of the flash pipe. Establish N2 hook up to instrument air header. Use service point N2 to be connected to hook point behind panel. Isolate B/L Inst Air valve before opening Nitrogen to header carry out the following operation.

Taking a suitable margin of time as to the autonomy available, proceed with the shutdown of circulating pumps P 202. The sequence of the operations to be effected on the reactor after the shutdown of P202 are the same as provided for electrical power failure (see para 6.2.1.1 a and b).

Remove completely the polymer from flash drum V 301 and bag filter F 301, conveying the product along the process line.

Until propylene arrives to V 301, and to F 301, recover it regularly into V 304. When the arrival leaves off, stop machine (P 302 A/S, P 301 A/S, P 304 A/S, K 301 A/S)

Gradually stop the extrusion.

Empty FB 501 as much as possible.

When steam is closed, stop pump P 501 A/S and compressor K 501 A/S.

Discharge drier FB 502 as much as possible, then stop blower B 501 A/S and pump P 502 A/S.

Lack of Propylene:

This failure can occur for two reasons:

Case A- Lack of make up propylene at B.L.

Case B- Interruption of feed to reaction owing to the following causes:

Shutdown of pump P 301 A/S and delayed stand by start up.

Line troubles : Clogging of filters, great losses, etc.

Case A-Tank V304 is, usually, kept at 55% level and, therefore, it allows an autonomy of about 2 hour under the full plant capacity.

Therefore, the time to carry out the following operations is available:

Stop the catalysts.

Introduce emergency killer (1% CO)

Close propylene feeds to reactors except for the flushing to pumps P201 and P 202.

When level of V 304 is at the minimum, actuate the emergency shutdown performing the operations given below, to avoid the cavitation of pumps P 301A/S.

Stop pump P 201 and P 202.

Close flushing propylene to the above pumps.

Then, stop pumps P 301A/S.

Case B:

Effect the emergency discharge of R 201 to V 802 using HS 1806.

Introduce the emergency killer into R 202 keeping P 202 in operation for some minutes to disperse the killer inside the reactor.

Stop P 202.

Keep under control temperature and pressure in R 202. If due to the reaction they tend to increase, reintroduce the emergency killer and drain from the emergency bottom discharges for 3 minutes

In case the reaction has been stopped, do not discharge to blwodown, but empty the reactors along the standard process line and through the service flash to V 301, using all the bottom discharge (HIC) to remove all the thickened phase.

Hydrogen failure

No risks for the plant, but an off-spec product would be produced, therefore, it is necessary to stop the catalyst and dilute the reaction keeping the plant regularly under operation.

Ethylene Failure:

It is only used for random copolymers. The case is similar to that of hydrogen above, following the same procedure.

Lack of Teal and Donor.

Both affect the obtained product quality. Particularly, the lack of Donor can lead the production of high quantity of atactic. Which may choke the lines/vessels.

Stop the catalytic paste feeding.

Introduce the service killer (30% CO)

Dilute the reaction.

Machinery failures:

Stopping of P 201.

It involves the catalyst decantation on R 201 bottom. It actuates the block of I 1801 which causes:

Stopping of catalysts.

Closing of flushing propylene to pump.

Closing of R 201 discharge to R 202.

Opening of bottom discharge to V 802 blowdown.

The 30” delayed closing of propylene to R 201.

Stopping of P 202

It also involves the polymer decantation on the lower bends of R 202 reactor. To avoid that an uncontrolled reaction develops on bottom thus causing the clogging of the equipment, the stopping of pump will actuate I 1901 which will cause the following actions:

Stopping of catalysts.

Closing of hydrogen and ethylene if the latter is opened.

Moreover, it is necessary to actuate immediately I 1803 by HS 1809 A/B, which causes:

Stopping of P 201.

Intervention of interlock 1801 (R 201 emergency discharge to V 802).

Closing of balancing line between R 202 and V 202.

Closing of propylene to R 202 and P 202.

Closing of discharge valve from R 202 (LV 1801)

Consequently, proceed as follows:

Introduce the killer.

Cool to the maximum the reactor setting TRC 1901 at 20 C.

Discharge reactor to blowdown V801, acting on HS 1905 A/B for 3-4 minutes.

Follow same as for electrical power failure case.

Stopping of P 203 A

The thermal regulation in R 201 is jeopardized, but the plant can run because there is still the possibility of cooling the jacket.

Keep the temperature in R 201 controlled, by manually operating TV 1802, as the related controlled is no longer utilizable in automatic.

If it is foreseen that the shutdown is long, connect TV 1802 directly to TRC 1801 (R 201 temperature).

Stopping of A 301 (agitator in V 301)

The stopping of the dynamic separator involves a remarkably increase of the polymer entrainments towards the scrubber C 301 thus deriving clogging risks.

Take actions as follows:

Stop the feeding of catalysts.

Align the R 202 discharge with V 802 blowdown.

Introduce the killer (1% CO)

Close entirely propylene to reaction, except the flushing to pumps and the pressurization one to V 202.

The part of downstream plant can remain in operation, by discharging polymer along the process line (F301-FB 501 –FB 502 – PK 605), emptying entirely the steamer and keeping in recirculaion the scrubber C301 at the minimum flowrate. Also compressors K301 A/S and K 501 A/S will run by recirculating on themselves in bypass.

CHAPTER –V

**INTERLOCKS DESCRIPTION OF PP PLANT**

(N.B : [Extruder interlocks](#extrdrinterlock) described in Extruder Chapter)

1. I 1101 Shutoff process fluids to the plant in emergency condition.

Causes of actions:

HS 1101A and B (shut down) closure.

Actions:

Shuts HV 1101.1 (propylene fed to plant)

Shuts HV 1101.2 (ethylene fed to plant)

Shuts HV 1101.3 (hydrogen fed to plant)

Shuts HV 1101.4 (purge gas to cracker)

The action of HS 1101 A (reset) opens the valves at the end of emergency.

2. I 1201 Shutoff Teal from Ist cylinder to V101:

Causes of actions

HS 1205 B start (local push-button)

HS 1205 A start (local panel mounted push button)

BSH 1201 (flame detector on Ist cylinder)

LSH 1304 (high level of teal in the safety pot V102)

Actions:

Shuts PV 1201 (nitrogen to cylinders for teal transferring)

Shuts HV 1201 (nitrogen to Ist cylinder for teal transferring)

Shuts HV 1207 (teal from Ist cylinder to V 101)

Shuts HV 1202 (Purge to hydraulic pot T 102)

The same HS 1205 reset opens the valves.

3. I 1202 Shut-off of Teal from 2nd cylinder to V-101:

Causes of actions

HS 1206 B start (local push button).

HS 1206 A start (local panel mounted push button)

BSH 1202 (flame detector on 2nd cylinder)

LSH 1304 (high level of teal in the safety pot V 102)

Actions:

Shuts PV 1201 (nitrogen to cylinders for teal transferring)

Shuts HV 1203 (nitrogen to 2nd cylinder for teal transferring)

Shuts HV 1208 (teal from 2nd cylinder to V 101)

Shuts HV 1204 (purge to hydraulic pot T 102)

The same HS 1206 reset opens the valves.

4. I 1301 Shut-off of Teal feed to V 101.

Causes of action

LSH 1301 (high level in V 101)

LSH 1302 (high level in V 101)

Actions:

Shuts HV 1309.1/2 (teal feed from Ist/2nd cylinder)

5. I 1501 Catalyst paste loading and preparation:

Catalyst can be loaded(opening of the valve HV 1506 through HS 1506) only provided the following conditions are fulfilled:

PSH 1507 is not in shut down condition( P< 500 mm H2O)

PSL 1507 is not in shutdown condition(P>20mm H2O)

HZSH 1503 gives indication that the valve HV 1503 on blanketing line in open.

B. The vessel V103 can be depressurized(opening of the valve HV 1504 through HS 1504) only if:

PSH 1507 is in shutdown position (P> 500 mm H2O)

The vessel V103 can be put under vacuum (opening of the valve HV 1505 through HS 1505) only if:

PSH 1507 is not in shutdown position(P<500 mm H2O).

HZSL 1503 gives indication that the valve HV 1503 is closed.

HZSL 1504 gives indication that the valve HV 1504 is closed.

HZSL 1506 gives indication that the valve HV 1506 is closed.

The vessel V103 can be put under blanketing pressure (opening of the valve HV 1503 through HS 1503) only if:

PSH 1507 is not in shut down position (P<500 mm H2O)

PSL 1507 is not in shutdown position(P>20mm H2O)

6. I 1601 Operation of the pumps P 107 A/S:

Start up of the pumps is actuated by PSL 1609 (P<50 kg/cm2g). Stop of the pumps is actuated by PSH 1610 (P>60 kg/cm2g). Both the pumps should be switched to AUTO, stopped or restarted at the same time by local, 4 positions, selector switch.

The pumps run in parallel. In case of a failure of either pump (no start), an alarm is given only if the PSL 1609 has been actuated.

XAL 1601 shall signal the failure to start of either pump.

7. I 1701 Catalyst shut off:

Causes of actions:

HS 1702a and B (shut down)

FSLL 1703 (low propylene flow to prepolymerizer R 201)

Actuation of I 1801 (shut off of R 201)

Actuation of I 1802 (very high level in reactor surge drum V 202)

Actuation of I 1803 (shut off of reactor R 202 feeds)

Actuation of I 1901 (stop of reactor pump P 202)

Actions:

Stop Teal flow P 101 A/S by resetting the strokes to zero.

Stop Donor flow P 104 A/S (by resetting the strokes to zero.

Stop catalyst flow P 108 A/S (by resetting the strokes to zero.

Panel alarm QA 1701.

I 1701 is manually reset through HS 1702A.

Provide a key for the interlock exclusion for FSLL 1703.

8. I 1801 Shut down of prepoly R201 and discharge to blow down:

Causes of actions:

HS 1806 A and B (shut down).

Stop of prepoly pump P201 (XSL 1802)

Actuation of I 1803 (shut off of reactor feeds)

PSHH 1801 (38 kg/cm2g)

TSHH 1801 (28 0C)

Actions:

Stops the pump P 201.

Shuts the catalyst feeds (I 1701)

Shuts the valve FV 1801 (propylene feed to P 201)

Shuts the valve HV 1803 (discharge to R 202)

Opens the valve HV 1804 (discharge to blow down V802)

With a 30 sec delay, shuts the valve FV 1703 (propylene feed to R 201)

Panel alarm QA 1801.

I 1801 is manually reset through HS 1806 A(reset)

Provide a key for the interlock exclusion for XSL 1802.

Provide a key for the interlock exclusion PSHH 1801.

Provide a key for the interlock exclusion for TSHH 1801.

9. I 1802 Shut off of feeds to prepoly and to Reactor

Causes of actions:

HS 1808 A and B (shut down)

LSH 1804 (very high level in reactor surge drum V 202.

Actions:

Actuates I 1701 (catalysts shut off)

Shuts the valve FV 1701.1/2 (hydrogen feed to reaction)

Shuts the valve FV 1702 (propylene feed to R 202)

Shuts the valve FV 1804 (ethylene feed to R 202)

With a 30 sec delay, shuts the valve FV 1703 (propylene feed to R 201)

Panel alarm QA 1802.

I 1802 is manually reset through HS 1808 A (reset)

Provide a key for the interlock exclusion for LSH 1804.

10. I 1803 Shut off of Reactor R 202:

Cause of actions:

HS 1809 A and B (shut down)

Actions:

Actuates I 1701 (catalysts shut off).

Actuates I 1801 (prepoly shutoff)

Stops the pump P 202.

Shuts the valves HV 1809 (connection between V202 and R 202).

Shuts the valves FV 1701 ½ (hydrogen feed to reaction)

Shuts the valves FV 1804 (ethylene feed to R202)

Shuts the valves FV 1702 (propylene feed to R 202)

Shuts the valves FV 1901 (propylene feed to P 202)

Shuts the valves LV 1801 (polymer slurry from R 202)

Panel alarm QA 1803.

I 1803 is manually reset through HS 1809 A (reset)

11. I 1804 Shut off of propylene feed to E 203.

Causes of action:

PSH 1804 activation (high pressure in steam line to E 203 due to tube failure in the exchanger)

PSH 1803 activation (high pressure in V 202 reactor surge drum).

Action:

Shuts the valve PV 1802.1 (propylene feed to E 203). I 1804 is automatically resetted when both causes become normal

12. I 1901 Stop of Reactor pump P 202

Causes of actions:

Stop of reactor pump P 202 (XSL 1901)

Action:

Actuates I 1701 (catalysts shut off)

Shuts the valve FV 1701.1/2 (hydrogen feed to reaction)

Shuts the valve FV 1804 (ethylene feed to R 202)

Panel alarm QA 1901

At P 202 restart, hydrogen and ethylene feeds are resumed. Catalysts feeds can only be accomplished after resetting I 1701 through HS 1702 A reset.

provide a key for the interlock exclusion for XSL 1901.

13. I 1902 Top Reactor Discharge (Emergency vent)

When the reactor pressure is increasing:”

at P = 36 kg/cm2g, PSH 1901 gives alarm PAH 1901.

at P = 38 kg/cm2g, the presence of PSH 1901 and PSHH 1901 at the same time opens the valves HV 1905 1/2/3, located on the reactor bottom elbows and gives alarm on panel QA 1902.

When the pressure is decreasing:

\* the valves HV 1905 1/2/3 are closed, when the pressure falls below 36 kg/cm2g (both PSHH 1901 and PSH 1901 are no longer active)

Provide a key for the interlock exclusion for PSH 1901 PSHH 1901.

14. I 1903 Low level of water in Reactor cooling circuit:

It is actuated by LSL 1903 (low level in T 201), that starts the pump P 205.

Stop of the pump is actuated by LSH 1902 (high level in T 201).

15. I 2001 Automatic restart of the Reactor water pumps:

It causes the pump P 204A to start automatically should the pump P 204S in operation stop and vice versa.

16. I 2002 Emergency killer injection to reaction:

Operation sequence in opening:

HS 2003 start shuts the valve HV 2003 (discharge to the flare.

HS 2002 start opens the valve HV 2002 (killer from cylinders).

Permission: at least 3 sec after the action A1 has been completed.

HS 2001 starts open the valves HV 2001 1-6(killer to R 201 – R 202.

Permission : at least 3 sec after the action A2 has been completed/and PSL 2003 is not active (P>50 kg/cm2)

Remarks

Sequence is allowed only with the indicated priority.

If during the killing the pressure in the killer header falls below 50 kg/cm2 (signaled by PSL 2003), the valves HV 2001.1 to 6 must close.

Operation sequence is closing:

HS 2001 reset shuts the valves HV 2001. 1 to 6.

HS 2002 reset shuts the valves HV 2002

Permission : at least 3 sec after the action of HS 2001.

HS 2003 reset opens the valve HV 2003.

Permission : at least 3sec after the action of HS 2002.

Remarks:

The logic system will prevent erroneous acting of switches in either opening or closing killer injection.

17. I 2101 Low Flow Rate of P 202 Bearing Lubrication Oil:

It is actuated by FSL 2101 (low flowrate of oil), that starts the spare pump

PK 201/P1A or P1S.

When the flow rate comes back to normal conditions, I 2101 stops the pump previously running.

18. I 2102 Automatic Restart of the P 202 Bearing Lubrication Oil Pumps:

It causes the pumps PK 201/P1A or P1S to start automatically should the pump is operation stop.

19. I 2201 High level or Low Temperature in Flash Drum V 301:

Causes of actions :

LSH 2202 (high level in V 301)

TSL 2206 (low temperature of vapours from V 301)

Actions:

Shuts the valve FV 1803( flushing of the secondary flash)

Shuts the valve FV 2201 (flushing of the reactor discharge)

Actuates I 2202

Panel alarm QA 2201

Provide keys for interlock exclusions of LSH 2202- TSL 2206

20 I 2202 Shut-off of Connection Between R 202 and V 301:

Cause of actions:

Actuation of I 2202

Actions:

Shuts the valve LV 1801 (slurry discharge from R 202)

The above action is performed only if the 3-way valves HV 1904 and HV 2204 are not both lined up to blow down V 802.

If these valves are at the same time lined upto blowdown V802.

Permission for HZSL 1904 and HZSL 2204 respectively - the valve LV 1801 is automatically opened even if there is the cause of interlock.

21 I 2203 Shut-off of Connection Between V 301 and F 301.

Cause of actions:

LSH 2204 (high level in F 301)

PSH 2203 (high pressure in F 301)

Actions:

Shuts the valve LV 2201 (polymer discharge from V301)

Shuts the valve FV 2203 (bottom discharge from C 301)

Panel alarm QA 2203.

The above actions are performed only if the 3-way valve HV 2201 is not lined upto blowdown V802.

If this valve is lined upto blowdown- permission from HZSL 2201- the valves LV 2201 and FV 2203 are automatically opened even if there is the cause of interlock

Provide keys for interlock exclusion of LSH 2204 - PSH 2203

22. I 2204 Shut-off of F301 Bottom Discharge:

Causes of actions:

TSL 2207 (low temperature in F 301)

LSL 2205 (low level in F 301)

dPSL 2206 (low diff. pressure between F301 and FB 501)

LSH 2902 (high level in FB 501)

Actions

Shuts the valve LV 2203 (polymer discharge from F 301)

Panel alarm QA 2204

Provide keys for interlock exclusions of TSL2207, LSL2205, dPSL 2206, LSH 2902

The system automatically resets normal control as soon as the causes that required its intervention causes.

23 I 2301 Automatic Restart of C 301 Reflux Pumps:

It causes the pump P302 A to start automatically should the pump P302 S in operation stop.

24 I 2401 Automatic Restart of Propylene Feed Pumps:

It causes the pump P 301 A or P 301S to start automatically should the pump in operation stop.

25. I 2402 Shut off of Propylene to E 302

PSH 2403 (high pressure of steam to E 302) shuts the valve PV 2401 (propylene to E 302) in case of tube rupture in the heat exchanger E 302.

26 I 2403 Shut off of Propylene to P 301 A/S

PSL 2404 A or PSL 2404 S, located on P 301 A/S suction, shuts the valves HV 2401 A/S (propylene interlock system)

Causes of actions:

LSHH 2504 (very high level in K.O. drum V 303)

PSH 2502 (low pressure on compressors suction)

Action:

Stops the compressor in operation.

Provide keys for the interlock exclusions LSHH 2504- PSL 2502.

28 I 2601 Shut - off of Flash Drum Activator A 301

ZSHH 2602 (very high position of the piston rod in WA 301, due to seal oil failure) stop the agitator A 301.

Provide key for the interlock exclusion.

29 I 3001 Shut off of Purge Gas Compressors K 501 A/S

(in addition to the package interlock system)

PSL 3003 (low pressure on compressors suction) stops the compressor in operation.

Provide key for the interlock exclusion

30 I 3101 Shut off of FB 501 Bottom Discharge

LSH 3102 (very high level in FB 502) shuts the valve LV 2901 (polymer discharge from FB 501)

Provide key for the interlock exclusion

31 I 3102 Shut off of Blowers B 501 A/S

32 I 3103 Shut off of Blowers B 501 A/S

PSL 3105 (low pressure on blowers suction) stops the blower in operation.

PSH 3108 A or PSH 3108 S ( high pressure on delivery) stop the blower B501A or B501S respectively.

provide keys for the interlock exclusions PSL 3105 - PSH 3108 A and S.

**PP Beads Conveying System:** Interlock Systems Description:

33 Sequence I 3601

Causes of actions:

LSH 3608 actuation (T 601 high level)

Action:

LV 3101 closing (discharge of drying fluid bed to PP Powder pneumatic transport)

34 Sequence I 3602

By means of HS 3601 push button start blower starts (B602 A or S depending on HS 3605 position)

Blower can start only if it’s suction valve opened (permission from ZSH 3601 A or S ) bypass valve HV 3602 is opened (permission from HZSH 3602) and fan B601 A or S is running (see I 3605). If the suction pressure falls below the set point of PSL 3609) an alarm is given.

The blower stops if one of the following conditions is set:

Delivery pressure higher than the set point of PSH 3614 A/S (no bypass)

XSL 3603 A or S (depending on HS 3615 position) is occurring.

Suction pressure lower than the set point of PSLL 3610 (can be by passed).

Suction valve (ZSH 3601 A or S) not completely opened (cannot be bypassed)

Delivery temperature higher than the set point of TSH 3615 (no bypass)

PSLL 3610 must be temporary excluded by means of a timer (approx 5 sec) at blower start up.

After shut down the restart can be done only by means of reset start push button.

35 Sequence I 3603

Rotary valve X 601 A or S is actuated by start push button HS 3607 (depending on selector HS 3616 position) and if are realized all the following conditions of permission:

Run of the blower and the fan selection.

Delivery pressure not higher than the set point of PSH 3613 (bypassed).

Delivery pressure not lower than set point of PSL 3613. (bypassed).

Not wrong positioning of the diverter valves compared to the path selected by means of HS 3618 and HS 3612 (HZSL 3603/3604 - 3605 and HZSH 3603/3604 - 3605 limit switches)

Opening of the butterfly valve HV 3620 A or S (depending on HS 3616 position).

After starting of rotary valve the following automatic sequences are operating:

Start of cleaning cycle of filter F603 through the 2 solenoid valve KV 3604 A and B).

(The cycle is the following activation of solenoid valve KV 3604 A for a time of 0.2 seconds stopping for a time 2.5 minutes) activation of solenoid valve KV 3604 B for a time of 0.2 seconds stopping for a time of 2.5 minutes reactivation of solenoid valve KV 3604 A and so on.

Opening of butterfly valve HV 3619 A/S (depending on HS 3616 position).

The cycle is stopped when the rotary valve is in stop condition. The rotary valve stops if one of the following conditions is met:

One of permission conditions is not realized.

Wrong position of butterfly valve under rotary valves (HZSH 3620 A or S and HZSL 3620 A or S.

Activation of stop push HS 3607

For shut down of rotary valve the following automatic sequence is operating:

Closure of the butterfly valve HV 3620 A or S.

Stop of cleaning cycle of filter F 603.

Note:

After the shut down the restart can be done only by means of reset and start push button.

Nitrogen flushing of the rotary valve, which is taken line, should be started and same for other is to be isolated.

36 Sequence I 3604:

Actuation of XSH 3601 A or S (run of the blower selected by means of HS 3606) starts F601 A or B, depending on which silo is selected by means of HS 3618.

Actuation of XSL 3601 A or S (stop of B602 A or S) stops B601 A or S

37 Sequence I 3605

The fan B601 A or B (depending on HS 3615 position) starts by means of HS 3614 push button.

Stop of fan will be done manually by means of push button HS 3614. Fan is automatically stopped only by low pressure level PSLL 3604. The fan must be started before blower. The running of the fan also when blower is stopped is not troubling.

38 Sequence I 3610 (Blender loading)

By means of HS 3612 push button, or automatically by signal input coming from blending cycle logic, the following automatic sequence starts:

Stop of the feeding rotary valve X601 A or S and after a time of approx 30 seconds (to clean the line)

Positioning of the diverter valves (HV 3603 and HV 3605) involved in the connection to cyclone WC 601 (general remarks : there is no change of filter because the change is strictly connected with the silo selector. HS 3618 which position is unchanged in these operation).

Once the valves are positioned (HZSH 3605).

Opening of the butterfly valve HV 3608 under the cyclone WC 601 and once opened (HZSH 3608)

Start of the rotary valve X 603 (together with flushing nitrogen valve KV 3602) and once started (SS3602).

Start of the pneumatic haulage rotary valve X 601 A or S.

When the loading is completed (automatically by means of weighing contact, or manually by means of HS 3612 pushed in stop positioning the following automatic sequence is operating:

Stop of the rotary valve X 601 A or S and X 603 (with the closure of the flushing nitrogen valves KV 3602 and KV 3606 A/S) and closing of the valve HV 3608.

After a time (approx 30 sec) sufficient to clean the line from the product and to collect it in the chamber under the cyclone WC 601, positioning of the diverter valves so to feed the product into the silo selected by HS 3618.

Once the valves are positioned (HZSL 3603/3604- 3605)

Restart of the rotary valve (X601 A or S)feeding the pneumatic haulage.

39 Sequence I 3611 (Delivery Silo Change)

Moving the proper selector (HS 3618) the following sequence is operating:

Stop of the rotary valve X 601 A or S and after an interval suitable to clean the line.

Activation of the filter (F601 A or B depending on the selected silo (SI 601 A or B) and deactivation of the other one.

Positioning of the HV 3604 valve according to the new selected silo and once the valve is positioned (HZSH 3604 and HZSE 3604 limit switches).

Restart of the feeding rotary valve X 601 A or S.

40. Sequence I 3612 (Valve HV 3602 Opening Closing):

Valve HV 3602 will be normally open when the blower is not running.

After a time of approx. 10 sec from blower starting the valve will be closed slowly (by a suitable pneumatic regulation).

The valve must be opened when, during the normal operation one of the diverter valves HV 3603/3604/3605 starts to move to change direction for a silo changing or for a product call from the blender.

The valve will close as soon as all the three diverters will be positioned according the selected new path.

The control will be done through the limit switches HZSH 3603/3604/3605 and HZSL 3603/3604/3605.

Pneumatic Haulage Start up:

Positioning of HV 3603-3604-3605 in direction of the silo to be loaded and choice of the filter (F601 A or B) to be activated at blower start up, both by means of a proper selector (HS 3618).

Fan start up (B601 A or S depending on HS 3615 position) by means of HS 3614 push button.

Blower start up (B602 A or S depending on HS 3606 position) by means of HS 3601 push button, which action is possible only if a fan is running.

Total filling of the circuit with nitrogen introduced under pressure control through PV 3604.

Air will be blown out through PSV 3630 A or S bypass (general remark wish blower and fan running).

When oxygen is below the dangerous limit it is possible to start the pneumatic haulage feeding rotary valve X 601 A or S.

Start up of the rotary valve (X601 A or S) depending on HS 3616 position by means of HS 3607 push button.

**PP PELLETS PNEUMATIC CONVEYING SYSTEM AND SILOS:**

Interlock System Description:

41. Sequence I 3801:

Cause of action:

PSH 3602 A or S (depending on which blower is running).

B701A/S delivery pressure higher than its set point.

TSH 3601 B 701 A/S delivery temperature higher than its set point.

Action:

Stop of blower B701 A or S (depending on HS 3809 position)

42. Sequence I 3802 (Start of Sequence):

By means of HS 3812 choose the feeding silo (one of the analysis silo SI 701 A-D or the homogenization silo SI 702)

By means of HS choose the delivery silo (the homogenizer SI 702 or the off-grade silo SI 704 or the bagging machine silo SI 703.

The positioning of the diverter valves involved in the connection is realized pushing a proper button (HS 3815).

If the involved valves have not been correctly positioned an acoustic alarm warns the operator that the connection is not realized and an interlock doesn’t permit the feeding rotary valve to start.

At this point push the blower start button HS 3708 and when the pressure is higher than PSL 3803 value the feeding rotary valve can start.

Acting on the rotary feeding start button HS 3814A the butterfly valve under the rotary feeder (previously selected by means of the feeding silo selector HS 3812) opens.

As it is open (signal from limit switch of valve completely open) the rotary valve starts.

At the end of the product transfer or of the homogenization cycle the rotary valve can be stopped by the stop button HS 3811 B according to the following sequence: rotary feeder stop butterfly valve closing after few seconds.

Delivery silo switching shall be possible during the pneumatic haulage running. Acting on silos selection and then on valves positioning button, the following sequence shall be realized:

Stop of feeding rotary valve.

Start of a timer for line cleaning.

After the prefixed time positioning of the diverter valve.

After correct positioning feeding rotary valve restarts.

If the blower delivery pressure reaches PSH 3803 value or goes down the PSL 3803 value, the rotary valve is stopped.

Rotary valve restarts when blower delivery pressure is still between PSL 3803 and PSH 3803 values.

If the blower stops a signalization XLH 3801 A or S will be activated and the feeding rotary valve is stopped.

**CHAPTER - VI TO X**

**VI.** [**TROUBLE SHOOTING**](#TROUBLESHOOT)

**VII.** [**DATASHEETS OF EQUIPMENTS**](#DATASHEETS)

**VIII. INSTRUMENTATION IN PP PLANT**

**IX. HYDROGEN FACILITY**

**X. PROCESS FLOW DIAGRAM**

VI. **TROUBLE SHOOTING**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sr No | | | Problem | | | Cause/Solution | | | |
| 1 | | | Loss of Teal Flow | | | Loss of suction/Block Teal supply at precontacting pot. Check pump stroke and that coupling is turning. Check air valves at tank and pump suction. Block pump discharge manual valve and bleed to contaminated oil drum. Flush the pump with oil, reprime and bleed to contaminated oil drum. Reprime with teal, open manual valve prime line to V 201, realign at V201. | | | |
| 2 | | | Loss of Teal Flow | | | Loss of suction due to plugged filter/Block Teal supply at V201. Block discharge and bleed to contaminated oil drum. Bypass the suction filter and reprime pump. Open discharge and prime line to V 201, realign at precontacting pot. | | | |
| 3 | | | Loss of Teal Flow | | | Tank pressure low/ Block Teal supply at V201. Check nitrogen pressure regulator for minimum of .1 kg/cm2g. Confirm level of 50% minimum in seal oil pot. Confirm level of at leas 30% in V101. Confirm 50% flow on Nitrogen rotameter to V 101. Reprime pump and realign to V 201. | | | |
| 4 | | | Loss of Teal flow | | | Plugged Micro-motion/ Block Teal supply to V 201.Block Teal pump discharge and bleed to contaminated oil drum. Line up micromotion meter to contaminated oil and flush with oil thru meter and bypass around meter. Block oil, reprime pump with Teal and align to meter, confirm pumping ability to contaminated oil, before priming up to V 201. If micromotion will not uplug, open bypass isolae meter, run pump strokes at same output value as before pluggage. | | | |
| 5 | | | Loss of ingredient flows | | | Plugged inline mixer/Block V 201 outlet valves to plugged inline mixer. Check for propylene line up at supply valve to spare mixer. Switch Ram valve at pre poly for spare mixer line inlet to the open position. Block the other Ram on plugged mixer inlet. Confirm that propylene flow is good with boardman on FIC 1703. Put an oil flush on the spare mixer and confirm flow evidenced by seal oil pumps kicking on and off. Block oil flush; align valve from V 201 to mixer ingredient supply valve. Open mixer supply valve and observe for pressure drop on V201. | | | |
| 6. | | | Loss of Donor flow | Loss of suction/Block Donor supply to V 201. Check pump strokes. Check for level of at least 20% in Donor storage tank. Check valve alignment to pump from tank. Bypass filter in suction line. Reprime pump. | | | | | | |
| 7 | | | Erratic Donor flow | Insufficient suction/ Check Nitrogen pressure on donor tanks. Bypass filter in suction pump if needed. | | | | | | |
| 8 | | | Loss of Donor | Plugged micro-motion meter evidenced by high discharge pressure and no flow/ Block donor supply valve to V 201 precontacting pot. Prime to at least 7 kg/cm2g above V 201 operating pressure. Open Donor supply to precontacting pot and check flow. | | | | | | |
| 9 | | | Loss of Catalyst | Feed valves did not open when cylinders switched/ Block catalyst to V 201. Check catalyst panel for power on. Check that the panel is in automatic and feed mode. Check that computer has feed position confirmation. Check that recharge valves are closed on both cylinders. Check for full light on spare cylinder. Check for no pressure light clear on spare cylinder. Switch to manual on local panel and select cylinder with full light using HS 141. Confirm feed valves open. If not, switch back and forth until they open, check 4 way valve in oil line. When feed valves open and line pressure is above precontacting pot realign catalyst. Catalyst cylinder will not switch in automatic unless both feed valves close on empty cylinder.  Catalyst panel in auto mode. Recharge valves closed on both cylinders. 4 way oil valve switches and confirms. Full light on and no pressure light clea on spare cylinder. | | | | | | |
| 10 | | | Loss of catalyst | Hydraulic oil pump lost suction / Block catalyst supply to V 201. Check stroke on pump. Check level in T 106 oil supply tank and Nitrogen purge, FICV 1601. Bypass suction filter. Switch pumps it will not prime. | | | | | | |
| 11 | | | Loss of Catalyst | Outage of 15 minutes can not establish feed/ Put FIC 1702 in automatic. Align steam to loop jacket to maintain loop temps at 70 0C. After 90 mins without catalyst, block ingredients to precontacting pot. Flush the precontacting pot with oil to the in line mixer. Block hydrogen to loop | | | | | | |
| 12 | | | Loss of Donor | After 15 minutes without Donor and unable to establish pumping/ Inject CO to R 202. Block inline mixer and flush with oil. Block all ingredients to pre contact pot and dump it to contaminated oil drum and flush with oil, shut down precontacting pot agitator. Set FIC 1702 in auto and block hydrogen. Use steam on loop jacket to maintain 70 C. | | | | | | |
| 13 | | | Loss of Teal | After 30 minute without Teal and unable to establish flow/ Block catalyst to precontacting pot. Continue Donor pumping for 90 mins and hydrogen. Use steam to keep loop at 70 0C. | | | | | | |
| 14 | | | Loss of propylene flow on FIC 1703 to pre poly | Plugged mixer supply line / Switch to spare mixer line after blocking all ingredients from V 201. The pump strokes on ingredients should be at zero due to I 1701 activation. Also block the plugged mixer line Ram valve before putting spare in service. | | | | | | |
| 15 | | | Loss or propylene flow on FIC 1703 | Control valve problem/ Check control valve position in field. Have boardman stroke 0 to 100%. Bglock ingredients from V 201, the mixer supply line to prepoly will plug with no flow on FIC 1703. Isolate the plugged line. If control valve is not operational, before switching to spare open the bypass at FV 1703 to 20%. | | | | | | |
| 16 | | | Temp control on  R 201 | Refrigerated H2O/ Check supply pressure a pre poly jacket pump. Check for operation of temperature control valve on outlet of prepoly jacket. Check for temp problem at refrigerated H2O skid. Check level in surge drum and flow on recirculation controller at skid. | | | | | | |
| 17 | | | High pressure  R 201 | Restriction of discharge from HV 1803 to R 202/ Check valve position of HV 1803. High pressure on R 201 may be caused by pressure on loops. If line is restricted activate I 1801 and dump  R 201. Try to take R 201 again in line after filling with and tripping to R 202. If choke persist, Isolate and flush precontacting pot inject CO to loops. | | | | | | |
| 18 | | | Loss of prepoly pump P201 | High amps/ Confirm that HV 1803 closed from R 201 to R 202. Confirm HV 1804 dump valve opened. Manually block at R 202 inlet. FIC 1703 and FIC 1801 control valves. Block the in-line mixer ingredient supply valves, block ingredients supply valves to V 201 dump the precontacting pot to contaminated oil drum and flush with oil for 15 mins. Inject CO to R 202. | | | | | | |
| 19 | | | Loss of flow to  P 201 bushing flow | Plugged auxiliary filter/ Check to bushing flow filter differential pressure. Switch the filter if more than 1 bar. | | | | | | |
| 20 | | | Loss of flow to P201 bushing | Control valve/ Check control valve for proper operation. If not working use bypass valve to attain desired flow. | | | | | | |
| 21 | | | High temp on R 201 | Excessive catalyst feed/ Block catalyst to V 201. Consider teal/donor bypass to mixer to immediately remove catalyst feed to R 201. Increase refrigerated H2O flow to R 201 jacket. Monitor R 202 temperature. | | | | | | |
| 22 | | | Loss of P 201 seal | | | | Loss of seal oil pressure or distintegration of seal/ Activate I 1801 and dump R 201. Manually block bushing and propylene flow to R 201. Confirm HV 1804 opened to dump. Manually block R 201 to R 202. Inject CO to R 202.  Use steam on jackets to keep loop at 70 0C. Put FIC 1702 in automatic. Isolate precontacting, in line mixer and flush to contaminated oil. | | | |
| 23 | | | Loss of ingredients | | | | Both mixers plugged/ CO to R 202. Block in and flush the precontacting pot to contaminated oil drum. Put FIC 1702 in automatic. Use steam on loop jacket to control temp at 70 0C | | | |
| 24 | | | Temperature spike on pre poly | | | | Return to system of lost ingredient/Always monitor the temp on prepoly when getting flow return of teal , catalyst or donor. Adjust refrigerated water in manual then back to automatic. Be aware that a hot reaction in the pre poly will result in the same effect on R 202. Increase propylene ahead of time on R 202, FIC 1702, when the pre poly reaction is increasing, to help keep density and temp under control on R 202. | | | |
| 25 | | | High temp on R 201 | | | | Reaction related/ At 25 C block mixer inlet and flush with oil. Isolate precontacting pot and flush to contaminated oil drum. Increase propylene flow to R 201 to help turn temp. Increase refrigerated H2O to jacket. At 35 0C actuate I 1801 to take it off the reaction. Monitor R 202 reaction, temp and density. | | | |
| 26 | | | High temperature on  R 202 | | | | Cooling water problem/ Increase propylene flows. Confirm jacket water circulation pump running. Confirm temperature control valve for cooling water supply open to loop jacket. Confirm booster pump running and compare inlet / outlet temps. Confirm operation of the loop circulation pump. Check level in water expansion drum. At 72 take out ingredients. At 73 inject CO to turn temperature. | | | |
| 28 | | | High pressure on R 202 | | | | Insufficient outlet flow from loop/ Increase valve position of LV 1801 in manual or lower set point on pressurization drum level. If pressure still high open HIC 1909 and HIC 1910. Check for excessive increase in propylene flows to R 202. Check and monitor FIC 2201 flow indication. | | | |
| 29 | High or low pressure on R 202 | | | | | | | Temperature changes/ Check temperatures on loop. Changes in loop temps can cause expansion or contraction of propylene volume in loop and by changing the level in pressurization drum can influence the pressure. |
| 30 | High pressure on loop with level dropping in pressurization drum | | | | | | | Level indicator malfunction/ Open LV 1801 to approximate valve position in manual to turn pressure. Compare sight glass with level indicator on pressurization drum. Switch to spare level indicator on V 202. Heavy rainstorms have caused condensing in the vapor leg of these L.I.S and caused false level indications. |
| 31 | Density in loop on the rise 2 to 3 increments above set point. | | | | | | | Rate increase/ Break cascade on loop density control and increase propylene manually 1% valve. Hold in manual until flow settles then back to cascade. Increase more as needed to turn. Check temperature control and ingredient feed rates. Adjust intake manually to propylene feed tank to help maintain level then cascade. |
| 32 | Xylene insoluble low | | | | | | | Lack of Donor / Check donor pumping rate setpoint to propylene flow. Check level drop. Decrease teal/donor ratio. Check propylene feed for poisons. Check bag filter flake for tackiness. |
| 33 | Loss of hydrogen feed | | | | | | | Regulator failure/  Switch to the spare regulator, check hydrogen trailer pressure. If hydrogen flow is out of loop for more than ten minutes. Block the in-line mixer/  Switch to the spare inline mixer, check hydrogen trailer pressure. If hydrogen flow is out of loop for more than ten minutes. Block the in-line mixer and flush with oil. Isolate precontacting pot and flush to contaminated oil drum. Add CO to the loops. Place FIC 1702 in automatic control loop at 70 0C using steam on jacket. |
| 34 | Shut down of loop circulation pump P 202 | | | | | | | Loss of pump/  It pump does not start during reacceleration period. Add CO to the loop, block mixer ingredient inlet and oil flush. Increase propylene FIC 1702. Block hydrogen to the loops. Open cooling water to loop jacket 100% continue to add propylene to loop and thin out. Monitor flash drum temps. |
| 35 | High level in pressurization drum | | | | | | | Lack of outlet flow from loops/  Increase valve position of LV 1801. Confirm flow on FIC 2201 transmitter. Open HIC 1910 if needed. Check loop temperatures, pressure, density, and propylene flows. A very high level at V 202 will intercept FIC 1702, and hydrogen flows to the loops. |
| 36 | Low temp on flash drum overhead | | | | | | | Flash drum feed inline heater fouled/  Switch HS 1904 to the spare transfer header. Monitor TIC 2201. Check steam traps on spare line header. | | |
| 37 | Low temp in flash drum overhead | | | | | | | Excessive increase in flow from loops to flash drum/  Place PIC 2201 in manual and increase steam pressure. Check LIC 1801 valve position, place in manual and reduce if possible. Trend the FIC 2201 controller to check on flow increase. Monitor pressure on loops and check FIC 1702 for increases. Monitor TIC 2201, place steam PIC 2201, back to cascade when at 70 0C. | | |
| 38 | Low temp on TIC 2201 less than 50 0C | | | | | | | Loss of steam or fouling of main and spare transfer headers/  Divert Hs 1904 and HS 2204 to blowdown. Manually close and block FIC 1702. Block in catalyst to the pre pot. When the problem is resolved, divert HS 1904 and HS 2204 back into system. If unable to resolve, inject CO to loops, block teal, donor and hydrogen to loops. Put FIC 1702 in automatic, use steam to control loops at 70 0C. Monitor feed tank level, as loss of return flow from recovery will require increase in propylene intake. | | |
| 39 | Erractic indication on flash drum LT 2201 | | | | | | | Static build up or level transmitter malfunction/  Put LIC 2201 in manual and reduce valve position to build level slowly. Monitor TI 2202 flashdrum bottom temp. Check level in recycle gas filter for increase or decrease. | | |
| 40 | TI 2202 flashdrum bottom temp heating up. | | | | | | | Catalyst buildup and reduction or loss of flow from V 301 to F 301 Increase valve position from 10 to 15% on LIC 2201. Monitor TI 2202 for drop in temp while observing bag filter pressure or recycle compressor suction pressure for increase. Upon sharp pressure rise or drop in TIC 2201 temp, place LIC 2201 back to automatic. | | |
| 41 | Erratic TIC 2201 and TI 2202 temps | | | | | | | Cycling of flow and steam pressure on heated transfer line from R 202. Uneven flow loops to flashdrum/  Switch LIC 1801 to manual and select a valve position that holds or slowly reduces level in pressurization drum. Check TIC 2201 and adjust steam PIC 2201 manually if needed. Allow system to settle, monitoring temperature and pressures.. Check the density control on loops. Be aware that changes in the FIC 1702 flow | | |
|  | contd.. | | | | | | | influences pressure and level in the pressurization drum.  Steadiness of pressure on the system will yield better density control. Check ingredient add for cycling. Check the propylene feed line pressure. | | |
| 42 | High amps on flash drum dynamic separator | | | | | | | Carryover of fines/  Check steadiness of flow FIC 2201. Check temp control on TIC 2201. Check level control on flashdrum. | | |
| 43 | High amps on flash drum dynamic separator | | | | | | | Lack of feed flow/  Trend FIC 2201 for flow. Crack in flushing propylene to maintain minimum of 6900 kg/hr at FIC 221. Check valve position of LIC 1801 and level in pressurization drum. Check temperature control on TIC 2201 | | |
| 44 | High amps on dynamic separator | | | | | | | Lack of lubrication/  Check oil level in seal oil pot. Check cooling water to seal oil exchanger. Add grease to upper and lower bearing. | | |
| 45 | Loss of dynamic separator agitator | | | | | | | High amps/  Divert HS 1904 and HS 2204 to blowdown. Manually close FIC 2201 and block. Attempt to restart agitator. When diverting back into system, reduce feed rate from R 202 temporarily so as not to shock the system and operate steam pressure to transfer line in manual initially. Monitor feed tank as loss of return flow from recovery will require increase in propylene intake to the unit. | | |
| 46 | Level rise on flash drum level controller | | | | | | | Possible buildup of flake of flashdrum upper walls/  Increase LIC 2201 in manual and observe for blow through. Increase flushing propylene at FIC 2201. Check trend pens for changes in levels at nuclear transmitter. | | |
| 47 | High temp on TIC 2201 flashdrum overhead | | | | | | | Reduction of flow from loops/  Check LIC 1801 for decrease in valve position. Cut steam valve to transfer line. Increase flushing propylene at FIC 2201. | | |
| 48 | Low level at propylene condenser E 301 | | | | | | | Buildup of inerts in system/ Increase vapor vent at FIC 2304 to remove inerts. Check cooling water supply to unit. Check pressure control on E 301 and return flow to feed tank V 304. Check flow on FIC 2201. | | |
| 49 | High pressure at E 301 on PIC 2301. | | | | | | | Loss of return flow to feed tank/ Check P 302. Check valve position of PIC 2301 and LIC 1801. Check air valve at exchanger outlet pump suction line. Start spare P 302. | | |
| 50 | High temp TI 2301 on flow from tower to recycle gas filter. | | | | | | | Loss of flow/  Check valve position of FIC 2203 at tower bottom. Open flushing propylene at tower bottom to clear line. Check steam to jacketed line and trap. Check regulator and propylene purges at flow transmitter. | | |
| 51 | Low temp on flow from tower to recycle gas filter. | | | | | | | Excessive flow or loss of heat transfer/  Check flow rate and reduce. Check steam to jacket pressure. Check trap for proper operation. | | |
| 52 | | High pressure on recycle gas filter. | | | | | | Blow through from LIC 2201/  Reduce valve position from flashdrum. Raise the level control set point at LIC 2201. | | |
| 53 | | High pressure on recycle gas filter | | | | | | Loss of recycle/compressor/  Check PIC 2202 for control of pressure blow down at 1 kg/cm2. Attempt to restart compressor. | | |
| 54 | | High pressure on recycle gas filter | | | | | | Unknown/  Check flashdrum for blow through. Check level control on bag filter. Check differential pressure on F 302. Check suction pressure at K 301. Check differential pressure on recycle gas filter socks. Check propylene pulsators for blow through. | | |
| 55 | | Low temp at bag filter bottoms | | | | | | Propylene liquid at bag filter/ Check TIC 2201. Check TI 2202. Check level at flash drum. Check temp and flow from C 301 to recycle gas filter. | | |
| 56 | | Low differential pressure recycle gas filter to steamer. | | | | | | Loss of level in recycle gas filter/ Check feed from flash drum to F 301. Close LIC 2203 recycle gas filter outlet. Check pressure on recycle gas filter. | | |
| 57 | | Low differential pressure recycle gas filter to steamer | | | | | | High steamer pressure/  Check level in recycle gas filter, close LIC 2203. Check suction pressure and load at off-gas compressor. Check level control on steamer. Check recycle gas filter pressure and feed from flashdrum to recycle gas filter. | | |
| 58 | | High pressure on steamer | | | | | | Loss of off gas compressor/  Lower PIC 3002 to control pressure, restart compressor. | | |
| 59 | | High pressure on steamer | | | | | | Recycle gas filter level low/  Increase level in recycle gas filter. Check differential pressure indicator between steamer and recycle gas filter to confirm proper differential. | | |
| 60 | | High pressure on steamer | | | | | | Off-gas compressor not loading/  Check position of suction of suction pressure controller on compressor. Check discharge pressure on compressor, lower PIC 3005 if needed. Check for return flow from PIC 3005 to off gas header. | | |
| 61 | | | High pressure on steamer (contd) | | Off gas compressor not loading (contd)/  Check level in off-gas compressor discharge oil collection tank V 502. Check level in E 504. | | | | | |
| 62 | | | High pressure on steamer | | Restriction at tower overhead/ Check level in scrubber C 501. | | | | | |
| 63 | | | High temp on steamer scrubber vapor line | | Lack of heat transfer/  Check circulation rate of scrubber water. Check exchanger for temperature change. Crack in process water to suction of pumps. Reduce steam flow on FIC 2904. | | | | | |
| 64 | | | Erratic steamer level and pressure | | Possible low xylene insoluble material/  Check recycle gas filter flake for tackiness. Check donor pumping rate, decrease teal/donor ratio. Check recycle gas filter level indication; operate valve on steamer outlet and recycle gas filter outlet in manual. | | | | | |
| 65 | | | Erractic steamer level and pressure (contd) | | Off-gas compressor loading/unloading  Check off-gas compressor discharge PIC 3005 and flow to the off gas system. Lower PIC 3005 set point to keep compressor loaded. Swinging steamer pressure will cause level to change erratically. | | | | | |
| 66 | | | Low steamer bed temp | | Level indication bad or steam related/  Check level transmitter vapor leg sightglass for oil level. Check steam pressure and temperature at FIC 2901 and FIC 2902. Increase level in steamer. Check steam flows and inlet pressures to the steamer plenum. Check condensate traps on steamer plenum outlet lines. | | | | | |
| 67 | | | Steamer bed temp low | | Steamer jacket pressure low/  Check jacket steam control valve for operation. Confirm pressure on PIC 2901. Check trap for proper operation. | | | | | |
| 68 | | | Low pressure on steamer | | Lack of feed from recycle gas filter or malfunction of compressor/  Check valve position from recycle gas filter to steamer. Check local suction pressure and valve position of pressure control valve at off gas compressor. | | | | | |
| 69 | | | High temp on dryer blower suction | | Lack of h heat transfer at scrubber/  Check scrubber water circulation rate. Check exchanger for temp change. Start the spare pump or crack in process water to suction. Check temp of flake bed in dryer. Check for excessive flow on blower. Check level in dryer. | | | | | |
| 70 | | | Low temp on dryer bed. | | | Insufficient heat/  Check heater outlet temp. Check for proper operation on steam trap for heater. Check flow on blower. Check level in dryer, raise if too low. The dryer has a spiral conveyor and if level is too low, the temperature probe will not be in flake. Raise steam flows to steamer. This increase will raise flake inlet temp to the dryer. | | | | |
| 71 | | | Low pressure on dryer | | | Lack of nitrogen make up/  Check the suction pressure controller for output to nitrogen make up valve. | | | | |
| 72 | | | Loss of dryer blower | | | Low suction pressure/  Close valve from steamer to dryer. Check suction pressure controller. Check for proper water seal on tower increase process water to pump suction. Check blower suction knockout drum for level.  Restart blower with recirculation valve open 30 to 40%, slowly pinch down to attain flow. Begin feeding from steamer to dryer again. | | | | |
| 73 | | | Loss of dryer blower (contd) | | | High discharge pressure/  Close valve from steamer to dryer. Check blower discharge knockout for water. Lower the level in the dryer. Restart blower with recirculation open 30 to 40%. Pinch down slowly to attain flow. Monitor heater inlet pressure while increasing flow. Begin feeding from steamer to dryer. | | | | |
| 74 | | | Flake lines carry to dryer scrubber | | | Cyclone malfunction/  Check steam pressure to cyclone ejector. Check bottom cone of cyclone for restriction, evidenced by cold to the touch. Tap on the cyclone cone to try and break up buildup. | | | | |
| 75 | | | Loss of dryer blower | | | Cannot get either blower to stay running or loss of palletizing transfer system not regained/  After levels stack up in steamer and bag filter, divert HS 2201 under flash drum to flare. Inject CO to the loops.  Block ingredients to mixer: oil flush. Isolate V201, shut down agitator and flush to contaminated oil. Put FIC 1702 in auto, block hydrogen. Maintain 70 0C on loops using steam on jacket. | | | | |
| 76 | | | Loss of flake transfer feeder | | | Loss of nitrogen flow in flake transfer line to storage/  Close dryer outlet valve. Reduce steamer outlet valve by 50% of valve position. Stack levels until feeder is restarted. If not restarted refer to shut down and divert of HS 2201. | | | | |
| 77 | | | Loss of steam to unit | | | | Inject CO to loops block ingredients and flush V201. When flash drum overheads reach 60 0C, divert HS 1904 and HS 2204 to flare. Put FIC 1702 in auto, block or greatly reduce cooling water to jackets on loops to try and keep temperature up on loops. Manually close FIC 2201. When loop reactors reach 420 on density, shut down P 201 and P 202. Isolate loop from blowdown and block in propylene flows. | | | |
|  | | |  | | | |  | | | |
|  | | |  | | | |  | | | |

**CHAPTER –VII**

**DATA SHEETS OF EQUIPMENTS**

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# EQUIPMENT LIST (PP PLANT)

**AGITATORS**:

Items Description

A101A/B Diluent/Donor Blending Agitator

A102 Oil/ Grease Mixing Agitator

A103 Catalyst Mixer Agitator

A201 V201 Agitator

A301 V301 Agitator (Dynamic Separator)

A501 Additive / Diluent Mixer Agitator

A601 T603 Agitator

A902 Waste Oil Mixer

**BLOWERS**

B501A/S Dryer Blowers

B601A/S Powder Conveying Fans

B602A/S Powder Conveying Blowers

B603 A/S Pellet Conveying Air Blowers

B604A/S Fans for Dedusting System (Rathi System)

B701 A/S Pellets Conveying Blowers

III **COLUMNS**

C301 Recycle Propylene Scrubber

C302 Teal Absorption Column

C501 Steamer Scrubber

C502 Dryer Scrubber

**HEAT EXCHANGERS**

E 101 V103 Jacket Water Heater

E 201 Prepoly Feed Cooler

E 202 Reactor Jacket Water Cooler

E 203 Propylene Vaporizer of V 202

E 301 Propylene Condenser of C 301

E 302 Propylene Vaporizer of V 304

E 303 Propylene Scrubber Reboiler

E 304 Recycle Gas Cooler of C 302

E 305 Feed Pump Cooler of V 304

E 306 Polymer Heater Flash Lines

E 501 Steamer Scrubber Condenser

E 502 Dryer Loop Cooler

E 503A/S N2 Heater of Dryer

E 504 Off Gas Cooler of K501 A/S

E 601 Blowers Intake Cooler (B 602 A/S)

E 602A/S Cutting Water Cooler Extruder

E 603 Pneumatic Haulage Cooler (B603 A/S)

E 604 Blowers Delivery Cooler (B602A/S)

E 701 Blower Cooler (B701A/S)

V. **FILTERS**

F101 Teal Filter

F102 Flushing Oil Filter in Teal area.

F 103 Donor Loading Filter.

F104A/S Donor Filters

F 105 Oil / Grease Filter

F 106 Hydraulic Oil Filter

F 107 Hydraulic Oil Filter

F 201 A/S Propylene Filters

F 202 A/S Hydrogen Filters

F 203 A/S Ethylene Filters

F 204A/S P202 Flushing Filters

F 301 Recycle Gas Filter (Bag Filter)

F 302 A/S Guard Filter for Propylene

F 503 Diluent Filter (In Irganox System Oil unloading line)

F 601A/S Silo Filters

F 602A/S Blowers Safety Filters

F 603 Dryer Hopper Filter

F 604 Bag Filter (for Rathi System)

F 605 Air Filter (B 603 d/s)

F 606A/S Inlet Air Filters (B 603 A/S)

F 607 A/S Cutting Water Filters

F 609 DM Water Filter

F 701 A/S Inlet Filter in B 701 A/S (PK 702)

VI **PUMPS AND COMPRESSORS**

P 101 A/S Teal Metering Pumps

P 102 Flushing Oil Pump in Teal Area

P 103 Donor Loading Pump

P 104A/S Donor Metering Pumps

P 105 Oil/Grease Unloading Pump

P 106 Catalyst Tank Jacket circulation pump

P 107 A/S Pressurization oil pump for Seals

P 108A/S Catalyst Metering Pumps

P 109 Oil Loading Pump into T106/107

P 201 Prepoly Reactor circulation pump

P 202 Poly Reactor circulation pump

P 203 Prepoly Jacket water circulation pump

P 204A/S Reactor cooling water pumps

P 205 Demi-water pump for R 202 jacket make up

P 206 Precontacting pot jacket water circulation pump

P 301A/S Propylene feed pumps

P 302A/S Scrubber Reflux Pumps

P 303 Oil Unloading pump of C302

P 304 A/S Absorption oil pumps of C 302

P 501 A/S Steamer Scrubber Pumps

P 502 A/S Dryer Scrubber Pumps

P 601 A/S Cutting water pumps of Extruder

P 801 A/S Chilled water pumps

P 802 A/S Condensate delivery pump

P 901 Gear pump (Exhaust oil system)

P 902 Gear pump (Recovered oil pumps)

K 101 Catalyst tank evacuation pump of V 103

K301A/S Recycle Gas Compressor

K 501A/S Steamer off gas compressor

K 801 N2 compressor

K 802 Hydrogen booster compressor

K804 Hydrogen booster compressor

K803 Hydrogen make up compressor

PK 101 Catalyst Metering Unit

PK 201 Reactor pump bearing lubrication system

VII **ATMOSPHERIC TANKS**

T 101 A/B Donor Storage Tank

T 102 Hydraulic Pot

T 103 Exhaust oil tank

T 104 Flushing oil tank

T 105 Oil/Grease Tank

T 106 Hydraulic Oil Surge Drum

T 107 Pressurization oil drum

T 201 Water expansion drum of R 202

T 503 Knock out drum for B501A/S

T 601 Dryer hopper

T 603 Additives hopper

T 604 Cutting water tank

T 605 Pellets feed hopper

T 801 Chilled water surge drum

T 802 Condensate recovery tank

T 901 Regenerated oil surge drum

VIII **REACTORS**

R 201 Prepoly reactor

R 202 Poly reactor

WP 201 P 201 Seal pressurization system

WP 202 P 202 seal pressurization system

WA 301 A 301 Seal pressurization system

IX **SILOS**

SI 601 A/B Powder Silo

SI 701A to D Pellets storage silos

SI 702 Homogenizer

SI 703/704 Bagging silo

X **VESSELS**

V 101 Teal surge drum

V 102 Safety pot

V 103 Catalyst Tank

V 104A/B Catalyst Cylinders

V 105 Pressure Dampner for P 107 A/S

V 106 A 103 flush oil pot

V 201 Precontacting pot

V 202 Reactor surge drum

V 203 Seal oil drum for P 201

V 204 Additive pot for R 202 jacket water

V 205 P 202 seal pot

V301 Flash drum

V 302 Blow back gas drum

V 303 KO drum for compressor (K301)

V 304 Propylene feed drum

V 305 A/S P 301 A/S Seal pot

V 306 A/S P 302 A/S Seal pot

V 307 A/S P 304 A/S Seal pot

V 502 Oily fraction collector

V 801 High pressure blow down

V 801A High pressure blow down

V 803 Additive pot for chilled water

V 804 Blow down drum

V 808 Nitrogen gas vessel

V 901 Exhaust oil surge drum

V 902 Oil regeneration vessel

XI MISCELLANEOUS EQUIPMENTS:

Item Description

J 201 Reactor Jacket Inline Heater

J 501 Steamer cyclone ejector

J 502 Dryer cyclone ejector

J 901 Exhaust oil regeneration vessel ejector

FB 501 Steamer

FB 502 Dryer

WC 501 Steamer cyclone

WC 502 Dryer cyclone

WC 801 Blowdown cyclone

WH 501 Additive loading hopper of T 501

WW 601 Pellets weigh scale in extruder

WS 601 Polymer pellets screen extruder

WW 602 Additives scale extruder

WH 601 Additives loader into mixer

WC 601 PP Polymer cyclone for loading in blender

WM 601 PP Additive Mixer (Blender)

WM 602 Continuous mixer (screw conveyor)

PK 601 PP Beads/Flakes metering unit

PR 601 Rotary feeder above PK 601

PK 602 Solid Additive metering unit

PK 603 Extruder

PK 604 Polymer Pellets Dryer

PK 605 Pneumatic conveying for PP beads from dryer to silo

PK 606 Pellet conveying to storage silos

PK 607 Dedusting system

SC 601 A/B Screw Conveyors for SI 601 A/B

H 601 Powder hopper

H 3701 Extruder hopper

X 601 A/S Rotary feeders (Below T 601)

X 602 A/S Rotary feeders (below T 605)

X 603 Rotary feeder (below WC 601)

X 604 Rotary feeder for dedusting system.

WL 101 Catalyst lifting hoist

BP 701 A/B Automatic bag placer

PK 701 A/B Bagging unit

PK 702 Conveying pellets from SI 702 to bagging

X 701 A-D Rotary feeders below silo 701 A to D

X 702 Rotary feeder below SI 702

W 701 A/B Metal detector

W 702 A/B Bag check weigher

W 703 A/B Bag rejector

W 704 A/B Bag conveyor to palletizer

W 705 A/B Bags conveyor to palletizer

W 706 A/B Palletizers

W 707 A/B Pallets Accumulators

PK 801 A/S Chiller package

# PUMPS

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sr  No | Pump  No | Description  Of pump | Flow in m3/h | Suction press in kg/cm2g | Disch.press in **kg/cm2g** | Diff press in **kg/cm2g** | Nor. rating in KW | NPSH reqd | Nor. amp drawn | No load amp | Matl of cons | Type of seal | Type of pump | Supplier |
| 1. | P101A/S | Teal metering pump | Lph or  3.2 kg/hr | 0.07 | 50.07 | 50 | 0.4 | 0.5 kg/m2 | 1.05 |  | SS316 | - | Double diaphragm metering pump | Nikkiso Co.Ltd Japan |
| 2 | P102 | Flushing oil pump | 1.0 | 1.0 | 6.0 | 5.0 | 0.75 | 1-2 metre | 1.8 | 0.80 | C.S | Mech seal (self flushing) | Ext. gear | Air Auto Engg, Bombay |
| 3 | P103 | Donor loading pump | 1.0 | 1.0 | 2.5 | 1.5 | 0.56 | 1-2 metre | 1.35 | 0.72 | AISI  304SS | -do- | -do- | -do- |
| 4 | P104A/.S | Donor metering pump | Lph or  1.5 kg/hr | 0.02 | 50.02 | 50 | 0.4 | 0.5 | 1.5 | - | SS316 | - | Double diaphragm metering pump | Nikkiso Co Ltd. Japan |
| 5 | P105 | Oil/Grease unloading pump | 1.0 | 1.0 | 6.0 | 5.0 | 0.56 | 1-2 meter | 1.65 | 1.0 | C.S | Mech seal (self flushing) | Ext. Gear Pump | Air Auto Engg Bombay |
| 6 | P106 | Catalyst tank jacket circulation pump | 10 | 3.3 | 5.3 | 2.0 | 1.5 | 2.1m | 3.17 | 1.66 | C.S | Mech seal (self flushing) | C.F | Khimline |
| 7 | P107 | Pressurisation oil pump | 130 Ltre/hr | 1.5 | 61.5 | 60 | 0.55 | - | 1.7 | - | C.S | Mech seal | Gear pump | Gear pump Switzerland |
| 8 | P108A/S | Catalyst metering pump | 3 LPM | 1.13 | 50 | 48.87 |  |  | 1.6 |  | S.S. | Gland pkg | Plunger | Hydro service Italy |
| 9 | P109 | Oil loading pump | 1.0 | 1.0 | 2.5 | 1.5 | 0.56 | 1-2 | 1.4 | 0.72 | C.S | Mech seal (self flushing) | Ext Gear Pump | Air Auto Engg Bombay. |
| 10 | P201 | Prepoly reactor circulation pump | 250 | 36.0 | 36.135 | 0.135 | 11 | 5.5m | 22 | - | C.S | Double mech seal (back to back type) | Axial propeller | Pompe Gabbionetta, Italy |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sr  No | Pump  No | Description  Of pump | Flow in m3/h | | Suction press in kg/cm2a | | Discharge press in kg/cm2a | | | Diff press in kg/cm2g. | | Normal rating in KW | | NPSH reqd | | Normal amp drawn | No load amp | | Mate of cons | | Type of seal | Type of pump | | Supplier | |
| 11 | P202 | Poly reactor circulation pump | 7000 | | 36.0 | | 37.14 | | | 1.14 | | 410 | | 32m | | 32 | - | | Inner C.S propeller Aluminium alloy | | Triple Mech seal (back to back internal and tandem external | Open axial propeller pump | | David Brown UK | |
| 12 | P203A/S | Prepoly jacket water circulation pump | 40 | | 3.3 | | 5.3 | | | 2.0 | | 5.5 | | 1.6 | | 11 | - | | C.S | | Mech seal(self flushing) | C.F | | Akay Industries Bombay | |
| 13 | P204A/S | Reactor Cooling water pump | 700 | | 2.8 | | 6.3 | | | 3.5 | | 110 | | 4.0m | | 200 | - | | C.S | | Mech seal (selfs flushing) | C.F | | Pompe Gabbionetta Italy | |
| 14 | P205 | Demi water pump | 10 | | 2.5 | | 6.0 | | | 3.5 | | 3.7 | | 2.8m | | 7.08 | 2.83 | | C.S | | -do- | -do- | | Khimline | |
| 15 | P206 | V201 jacket water circln pump | 2 | | 4.3 | | 5.3 | | | 1.0 | | 0.75 | | 1.8 | | 1.8 | 1.3 | | imp& casing:CS  Shaft:EN8 | | Mech seal (selfs flushing) | C.F. | | Khimline | |
| 16 | PK201 | P202 brg lubrication pump. |  | |  | |  | | |  | |  | |  | |  |  | |  | |  |  | |  | |
| 17 | P301A/S | Propylene feed pump | Nor.32 max.39 | | 19.21 | | 43.20 | | | 23.99 | | 75 | | 4.9 | | 122 | - | | A352  (LCB) | | Tandem Seal | Sundyne pump | | Nikkisu Co.Ltd. Japan | |
| 18 | P302A/S | Scrubber reflux pump | Nor.24 rated 29 | | 19.20 | | 23.24 | | | 4.04 | | 11 | | 1.8m | | 21 | - | | AISI 304 | | Tandem Seal | CF | | BPCL Allahabad | |
| 19 | P303 | Oil unloading  pump in C302 | 1.0 | | 1.15 | | 3.0 | | | 1.85 | | 0.56 | | 1-2m | | 1.4 | 0.72 | | C.S | | Mech Seal(self flushing) | Ext. gear | | Air Auto Engg  Bombay | |
| Sr  No | Pump  No | Description  Of pump | | Flow in m3/h | | Suction press in kg/cm2g | | Disch. press in kg/cm2g | Diff press in **kg/cm2g** | | Nor. rating in KW | | NPSH reqd | | Normal amp drawn | | | No load amp | | Mate of cons | Type of seal | Type of pump | Supplier | |
| 20 | P304A/S | Absorption oil pump | | 20 | | 1.66 | | 3.36 | 1.70 | | 3.7 | | 1.5m | | 7.39 | | | 3.80 | | C.S | Double mech seal(back to back type) | CF | Khimline pumps | |
| 21 | P501A/S | Steamer scrubber pumps | | 50 | | 1.47 | | 3.86 | 2.39 | | 7.5 | | 1.7m | | 13.82 | | | 6.20 | | C.S | Mech seal(self flushing) | CF | -do- | |
| 22 | P502A/S | Drier scrubber pumps | | 50 | | 1.24 | | 3.54 | 2.3 | | 5.5 | | 3.5 | | 10.5 | | | - | | C.S | Mech seal (self flushing) | CF | Khimline pumps Pvt.Ltd Bombay | |
| 23 | P503 | Diluent loading pump | | 1.0 | | 1.03 | | 2.23 | 1.2 | | 0.56 | | 1-2m | | 1.35 | | | 0.72 | | CS | -do- | Ext gear | Air Auto Engg Bombay | |
| 24 | P504A/S | Additive metering pump | | Nor.2.51/hr. max 5.01 | | 1.13 | | 11.13 | 10 | | 0.25 | | 0.1m | | - | | | - | | 316SS | Packing | Metering pump simplex | Dosapro Milton, Roy USA | |
| 25 | P601A/S | Cutting water pump | | 200 | | 1.1 | | 6.6 | 5.5 | | - | | 5.5 | | - | | | - | | AISI304 |  |  | W&P | |
| 26 | P602A/S | Barrel cooling water pump | | 18 | |  | | 4.0 |  | | 12 | |  | |  | | |  | | CS | Mech seal self flushing | CF | W&P | |
| 27 | P603A/S | Oil heating pump | | 50 | | 1.03 | | 10 | 8.97 | | 15 | |  | |  | | |  | | CS | Mech seal | CF | W&P | |
| 28 | P604A/S | Ext.Gear box Lube oil pump | | 35 | | 1.00 | | 4.0 | 3.0 | | 22 | | - | | 41 | | |  | |  | O-ring seal | Gear | W&P | |
| 29 | P801A/S | Chilled water pump | | 80 | | 1.22 | | 4.26 | 3.04 | | 18.5 | | 2.6m | | 32 | | | - | | CS | Mech seal self flushing | CF | Khimline pumps Bombay | |
| 30 | P802A/S | Condensate pump | | 3 | | 1.32 | | 6.56 | 5.24 | | 7.5 | | 0.6 | | 14.2 | | | - | | CS | -do- | CF |  | |
| 31 | P901 | Exhaust oil pump | | 0.11 | | 1.15 | | 2.15 | 1.0 | | 0.03 | | 1-2m | | - | | | 0.54 | | C.S | -do- | Ext.gear pump | Air Auto Engg | |
| Sr  No | Pump  No | Description  Of pump | | Flow in m3/h | | Suction press in kg/cm2a | | Disch.  press in kg/cm2a | Diff press in kg/cm2g. | | Nor rating in KW | | NPSH reqd | | Normal amp drawn | | | No load amp | | Mate of cons | Type of seal | Type of pump | Supplier | |
| 32 | P902 | Recovered oil pump | | 1.0 | | 1.05 | | 3.05 | 2.0 | | 0.24 | | 1-2m | | - | | | - | | C.S | -do- | -do- | -do- | |

# 3. HEAT EXCHANGER

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sr  No | Name of  Exchanger | Tag/  Type | Make | Fluid | | Shell side | | | | | | | | | | Tube side | | | | | | | | | | | | | |
|  |  |  |  | Shell | Tube | Press  Kg/cm**2** | | Temp 0C | | Matl Of const | | Thickness ,mm | | OD ,mm | | Area ,M2 | | No of tube | | No of pass | Dia/Length  Mm/mm | Thickness,mm | Matl Of const | Operating  Press Kg/cm2 | Inlet Temp,C | Outlet TempC | Hydrotest Press  Kg/cm2 | Heat duty  Kcal/h  X103 |
| Opr | Hydro  test | Inlet | Outlet |
| 1 | V103 water heater | E101  S&T | Reliance | Steam | H20  EG | 3.0 | 9.75 | 143 | 143 | SA106  GRB | | 7.11 | | 168.3 | | 1.51 | | 16 | | 2 | 20/  1500 | 2 | SA179 | 4.3 | 60 | 70 | 9.0 | 100 |
| 2 | Prepoly feed cooler | E201  S&T | GMML | Chilled water | C3 | 3.0 | 9.0 | 2 | 7 | SA106  GRB | | 7.8 | | 273 | | 8.5 | | 45 | | 8 | 20/  3000 | 2 | SA334  GRI | 35 | 45 | 10 | 72 | 73.5 |
| 3 | Reactor jacket water cooler | E202  P&F | Vulcan Laval | Primary DMW | Secondary CW | 7.0 | 10.5 | 61.2 | 54.6 | SS316 | | 0.6 | | DMW flow rate  770000 kg | | No of plates  97 | |  | |  |  |  | SS316 | 7.0 | 33 | 45 | 10.5 | 4600 |
| 4 | Propylene Vaporizer | E203  S&T | GMML | Steam | C3 | 3.0 | 9.75 | 143 | 143 | SA106  GRB | | 7.04 | | 219.1 | | 7.5 | | 45 | | 1 | 20/  3000 | 2 | SA334  Gr.1 | 33 | 45 | 80 | 67.5 | 161.4 |
| 5 | Propylene condensor | E301  S&T | - | C3 | CW | 18.0 | 33 | 46 | 45 | SA516  Gr.70 | | 12 | | 734 | | 220.2 | | 584 | | 4 | 20/  6000 | 2 | SA334  Gr.A | 4.5 | 33 | 40 | 10.5 | 788 |
| 6 | Propylene  Vaporizer | E302  S&T | GMML | C3 | Steam | 18.0 | 37.5 | 25 | 45 | SA576  Gr.70 | | 14 | | 828 | | 6.9 | | 29 | | 2 | 20/  1830 | 2 | SA334  Gr.1 | 3.0 | 143 | 143 | 9.75 | 320 |
| 7 | Propylene scrubber reboiler | E303  S&T | GMML | C3 | Hot water | 18.0 | 33.0 | 45 | 45 | SA334  Gr.1 | | - | | - | | 8 | | 77 | | 2 | 20/  800 | 2 | SA334  Gr.1 | 2 | 100 | 90 | 7.5 | 175 |
| 8 | Recycle Gas cooler | E304  S&T | GMML | Hydro  Carbon | Water | 0.45 | 7.5 | 70 | 40 | SS106  Gr.B | | 9.53 | | 406.4 | | 25.6 | | 136 | | 8 | 20/  3000 | 2 | SA179 | 4.5 | 33 | 38 | 10.5 | 30 |
| 9 | Feed pump cooler | E305  S&T | GMML | Hydro  Carbon | Water | 20 | 37.5 | 49 | 45 | SA333  Gr.60 | | 7.8 | | 273 | | 6.9 | | 45 | | 8 | 20/  2400 | 2 | SA334  Gr.4 | 4.5 | 33 | 40 | 10.5 | 35 |
| 10 | Steamer scrubber condenser | E501  S&T | GMML | Hydro  Carbon  + steam | CW | 0.2 | 5.25 | 104 | 45 | - | | - | | - | | 56.6 | | 300 | | 4 | 20/  3000 | 2 | SA179 | 4.5 | 33 | 42 | 10.5 | 755 |
| 11 | Dryer loop cooler | E502  S&T | GMML | CW | Process  water | 4.5 | 10.5 | 33 | 42 | SA515  Gr.60 | | 10 | | 485 | | 50.3 | | 164 | | 4 | 20/  4880 | 2 | SA179 | 1.0 | 50 | 45 | 5.25 | 250 |
| 12 | Nitrogen Heater | E503  A/S  Finned | BHPV | N2 | Steam | 0.3 | 0.625 | 40 | 110 | Fin data | | | | | | | | | | |  | - | SA179 | 3 | 143 | 143 | 9.75 | 88.2 |
| Type | MOC | | OD | | Thk | | Nos | | Area | |
| G | Al | | 50.4 | | 0.4 | | 11 | | 4.7m2 | |
| 13 | Offgas cooler | E504  S&T | Reliance | Hydrocarbon steam | Water 10% EG | 2.5 | 9 | 45 | 10 | SA106  Gr.B | | 7.04 | | 219.11 | | 4.3 | | 28 | | 4 | 20/  2440 | 2 | SA179 | 1 | 2 | 4 | 9.0 | 7.5 |
| 14 | Inlet nitrogen Cooler for B602A/S | E601  S&T | Buhler MIAG | N2 | CW | Flow rate 2100 m3/hr | - | 80 | 50 | SS304 | | - | | - | | - | |  | |  |  |  | Copper for tubes | AP for fins | 33 | 45 | - | 18.9 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Name of  Exchanger | Tag/Type | Make | Fluid | | Shell side | | | | | | | Tube side | | | | | | | | | | Heat duty  Kcal/h  X103 |
| Shell | Tube | Press  Kg/cm2 | | Temp 0C | | Matl Of const | Thickness ,mm | OD ,mm | Area ,M2 | No of tube | No of pass | Dia/Length  Mm/mm | Thickness,mm | Matl Of const | Operating  Press Kg/cm2 | Inlet Temp,C | Outlet TempC | Hydrotest Press  Kg/cm2 |
| Opr | Hydro  test | Inlet | Outlet |
| 15 | Disch Cooler for B602A/S | E604  S&T | -do- | N2 | CW | -do- | - | 115 | 70 | -do- | - | - | - |  |  |  |  | -do- | -do- | 33 | 45 | - | 28.3 |
| 16 | Cutting water cooler | E602A  P&F |  | Pri cutting water | Sec  CW | 4.5 | 12.0 | 60 | 50 | SS316 | Flow rate |  |  |  |  |  |  |  |  | 33 | 45 | 10.5 | 2000 |
| 17 | Cutting water cooler | E602S  P&F | Alfa lavel |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

# 4. COLUMNS

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sr.  No | Column No | Make | Service | No of trays | No of trays | Column dia M | Wall thickness mm | Matl. Constn. | Opr/desn. Per kg/cm2g | Hydro test per kg/cm2g | Safe opr. Pr. | No of man holes | Total | Opr./ desn. Temp in C. | Column height M |
| 1. | C301 | ISGEC | Propylene | 13 | 1-5  Segmental baffle tray. Sieve tray | 0.8 | 14 | LTCS  SA516  Gr.60 | 18/22 | 33 | 22 | 21 | 10 | 45  -45/100 | 10.08 |
| 2 | C-302 | Texmaco | Hydro carbon(density)0.8 | 5 | Sieve | 0.9 | 8 | LTCS  SA515 | 0.5/5 | 7.5 | 0.5 | 2 | 7 | 70/100 | 4.5 |
| 3 | C501 | Texmaco | Steam propylene | 10 | baffle(Disc)  2.4.6 baffle(Donnt) 7-10 | 1.0 | 8 | A515  Gr.70 | 0.2/3.5 | 5.25 | 0.2 | 3 | 16 | 100/145 | 13.0 |
| 4 | C502 | Texmaco | Water + N2 | 8 | 1.3  baffle(disc)  2.4 baffle 5 to 8 dual floare sieve tray | 1.2 | 8 | A515  Gr.70 | 0.1/0.5 | 1.0 | 0.1 | 1+1 hand hole | 7 | 60/110 | 9.0 |

# 5. REACTOR

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sr  No | Tag No | Make | Service | Dia in mm | Wall thickness in mm | Height in m | Volume m3 | Matl. Const | Shell data | | | | | Jacket data | | | | Total no. of nozzle |
| Press,Kg/cm2g | | | Temp.0C | | Press,Kg/cm2g | | Temp.0C | |
| op | design | Hydro  test | op | design | op | design | op | design |
| 1. | R201 | Fabricom, Italy | Propylene | 168.3 OD | 10 | 9 | 0.44 | A516  98.70 | 33 | 42 | 63 | 20 | -45  to  150 | 2.5 | 3.5 | 10 | 150 | 12 |
| 2 | R202 | Fabricom, Italy | Slurry | 609.6  OD | 14 | 27 | 53.4 | A516  98.60 | 33 | 42 | 63 | 70 | -45  to  150 | 5 | 6 | 60 | 140 | 22 |

# 6. AGITATORS

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sr  No | Name | Description | Material of construction | Impeller type | Blade type | No of blades | Speed(rpm) | KW rating | Full load current in amp | Shaft seal | Supplier |
| 1 | A101A/B | Donor Blender | Imp:AISI 304  Shaft AISI 304 | Pitched blade turbine | Flat at 45o angle | 6 | 250 | 0.3 | 1.4 | Stuffing box with packing | Standard Engineers Bombay |
| 2 | A102 | Oil/Grease mixer | Imp IS 226  Shaft:MS | -do- | -do- | 6 | 220 | 1.4 | 5.0 | -do- | -do- |
| 3 | A103 | Catalyst mixer | AISI 304 | Double ribbon | Double (Ext/Int) | - | 30 | 5.5 | - | Double mech. Seal  (back to back) | Samic Italy |
| 4 | A201 | Agitator for V201 | AISI 304 | - | Flat at 450 angle | 4 | 300 | 1.1 | - | Double mech. seal  (tandem type) | -do- |
| 5. | A301 | Dynamic Separator | AISI 304 | Basket | - | 36 | 1450 | 5.5 | - | Double mech. Seal  (back to back) | -do- |
| 6 | A501 | Additive/diluent mixer | AISI 304 | Pitched blade turbine | Flat at  45 0 angle | 6 | 180 | 1.12 | 2.7 | Stuffing box with packing | Standard Engineers Bombay |
| 7 | A601 | Agitator for  T 603 | - | - | - | - | 440 | 2.2 | 4.1 | - | Funken Japan |
| 8 | A901 | Waste oil mixer | Impeller IS 226 shaft EN 24 | Turbine flat blade | Flat at 900 angle | 6 | 180 | 2.2 | 5.0 | Stuffing box double mech seal (back to back) | Standard Engineers Bombay |

# 7. TANKS / VESSELS

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sr.No | Name of the vessel | Vessel No | Material of construction | | Operating condition | | Design condition | | Dimension | | Thk. In  mm | Vol in m3 | Vendor |
| Press in kg/cm2g | Temp,0 C | Press in  Kg/cm2 | Temp,0 C | Length in mm | O.D. mm |  |  |  |
| 01 | Donor storage tank | T101A/B | | SS | 0.015 | 35 | 3.5 | 100 | 1200 | 900 | 3 | 0.9 |  |
| 02 | Hydraulic pot | T102 | | CS | 0.015 | 35 | 3.5 | 100 | 1200 | 600 | 6 | 0.4 | Otoklin |
| 03 | Exhaust oil tank | T103 | | CS | 0.015 | 35 | 3.5 | 100 | 2000 | 1100 | 6 | 2.0 | Otoklin, Bombay |
| 04 | Flushing oil tank | T104 | | CS | 0.015 | 35 | 3.5 | 100 | 2000 | 1100 | 6 | 2.0 | -do- |
| 05 | Oil grease tank | T105 | | CS | 0.015 | 70 | 3.5 | 175 | 1900 | 1100 | 8 | 2.0 | -do- |
| 06 | Hydraulic oil surge drum | T106 | | CS | Atm | 35 | Atm | 100 | 1400 | 700 | 6 | 0.6 | -do- |
| 07 | Pressurization oil drum | T107 | | CS | Atm | 35 | Atm | 100 | 1400 | 700 | 6 | 0.6 | -do- |
| 08 | Water expansion drum | T201 | | CS | Atm | 60 | Atm | 100 | 2000 | 1100 | 6 | 2.15 | -do- |
| 09 | Additive storage tank | T501 | | SS | 0.015 | 80 | 3.5 | 175 | 1800 | 1100 | 6 | 2.1 | GMLL Karam Sat. |
| 10 | Additive Metering drum | T502 | | CS | 0.015 | 15 | 3.5 | 60 | 1600 | 800 | 6 | 0.07 | -do- |
| 11 | Dryer hopper | T601 | | SS304 | 0.1 |  |  |  |  |  |  |  | Buhler Miag Italy |
| 12 | Additive hopper | T603 | | SS | Atm | Ambient | Atm |  | 2595 | 1250/750 conical |  |  | W&P, Germany |
| 13 | Cutting water tank | T604 | | SS | Atm | 60 | Atm | 100 | 4000 | Breadth 1600 height 2000 length 4000 | 3 | 12 |  |
| 14 | Pellets hopper | T605 | | SS | Atm | 60 | Atm | 60 | 2000 | 1000 | - | 2.0 |  |
| 15 | Chilled water surge drum | T801 | | CS A515 | Atm | 5 | Atm | 100 | 3000 | 1400 | C | 5.0 | Siesta |
| 16 | Condensate collection tank | T802 | | CS | Atm | 100 | Atm | 120 | 1300 | 800 | 6 | 0.75 |  |
| 17 | Regeneration oil surge drum | T901 | | CS | Atm | 100 | Atm | 150 | 1300 | 700 | - | 0.5 |  |
| 18 | Teal surge drum | V101 | | SS | 0.015 | 35 | 16 | 60 | 800 | 700 | 5 | 0.38 | Siesta Steel Const. Pvt.Ltd. Mumbai |
| 19 | Safety pot | V102 | | SS | 0.015 | 35 | 16 | 60 | 575 | 4”NB | Sch.10 | 0.005 |  |
| 20 | Catalyst preparation tank | V103 | | SS | Full vacuum 10 | 60 | Full | 160 | 2150 | 800 | 11 | 1.25 | Samic. |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sr.No | Name of the vessel | Vessel No | Material of con | | Operating condition | | Design condition | | Dimension | | Thk. In  mm | Vol in m3 | Vendor |
| Press in kg/cm2g | Temp,0 C | Press in  Kg/ cm2 | Temp,0 C | Length in mm | O.D. mm |  |  |  |
| 21 | Catalyst cylinder | V104A/S | | SS | 50 | 10 | 100 | 60 | 1200 | 200 | - | 0.032 | TCM supply |
| 22 | Pressure Dampner | V105 A/S | | CS | 50-60 | Amb | 70 |  |  |  |  | 0.032 |  |
| 23 | Precontacting pot | V201 | | SS | 35 | 10 | 70 | -45/100 | 145 | 100 | - | 0.001 | Samic |
| 24 | Reactor V202 surge drum | V202 | | LTCS A516 Gr.60 | 33 | 75 | 45 | -45 to 100 | 6000 | 1500 | 36 | 11.9 | ISJEC |
| 25 | Seal pot (V201) | V203 | | SS | Atm | Amb | 48 | 90 | 460 | 160 | - | 0.011 | TC |
| 26 | Additive pot | V204 | | SS | 5.0 | 60 | 8.0 | 80 | 300 | 6” NB | Sch.10 | 0.005 | Unitop Engg Pvt.Ltd. |
| 27 | Seal Pot(P202) | V205 | | SS304 | Atm | Amb | 48 | -45/150 | 654 | 219 | - | 0.025 | David brown |
| 28 | Flash drum | V301 | | SS ASTM  A240  304 | 18 | 80 | 22 | 100 | 1850 | 196 | 12 | 1.950 | Samic |
| 29 | Block back gas | V302 | | CS | 5.0 | 45 | 10 | 90 | 600 | 400 | 6 | 0.09 | -do- |
| 30 | K.O. Drum | V303 | | CS | 0.5 | 45 | 5 | 90 | 1700 | 500 | 6 | 0.36 | -do- |
| 31 | Propylene V304 feed drum | V304 | | LTCS A516 Gr.60 | 20 | 50 | 25 | -45 to 90 | 12000 | 3200 | 42 | 100 | ISJEC |
| 32 | P302A/S seal pot | V306A/S | | - | Atm | Amb | 25 |  |  |  |  |  |  |
| 33 | P304A/S seal pot | V307A/S | | SS304 | 6 | 50 | 12 | 90 | 635 | 168.3 | - | 0.011 | Khimline |
| 34 | Oily Fraction Fraction Collector | V502 | | CS | Atm | Amb | 3.5 | 90 | 1000 | 500 | 6 | 0.2 |  |
| 35 | High pressure blowdown | V801 | | LTCS | 4.5 | 30 | 15 | -45 to 175 | 6000 | 3000 | 28 | 47.8 | ISJEC |
| 36 | High pressure blow down | V801A | | LTCS | 4.75 | 30 | 15 | -45 to 175 | 6000 | 3400 |  | 64.0 |  |
| 37 | Low pressure blowdown | V802 | | LTCS | 2 | 30 | 5 | -45 to 175 | 6000 | 2500 | 14 | 47.8 |  |
| 38 | Additive pot | V803 | | SS | 5.0 | 60 | 8.0 | 80 | 300 | 6”NB | Sch.10 | 5 ltr |  |
| 39 | Polymer collection | V804 | | LTCS | 0.1 | 30 | 5 | -45 to 120 | 2500 | 2500 | 8 | 15.4 | ISJEC |
| 40 | Hydrogen bullets | V805A/B | |  |  |  |  |  |  |  |  |  |  |
| 41 | Nitrogen gas vessel | V808 | | CS | 11 | Amb | 13.0 | 150 | 1450 | 2000 | 12 | - |  |
| 42 | Exhaust oil surge drum | V901 | | CS | 0.05 | 70 | 3.5 | 100 | 1500 | 900 | 6 | 1.0 |  |
| 43 | Oil regeneration vessel | V902 | | CS | 0.05 | 100 | 3.5 | 150 | 1800 | 1200 | 10 | 2.4 | Siesta |
| 44 | Seal press intensifier | WP201  WP202 | | SS304 | 36 | 35 |  |  | 918 | 200(ID) |  | 24 ltr |  |
| 45 | Seal press intensifier | WA301 | |  | 18.5 | 35 | 25  7 | 100  -45 | 744 | 150(10) |  | 10 lit |  |

# 8. SILOS

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sr.No | Silo No | Description | Op. press in kg/cm2 | Op. temp  0C | Design press in kg/cm2 | Design temp 0C | Vol in M3 | Length in M | Dia in M | Material of const | Supplier |
| 1 | SI601A/B | Powder storage silo | 0.02 | 80 | 0.05 | 100 | 530 | Cylindrical-17  Conical-3 | 6 | A240  TP304 | Bridge and Roof Calcutta |
| 2 | SI701A/B/C/D | Pellet storage silo | Atm | 60-70 | Atm | 80 | 170 | Cylindrical-12.5  Conical –1.5 | 4 | -do- | -do- |
| 3 | SI703/704 | Bagging silo | Atm | 60-70 | Atm | 80 | 170 | Cylindrical-12.5  Conical-2 | 4 | -do- | -do- |
| 4 | SI702 | Homogenizer | Atm | 60-70 | 450mm + static head | 80 | 150 | Cylindrical-16.5  Conical-3.850 | 4 | AISI304 | Denka Japan |

# 9. FILTER

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sr.  No | Filter No | Description | Flow rate per hr | Op. press in kg/cm2g | Op temp in C | Design press in kg/cm2 | Design temp in C | Max pr.drop mmwc | Type | No of cartridges | Filtering element | Core | Parti size out | Supplier |
| 1 | F101 | Teal Filter | 10 lit | 0.015 | Amb | 16 | 100 | 100 | Simplex | 3 | Porous SS316 | SS304 | 10  and above | IAEC |
| 2 | F102 | Flushing oil filter | 800 kg | 5.0 | 30 | 10 | 100 | 10000 | -do- | 1 | Sintered SS wire mesh | SS304 | -do- | -do- |
| 3 | F103 | Donor loading filter | 1000 kg | 1.0 | Amb | 5.0 | 100 | 1000 | -do- | 1 | -do- | -do- | -do- | -do- |
| 4 | F104 | Donor filter | 2 kg | 0.1 | Amb | 5.0 | 100 | 200 | -do- | 2 | SS316 porous | -do- | -do- | -do- |
| 5 | F105 | Oil/Grease filter | 800 kg | 6.0 | 70 | 10.0 | 100 | 20000 | -do- | 1 | Sintered SS wire mesh | -do- | -do- | -do- |
| 6 | F106 | Hydraulic oil filter | 250 kg | 0.2 | Amb | 5.0 | 100 | 2000 | -do- | 1 | -do- | -do- | -do- | -do- |
| 7 | F107 | Hydraulic oil filter | 9 kg | 0.1 | Amb | 5.0 | 100 | 1000 | Simplex | 1 | Sintered SS wire mesh | SS304 | 10  and above | IAEC |
| 8 | F201 A/S | Propylene filter | 20000 kg | 42.0 | 45 | 50 | 90 | 4000 | -do- | 6 | Polypropylene | -do- | 25  and above | -do- |
| 9 | F202 A/S | Hydrogen filter | 4 kg | 50 | 25 | 60 | 70 | 2000 | -do- | 1 | Poroussint. SS | -do- | 10  and above | -do- |
| 10 | F203A/S | Ethylene filters | 400 kg | 50 | 40 | 60 | 70 | 2000 | -do- | 1 | Polypropylene | -do- | 25  and above | -do- |
| 11 | F204 A/S | P202 flushing filter | 1200 kg | 34.5 | 45 | 50 | -45 to 90 | 4000 | -do- | 1 | -do- | -do- | 2  and above | -do- |
| 12 | F301 | Bag filter | 9600 kg | 0.5 | 70 | 5.0 | 85 | 500 | Pulse jet bag filter | 12 | -do- | -do- | - | Fluid Air(I) Pvt.Ltd. Bombay |
| 13 | F302 | Guard filter | 2500 kg | 2.1 | 70 | 5.0 | 90 | 200 | Simplex | 15 | Polypropylene | SS304 | 4  and above | IAEC |
| 14 | F503 | Diluent filter | 900 kg | 2.0 | 35 | 5.0 | 60 | 3000 | -do- | 1 | Sintered SS wire mesh | -do- | 10  and above | -do- |
| 15 | F601A/S | Silo filter | 1920 m3 | 300 m bar | 40 | 0.1 | 80 | 150 | Reverse pulse jet cleaning | 18 | Polypropylene | -do- | - | Buhler MIAG |
| 16 | F602 A/S | B602 suction filter | 2100 m3 | 0.2 | 40 | - | - | - | - | 1 | - | - | - | Buhler MIAG |
| 17 | F603 | Dryer Hopper filter | 180 m3 | 0.1 | 80 | 1.0 | 110 | 150 | Reverse pulse jet cleaning | 4 | Polypropylene | SS304 | - | -do- |
| Sr.  No | Filter No | Description | Flow rate per hr | Op. press in kg/cm2g | Op temp in C | Design press in kg/cm2 | Design temp in C | Max drop in pr. In mm H2O | Type | No of cartridges | Filtering element | Core | Parti size out | Supplier |
| 18 | F604 | Bag filter Rathi system | 3200 m3 | 1397 mm WC | 60-80 | - | - | 150 | Pulse type |  |  |  |  |  |
| 19 | F605 | Air filter E603 d/s |  |  |  |  |  |  |  |  |  |  |  |  |
| 20 | F606 A/S | Inlet air filter B603 |  |  |  |  |  |  |  |  |  |  |  |  |
| 21 | F607 A/S | Cutting water filter | 20000 kg | 5 kg/cm2 | 85 | 8 | 100 | 0.7 kg/cm2 | Duplex | 78 | Polyester | MS | - | Rathi |
| 22 | F608 | DM Water filter |  |  |  |  |  |  |  |  |  |  |  |  |
| 23 | F701 | Filter B701 u/s |  |  |  |  |  |  |  |  |  |  |  |  |

# 10. COMPRESSORS

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sr. No | Number | Description | Type | Capacity | Fluid handled | | Inlet conditions | | Outlet condition | | No of stages | Remarks |
| Temp | Pressure | Temp | Pressure |  |  |
| 1 | K101 | Vacuum pump for catalyst tank evacuation | Reciprocating | 46m3/hr | | Nitrogen | 70 C | 10 TORR | - | 760 TORR | One | \* |
| 2 | K301A/S | Recycle gas compressor | Reciprocating | 695m3/hr | | Propylene | I stage  45 C | I stage 0.357 kg/cm2g | II stage  88.14 C | II stage 20.417 | Two | @ |
| 3 | K501A/S | Purge gas compressor | Liquid ring | 200m3/hr(min) | | Purge gas propylene | 45 C | 0.15 kg/cm2g | 45 C | 2.53 kg/cm2g | One | # |
| 4 | K801 | Nitrogen compressor | Reciprocating | 55.97m3/hr | | Nitrogen | 30 C | kg/cm2g | 108.59 | 11.217 | One | $ |
| 5 | K803 | Hydrogen Compressor | Reciprocating | 390 Nm3/hr | | Hydrogen |  |  |  |  | Two |  |
| 6 | K802 | Hydrogen Compressor | Reciprocating |  | | Hydrogen |  |  |  |  | One |  |
| 7 | K804 | Hydrogen Compressor | Reciprocating |  | | Hydrogen |  |  |  |  | One |  |

(A) CP/CV =1.4;

(B) Rotary sliding vane type.

# Rated power 25 kw. Liquid ring fluid requirement 3.83m3. Cooling water reqd. for cooler : 13.41m3.

$ (A) Total BHP 15.13. (B) RPM 615. (C) Capacity reduction by UL90 outside operated free air unloader.

@

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| I Stage | | | | II Stage | | | |
| In | | Out | | In | | Out | |
| Temp,oC | Press,Kg/cm2g | Temp,oC | Press,Kg/cm2g | Temp,oC | Press,Kg/cm2g | Temp,oC | Press,Kg/cm2g |
| 45 | 0.357 | 108 | 5.607 | 88.14 | 5.607 | 110 | 20.147 |

HP 167.5

RPM 420

Piston displacement. I stage : 1132.6, II stage : 274.4m3/hr

Unloaders – UL-90; Clearance UL-47

**BLOWERS**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sr  No | Name | Description | Type of blower | Cap in m3/hr | Suction | | Discharge | | KW rating | Normal Amp drawn | Seal type | Direction of rotation | Supplier |
| Press. In kg/cm2 | Temp in C | Press in kg/cm2 | Temp in C |
| 1 | B501A/S | Drier blower | Roots positive displacement type | 5000 | 0.04 | 45 | 0.34 | 69 | 75 | 133 | Labyrinth type |  | Robuschi Italy (TCM supply) |
| 2 | B601A/S | Blower for maintaining press in conveying |  | 2000 | 0.015 | 70 | 0.08 | 80 | 11 | 21.4 |  |  | Buhler (Ferrari) Italy |
| 3 | B602A/S | Powder conveying blower | Roots positive displacement type | 2100 | 0.06 | 50 | 0.6 to 0.65 max 0.8 | 115 max | 90 | 155.9 | Labyrinth type |  | Buhler (Robuschi) Italy |
| 4 | B603 A/S | Pellet conveying from extruder house to silos | -do- | 2010 | atm | atm | 600 mbar | 90 | 75 | 133 |  |  | Buhler (Robuschi) |
| 5 | B604A/S | Fan for suction system | Centrifugal with radical blades | 4400 | Differential Press 325 Mm hg  Operating Temp 24 0C | | | | 15 | 28.3 | Asbestos sealing |  | Rieco Pune |
| 6 | B701A/S | Pellets conveying from silos to Homogenization bagging | Roots type | 3780 | Diff. Pr |  | 600 m bar | 70 | 132 | 229 |  |  | Buhler (Robuschi) |

**REMOTE OPERATED VALVES(**[**FLOW**](#FV)**/**[**TEMP**](#TV)**/**[**PRESS**](#PV)**/**[**LEVEL**](#LV) **CVs,**[**HVs**](#HV)**,HICs)**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sr  No | Tag No | Line size  and Sch | Service | Type of body | Body size | Port size | Actuator Type | DP shut off kg/cm2 | Failure  position |
| 1 | FV 1501 | 1” 40 Sch | Oil-grease to V103 | Angle note 1 | 1” | 1” | Piston | 40 | Locked |
| 2 | FV 1701.1 | ½” 40 Sch | F202 A/S outlet | Globe | ½” | CV=0.01 | Piston | 60 | Locked |
| 3 | FV 1701.2 | ½” 40 Sch | F202 A/S outlet | Globe | ½” | CV=0.001 | Piston | 60 | Locked |
| 4 | FV 1702 | 3” 40 Sch | Propylene from F 201A/S | Globe | 2” | 1 ½” | Piston | 40 | Locked |
| 5 | FV 1703 | 1 ½” 40 Sch | Propylene to Inline mixer | Globe | 1” | CV-10 | Piston | 40 | Locked |
| 6 | FV 1801 | 1” 40 Sch | Propylene Flush to P201 | Globe | 1” | CV=1.6 | Piston | 50 | Locked |
| 7 | FV 1803 | ½” 40 Sch | Propylene from V 202 top | Globe | ½” | CV=0.25 | Piston | 10 | Locked |
| 8 | FV 1804 | 1” 40 Sch | Ethylene Gas from F 203 A/S | Globe | 1” | CV=1.61 | Piston | 60 | Locked |
| 9 | FV 1901 | 1” 40 Sch | Propylene liquid to P 202 | Globe | 1” | CV=4.0 | Piston | 41 | Locked |
| 10 | FV 2201 | 1” 40 Sch | Flushing propylene from F201A/S | Globe | 1” | CV=4.0 | Piston | 41 | Locked |
| 11 | FV2203 | 1” 40 Sch | C301 bottom to F301 | Vee Ball | 1” | 1” | Diaphragm | 18 | Close |
| 12 | FV 2301.1 | 3” 40 Sch | Hot water to E 303 | Globe | 3” | 2 ½” | Piston | 5 | Locked |
| 13 | FV 2301.2 | 4” 40 Sch | Water to C501 | Globe | 3” | 2” | Piston | 5 | Open |
| 14 | FV 2304 | 1” 80 Sch | E 301 vent | Globe | 1” | CV=0.25 | Diaphragm | 22 | Close |
| 15 | FV 2402 | 3” 80 Sch | P 301A/S to E 305 | Globe | 2” | 2.25” | Diaphragm | 25 | Close |
| 16 | FV 2901 | 4” 40 Sch | Primary Steam to FB 501 | Globe | 3” | 3” | Diaphragm | 6.5 | Close |
| 17 | FV 2902 | 2” 40 Sch | Secondary Steam to FB 501 | Globe | 1 ½” | 1 ½” | Diaphragm | 6.5 | Close |
| 18 | FV 2904 | 1” 80 Sch | Steam to C501 | Globe | 1” | CV=2.5 | Diaphragm | 6.5 | Close |
| 19 | FV 4102 | 4” IS 1239 | Water+ EG to PK 801A/S | Globe | 3” | 3” | Diaphragm | 3.5 | Close |
| 20 | HV 1101/1 | 3” 40 Sch | Propylene BL to V304 | Ball | 3” | 3” | Piston | 25 | Locked |
| 21 | HV 1101/2 F.S | ½” 80 Sch | Ethylene from BL to F 203 | Ball | 1 ½” | 1 ½” | Piston | 70 | Locked |
| 22 | HV 1101/3 F.S | ½” 80 Sch | Hydrogen from BL to F202 A/S | Ball | ½” | ½” | Piston | 70 | Locked |
| 23 | HV 1101/4 F.S | 2” 40 Sch | Purge gas to B/L from E302/E504 | Ball | 2” | 2” | Piston | 2 | Locked |
| 24 | HV 1201 | ½” 80 Sch | Nitrogen to Teal drum | Ball | ½” | ½” | Diaphragm | 10.5 | Close |
| 25 | HV 1202 | ½” 80 Sch | Vent to T102 | Ball | ½” | ½” | Diaphragm | 10.5 | Close |
| 26 | HV 1204 | ½” 80 Sch | Vent to T102 | Ball | ½” | ½” | Diaphragm | 10.5 | Close |
| 27 | HV 1207 | ½” 80 Sch | Teal to V101 | Ball | ½” | ½” | Diaphragm | 10.5 | Close |
| 28 | HV 1208 | ½” 80 Sch | Teal to V101 | Ball | ½” | ½” | Diaphragm | 10.5 | Close |
| 29 | HV 1301 | ½” 80 Sch | V101 top discharge | Ball | ½” | ½” | Diaphragm | 5 | Close |
| 30 | HV 1302 | ½” 80 Sch | V101 bottom discharge | Ball | ½” | ½” | Diaphragm | 5 | Close |
| 31 | HV 1303 | ½” 80 Sch | Teal from V101 to F101 | Ball | ½” | ½” | Piston | 5 | Locked |
| 32 | HV 1304 A/S | ½” 80 Sch | P101 A/S suction | Ball | ½” | ½” | Piston | 5 | Locked |
| 33 | HV 1305 A/S | ½” 80 Sch | P101A/S delivery | Ball | ½” | ½” | Piston | 70 | Locked |
| 34 | HV 1306 | 1” 80 Sch | Drain into T102 | Ball | 1” | 1” | Piston | 5 | Locked |
| 35 | HV 1309.1/2 | ½” 80 Sch | Teal to V101 | Ball | ½” | ½” | Diaphragm | 5 | Closed |
| 36 | HV 1502 | ¾” 40 Sch | Nitrogen to V103 | Ball | ¾” | ¾” | Piston | 12 | Locked |
| 37 | HV 1503 | 2” 10 Sch | V103 blanketing | Ball | 2” | 2” | Piston | 12 | Locked |
| 38 | HV 1504 | 1” 40 Sch | V103 Vent | Ball | 1” | 1” | Diaphragm | 12 | Open |
| 39 | HV 1505 | 1 ½” 40 Sch | K101 suction | Ball | 1 ½” | 1 ½” | Piston | 12 | Open |
| 40 | HV 1506 | 3” 10 Sch | Catalyst to V103 | Ball | 3” | 3” | Piston | 12 | Locked |
| 41 | HV 1801 | 1” 40 Sch | Propylene from V 202 | Ball | 1” | Note 2 | Piston | 40 | Close |
| 42 | HV 1803 | 1” 40 Sch | I/V on R201 to R202 | Vee Ball | 1” | 1” | Piston | 33 | Close |
| 43 | HV 1804 | 1 ½” 40 Sch | R201 emergency bottom discharge | Angle Note 2 | 1 ½” | 1 ½” | Piston | 40 | Close |
| 44 | HV 1809 | 4” 40 Sch | V202 discharge | Ball | 4” | 4” | Piston | 40 | Close |
| 45 | HV 1902 | 4” IS 1239 | Water to J201 | Ball | 4” | 4” | Piston | 40 | Close |
| 46 | HV 1903 | 3” 40 Sch | Steam to J201 | Globe | 3” | 2 ½” | Piston | 6.5 | Close |
| 47 | HV 1904 | 1” 40 Sch | 3-way valve at R202 bottom | Ball | 1” | 1” | Piston | 40 | Locked |
| 48 | HV 1905 1/2/3 | 1 ½” 40 Sch | R202 Bottom Discharge | 600 piston | 1 ½” | 1 ½” | Piston | 50 | Locked |
| 49 | HV 1909 | 1” 40 Sch | R202 Bottom Discharge LDPE elbow | Vee Ball | 1” | 1” | Diaphragm | 40 | Close |
| 50 | HV 1910 | 1” 40 Sch | R202 Bottom Discharge GC elbow | Vee Ball | 1” | 1” | Diaphragm | 40 | Close |
| 51 | HV 2001 1/2/3/4/5/6 | 3/4” 40 Sch | 1% CO injection valve to R202 | 600 piston | 3/4” | 3/4” | Piston | 50 | Locked |
| 52 | HV 2002 | 1 ½” 40 Sch | CO gas from cylinder | Ball | 1 ½” | 1 ½” | Piston | 200 | Locked |
| 53 | HV 2003 | ½” 40 Sch | CO gas to flare | Ball | ½” | ½” | Piston | 80 | Locked |
| 54 | HV 2201 | 3” 10 Sch | 3-way valve at V301 bottom | Ball | 3” | 3” | Piston | 40 | Locked |
| 55 | HV 2204 | 1 ½” 40 Sch | 3-way valve at R 202 Discharge to V301/V802 | Ball | 1 ½” | 1 ½” | Piston | 40 | Locked |
| 56 | HV 2301 | 4” 40 Sch | E301 Discharge | Ball | 4” | 4” | Piston | 25 | Locked |
| 57 | HV 2401 A/S | 4” 40 Sch | V304 Discharge | Ball | 4” | 4” | Piston | 26 | Locked |
| 58 | HV 2402 | 1 ½” 40 Sch | V304 venting | Globe | 1 ½” | 1” | Diaphragm | 25 | Close |
| 59 | HV 4001 | 1” 80 Sch | Propylene vapour from V 801 | Globe | 1 ½” | 1” | Diaphragm | 15 | Close |
| 60 | HV 4002 | 4” 40 Sch | V802 bottom discharge | Ball | 4” | 4” | Diaphragm | 2 | Close |
| 61 | HV 4004 | 3” 40 Sch | 3-way valve from V301 to V801A/V802 | 1200 | 3” | 3” | Piston | - | Lock |
| 62 | HV 4005 | 4” 40 Sch | V 804 bottom discharge | Ball | 4” | 4” | Piston | - | Close |
| 63 | HV2501 | 1” 80 Sch | E304 Emerg vent | Ball | 1” | 1” | Diaphragm | 5 | Open |
| 64 | LV 1801 | 1” 40 Sch | R202 dicharge/V202 level control | Vee Ball | 1” | 1” | Diaphragm | 40 | Close |
| 65 | LV 2201 | 1 ½” 40 Sch | V301 level control | Vee Ball | 1 1/2” | 1 1/2” | Diaphragm | 22 | Close |
| 66 | LV 2203 | 4” 10 Sch | F301 level control | Vee Ball | 4” | 4” | Diaphragm | 5 | Close |
| 67 | LV 2301 | 2” 40 Sch | Propylene Reflux to C 301 | Globe | 1 ½” | 1” | Diaphragm | 22 | Open |
| 68 | LV 2401 | 3” 40 Sch | Propylene to V304 | Globe | 2” | 1 ½” | Diaphragm | 25 | Open |
| 69 | LV 2901 | 6” 5 Sch | Steamer level control | Vee Ball | 6” | 6” | Diaphragm | 3.5 | Close |
| 70 | LV 2904.1 | 1 ½” 40 Sch | Waste water to WB 501 | Ball | 1 ½” | 1 ½” | Diaphragm | 3.5 | Open |
| 71 | LV 2904.2 | 2” IS 1239 | Service water supply | Ball | 2” | 2” | Diaphragm | 3 | Close |
| 72 | LV 3001 | 1” 80 Sch | Water from K501A/S to C501 | Globe | 1” | CV=1.6 | Diaphragm | 4 | Close |
| 73 | LV 3003 | 1” 80 Sch | V501 outlet | Globe | 1” | CV=0.063 | Diaphragm | 4 | Close |
| 74 | LV 3101 | 8” 10 Sch | FB 502 Bottom line | Globe | 8” | 8” | Diaphragm | 0.5 | Close |
| 75 | LV 5102 | 1” IS 1239 | P802 A/S Diacharge | Globe | 1” | CV=6.3 | Diaphragm | 5.5 | Close |
| 76 | PV 1101 | 1 ½” 80 Sch | Ethylene Gas to F 203A/S | Globe | 1” | CV=11 | Diaphragm | 75 | Close |
| 77 | PV 1102 | ½” 80 Sch | H2 from BL to F202 A/S | Globe | ½” | CV=0.02 | Diaphragm | 60 | Close |
| 78 | PV 1201 | ½” IS 1239 | Nitrogen to Teal drum | Globe | ½” | CV=0.1 | Diaphragm | 10.5 | Close |
| 79 | PV 1802.1 | 1 ½” 40 Sch | Propylene to E 203 | Globe | 1” | CV=2.5 | Diaphragm | 40 | Close |
| 80 | PV 1802.2 | 1 ½” 40 Sch | V202 vent to blowdown | Globe | 1 ½” | 1” | Diaphragm | 40 | Close |
| 81 | PV 2201 | 3” 40 Sch | Steam to E 306 | Globe | 3” | 2 ½” | Diaphragm | 6.5 | Close |
| 82 | PV 2202 | 3” 40 Sch | F 301 vent | Vee Ball | 2” | 2” | Diaphragm | 5 | Close |
| 83 | PV 2301 | 3” 40 Sch | C301 pressure control | Globe | 2” | 1 ½” | Diaphragm | 22 | Close |
| 84 | PV 2401 | 2’ 40 Sch | V304 pressure control | Globe | 2” | 1 ½” | Diaphragm | 22 | Close |
| 85 | PV 2501 | 2” 40 Sch | K301A/S Discharge to suction | Globe | 1 ½” | 1” | Diaphragm | 20 | Open |
| 86 | PV 2901 | 1” 80 Sch | Steam to FB 501 jacket | Globe | 1” | CV=1.0 | Diaphragm | 6.5 | Open |
| 87 | PV 3002.1 | 1 ½”80 Sch | K501 A/S Discharge to suction | Globe | 1 ½” | 1 ½” | Diaphragm | 4 | Open |
| 88 | PV 3002.2 | 3” 40 Sch | Steamer pressure control | Globe | 3” | 2 ½” | Diaphragm | 3.5 | Open |
| 89 | PV 3005 | 1 ½” 80 Sch | Purge gas to B.L. | Globe | 1 ½” | 1 ½” | Diaphragm | 4 | Close |
| 90 | PV 3106 | 1” IS 1239 | Nitrogen make up | Globe | 1” | CV=4.0 | Diaphragm | 10.5 | Close |
| 91 | PV 4001 | 8” 20 Sch | V 801 Top | Globe | 6” | 6” | Diaphragm | 15 | Open |
| 92 | PV 4009 | 6” 20 Sch | V801A top | Globe | 6” | 6” | Diaphragm | 15 | Open |
| 93 | PV 4501 | 1 ½” 40 Sch | K802/K804 bypass | Globe | 1 1/2” | 1 1/2” | Diaphragn | 35 | Open |
| 94 | PV 4510 | 1 ½” 80 Sch | K803 bypass | Globe | 1 1/2” | 1 1/2” | Diaphragn | 100 | Open |
| 95 | PV 4554 | 1 ½” 80 Sch | H2 to LLD-HD | Globe | 1 1/2” | 1 1/2” | Diaphragn | 100 | Close |
| 96 | TV 1501 | 1” 80 Sch | T105 temp control | Globe | 1” | CV=6.3 | Diaphragm | 3 | Open |
| 97 | TV 1503.1 | 1 ½” 80 Sch | V103 temp control(steam) | Globe | 1 ½” | 1 ½” | Diaphragm | 3 | Open |
| 98 | TV 1503.2 | 1 ½”IS 1239 | V103 temp control(chilled water) | Globe | 1 ½” | 1 ½” | Diaphragm | 4.5 | Open |
| 99 | TV 1701 | 1” IS 1239 | V201 temp control | Globe | 1” | CV=2.5 | Diaphragm | 5 | Open |
| 100 | TV 1702 | 2” IS 1239 | Chilled water to E 201 | Globe | 2” | 2” | Diaphragm | 5 | Open |
| 101 | TV 1802 | 3” IS 1239 | Chilled water from R 201 loop | Globe | 2” | 2” | Diaphragm | 3 | Open |
| 102 | TV 2001.1 | 14” | Water to E 202 | Butterfly | 12” | 12” | Diaphragm | 5 | Open |
| 103 | TV 2001.2 | 12” 80 Sch | E202 bypass to P204A/S suction | Butterfly | 10” | 10” | Diaphragm | 5 | Close |
| 104 | TV 2908 | 1” IS 1239 | DMW to Pri.steam line to FB 501 | Globe | 1” | CV=0.25 | Diaphragm | 5.5 | Close |
| 105 | TV 2909 | 1” IS 1239 | DMW to sec steam line to FB 501 | Globe | 1” | CV=0.25 | Diaphragm | 5.5 | Close |
| 106 | TV 3106 | 1 ½” 80 Sch | Steam to E 503 | Globe | 1 ½” | 1 ½” | Diaphragm | 6.5 | Close |

**Miscellaneous items**

J201 : Steam Jet Ejector

Service : To Heat Water

Heated Medium : Water

Flow Rate : 70,000 kg/hr

Pressure : 2.0 kg/cm2

Temp : In/Out 0C = 30/80

Heating Medium : Steam

Flow Rate : 1200 kg/hr

Inlet pressure: 2.5 kg/cm2

Outlet pressure: 1.5 kg/cm2

MOC of Nozzle : SS304

J-901 : Steam Jet Ejector

Service : Evacuation

Motive medium:

Fluid Steam flow rate 60 kg/hr

Pressure 3.0 kg/cm2

Temperature 150 0C

Fluid Handled Flow rate 20.0 kg/cm2

Inlet temp 100 0C

Discharge pressure 760 mm Hg Abs

Evacuation Initial Press 820 mm Hg Abs

Requirement Final Press 300 mm Hg Abs

Evacuation 7-10 minutes

J 501 – Steamer Cyclone Ejector:

Design pressure 3.43 Bar

Design temp 175 0C

Working temp 105 0C

Fluid Circulated Steam

J502 – Dryer cyclone ejector

Design pressure 0.5 kg/cm2

Working pressure 0.1 kg/cm2

Working temp 80 0C

Design temp 120 0C

FB 501 steamer (steam jacketed)

Design pressure 3.5 kg/cm2

Operating pressure 0.2 kg/cm2

Design temp 150 0C

Operating temp 105 0C

Volume 10.2 m3

Material of const Avesta-254 SLX

Length 5200 mm (TL to TL)

ID 1500 mm

Thickness 8 mm

Jacket thickness 9 mm

Jacket design pressure 0.5 kg/cm2

Jacket working pressure 0.2 kg/cm2g

Volume 1600 lts

FB 502 Dryer

Design pressure 0.5 kg/cm2

Working pressure 0.1 kg/cm2

Design temp 120 0C

Working Temp 90 C

Volume 16.1 m3

Material of construction Avesta 254 SLX

Length 4500 mm (TL to TL)

ID 2000 mm

Thickness 5 mm

WC 501 – Steamer Cyclone

Design pressure 3.5 kg/cm2

Design temp 150 0C

Working temp 105 0C

Capacity 180 Lts

Length 3280 mm (including ejector)

ID 500 mm

WC 502 Dryer cyclone

Design pressure 0.5 kg/cm2

Working pressure 0.1 kg/cm2

Design temp 110 0C

Working temp 80 0C

Capacity 270 lts

Length 3535mm (including ejector)

ID 750 mm

Blowdown cyclone: WC 801

Design pressure 5 bar gauge

Working pressure 1 bar gauge

Design temp + 40 0C

Gas flow rate 75000 kg/hr

10 WH 501 – Additive loading hopper:

Hopper with slope of 60 and Grid

Material of construction AISI 304

Supplier REICO

11 WW 601 – Pellets weigh scale

Flow rate 8-12 T/Hr

Type Belt weigher load cell type

Accuracy + 0.5% of normal flow rate

Material of constn of belt Silicon polyster

12 WS 601 – Polymer Pellet Screen:

Screen size 2500 x 1400 mm

Design capacity 15 T/hr

Particle size 3-4 mm dia x 2.5 – 3mm length

Material of screen AISI 304

13 WW 602 - Additive scale:

Range 0-50 kgs

14 WH 601 – Additive loading to mixer

Hopper with slope of 60 with Grid

Supplier REICO

Material of constn AISI 304

15. WC 601 PP Polymer Cyclone:

Material of constn AISI 304

Supplier Buhler Miag Spa.

16 WM 601 – PP Additive Mixer

Capacity 500-1050 kg batch.

Mixing time 30 minutes

Type Ribbon blender

Total volume 3.82 m3

Working volume 2.83 m3

Design temp 100 0C

Design pressure 500 mm WC

Jacket Baffled

Agitator Double Impeller

Material of constn. SS304

Type of shaft seal Gland packing

Agitator speed 25 rpm

Type of drive Helical gear box roller chain

Power 40 HP

Accuracy 1.0%

Supplier Orbit

17 WM 602 – continuous mixer (screw conveyor)

Type Screw and Ribbon mixer

Feed rate 15.15 T/hr

Speed 100 rpm

Operating temp 40-80 0C

Full load current 6.9 amp

18 PK 601 PP Beads/flake metering unit

Feed rate Minimum 4000 kg/hr

Normal 9600 kg/hr

Maximum 15000 kg/hr

Material of constn SS304

19 SC 601 A/B – Screw feeder:

Diameter of screw 285 mm dia x 2400 mm length

Speed 100 rpm

Capacity 30000 kg/hr

Type of seal Gland packing type

Motor power 3.7 kw

Full load current 6.9 amp

20 H 601 – Service hopper

Capacity 700 lit

Size 1100 mm dia x 750 mm height

21 PR 601 – Refilling Feeder

Flow rate 36000 kg/hr approx

Power 3.7 kw

Full load current 6.9

22 PK 602 – Solid Additive metering unit

Flow rate 10 to 150 kg/hr

M.O.C. SS 304

23 PK 603 – Extruder:

Type of Extruder ZSK 220

No of barrel 8

Max. Torque 7000 Nm

Speed 226/181 rpm

Type of lubrication Forced/Screw pump

Type of bearing Roller

Type of seal Labyrinth/Viscoseal for screw shaft

Heating/Cooling Electric heating of barrels, heating oil for start up valve,

arrangement screen and pelletizer, close circuit cooling water

Screen Duel filter SWZ 1900

Pelletizer Variable speed

Motor rating 3400 kw

MOC barrel Nitrided steel

Screw Nitrided steel

Die Chrome steel

Cutter SS, Ferrotic knives

24. PK 604 – Gala Dryer

Type Centrifugal

Capacity 15 T/hr max of pellets

Motor rating 11 KW

Accessories Drive, Drive guard, agglomerate,Catcher, diverter valve,

air intake Filter

25 Centrifugal fan for dryer

Capacity 6800 Nm3/h

Static pressure 64 mm of WC

26 X601 A/S – Rotary valve for beads:

Design capacity 15 T/hr

Type Closed, side entry

Max speed 40 rpm

Material of rotor SS 321

27 X 603 – Rotary Valve for pellets

Same as X601 A/S

**CHILLER PK 801 EQUIPMENTS**

Compressor:

Type Screw compressor (Howden make)

Suction temp 5 0C

Suction pressure 2.5 to 3.0 kg/cm2g

Discharge temp 50 0C

Discharge press 11 to 12 kg/cm2g

RPM 1480

Power 93 kw

Condenser:

Type Shell and Tube

Size 16” dia x 11 feet long

Tube ¾” OD, finned copper tube, 3352mm Long

No of tubes 174 nos

Heat transfer area 87 m2

No of passes 3

Tube side Cooling water

Shell side Refrigerant (Freon-22)

Chiller

Type Shell and tube

Size 20” dia x 12’ long

No of tubes 252

Tube ¾” OD, seamless copper tube,3658 mm long

Heat transfer area 54 m2

No of circuits 2

No of passes/circuit 8

Tube side Freon-22

Shell side Chilled water (Brine)

Oil Cooler

Type Shell and Tube

Size 168 mm Dia x 1170 mm long

No of tubes 28

Tubes 5/8” OD, 120 mm long,Integrally finned copper

Shell side Oil

Tube side Cooling water

Oil Tank/Separator

Shell dia 508 mm

Height 1580 mm

Provided with demister pad of SS304 wire mesh

Oil pump

Type Gear

7. Expansion valves MVE 34 CP 100

**CHAPTER VIII**

**INSTRUMENTATION IN PP PLANT**

VIII INSTRUMENTATION IN PP PLANT

PP Plant instruments mainly consist of DIDC system to control the various parameters. This system is supplied by M/s. Yokogawa Keonics (India) Ltd. Bangalore.(Now Yokogawa Bluestar Ltd.)

This system mainly consists of operator console/station and field control stations. The field control station incorporate all the automatic control system functions and the operator stations provides the human interface.

Operator station/console include overview display panels upto 8 display pages with 800 control instruments per page combined with analog and digital control panel displays which simulates conventional panels, use defined colour graphic panels which can change dynamically with process status. Also it consists of scrolling historical alarms summary display and historical event logging, scrolling trend display, large process data files, user defined logging/reporting displays and printouts.

Field control station – CFBS2 field control station communicates with operator stations via the flexi-bus (HF) bus data highway.

Each CFBS2 field control station contains upto 6 microprocessor based FCU2 field control units and each microprocessor supports upto 8 loops (63 tags) and also contain dual redundant 24V DC supply. One back up control unit is installed in the cluster common unit for n:1 back up of the CFCU2 field control units in the cluster.

Analog and digital I/O signals between CFCU2 and CFBS2 and the field are connected via signal nests and terminal boards installed in the rear of the CFBS2.

Redundant configuration : The backup (redundant) process or automatically takes over process control from whichever one of the control units that fails.

A dual redundant cluster internal (CI) bus is provided between control units and the communication interfaces. The backup bus is used for data transmission if the active bus fails.

Dual redundant multipoint analog input/output cards (MAC2) can be provided either one of a pair can take over control without any process disturbance if the other one fails.

For interlock and safe S/D programmable logic controllers are used. This system 3/10 is supplied by M/s. Allen Bradley (I) Ltd. This system comprises of one processor (CPU), Memory Card, input/output scanner cards and KA (communication adaptor) module. Field inputs (contact) like pressure, temperature level are connected through input/output cards. These inputs/outputs are monitored by processor through remote I/O adaptor and I/O scanner cards and according to logic processor takes decision and gives a contact output to energize/ deenergize the particular solenoid coil according to S/D logic. In PP Plant, in extruder, bagging section M/s. Siemens (W. Germany) programmable logic controllers are used.

In PP Pant we have several microprocessor based radiometric instruments, basically used for continuous density and level measurements.

The total system consists of following major parts:

Radioactive source (CS 137) in source holder.

Detector circuit consists of sensor as ionisation chamber and signal conditioning circuitary.

Totally software controlled dedicated processor mounted in the control room for measurement of process parameter.

For this, source and detector are place on the opposite side of the process material. If we consider that the source has a fixed intensity then as the process level or density increases the radiation reached to the detector will decrease. This decrease is calibrated against process level and density.

In detector we have an associated continuous temperature controller (CTC) circuit used to maintain the temperature of ionisation chamber at 60 0C by a heater blanket assembly to avoid any fluctuation of reading by temperature change.

The conditioned frequency signal is sent to DDP by line driver from field i.e. the detector assembly. DDP senses the frequency and produces a 4-20 mA DC (galvanic isolated) by analog output board for the DCS system corresponding to total range of measurement.

DDP also performs :

Source decay compensation.

Standardization compensation.

Holding the calibration data and table.

Has the possibilities of several alarm setting.

Other special type instruments used in polymerisation area of PP Plant are mentioned as follows:

[Micromotion flow transmitter](#MICROMOTION).

[Vortex flow transmitter](#VORTEX).

[Metering pump](#METERING)

[Integral Orifice flow transmitter](#INTEGRALORIFICE).

**Micromotion flow transmitter**.

The micromotion mass flow meter measures mass directly. Until recently, no practical method of measuring mass of flowing fluid existed. Users had to derive mass from other measurements, such as volume. Unfortunately, volumetric flow meters donot measure mass, but the space it occupies. Therefore one must calculate the effect of temp and pressure on density when deriving mass from volume. Direct mass flow measurement avoids the need for complex calculations. It deals directly with mass, and since mass, does not change, a direct mass flow meter is linear without adjustment for variations in fluid properties.

This micromotion meter operates based on Newton’s second law of motion force equals mass times acceleration (F=ma). It uses this law to determine the exact amount of mass flowing through the meter. This flow meter has got one U-tube sensor which is also known as flow-tube assembly inside the sensor unit and one amplifier unit which can be located remotely from the sensor unit U tubes vibrate at its natural frequency when its drive coil is electrically energized. When fluid passes through this tube if gets twisted, and this amount of twist is directly proportional to the mass flow rate of flowing fluid, which is in turn measured by the position detectors incorporated in sensor. Remotely located amplifier converts this electrical signal received from U tube sensor to 4 to 20 mA DC current signal and sends this DC current signal to Control Room.

Micromotion flow meter in Polypropylene Plant are installed for measuring mass flow of Teal (FC 1302) and Donor (FC 1401) which are co-catalysts used alongwith the catalyst. The accurate proportion of these two co-catalysts is very much important for the final quality of polymer powder. They are also installed in inlet propylene from GC, Propylene to plant(discharge from P301A/S) and Propylene back to V304(P302A/S discharge)

# b. Vortex Flow Meter. The vortex flowmeter is used for measuring the flow velocity of gases in pipelines . The measuring principle is based on the development of a Karman vortex shedding street in the wake of a body built into the pipeline. In theory, this process enables measurements to be carried out in turbulent flows with a Reynolds number Re > 3000, but linear measurements are only, possible where Re>20000.

b

v

The periodic shedding of eddies occurs first from one side and then from the other side of a bluff body (vortex shedding body) installed perpendicular to the pipe axis. Vortex shedding generates a so-called “Karman vortex street” with alternating pressure conditions whose frequency is proportional to the flow velocity v. The non dimensional strouhal number S (primary head constant ) describes the relationship between vortex shedding frequency f (in Hz), width b of the body, and mean flow velocity v (in m/s)

The flexural vibration of the vortex shedding body is picked up in the primary head via sensors and analysed in the signal converter. In the case of gaseous, flowing media, the vibration frequency ranges between 10 and 1000 Hz.

To permit the mass rate of flow to be calculated from the volume rate of flow, either product pressure and temperature of product density at the installation location of the flow meter must be known factors.

**c.** **Metering unit:**

In conventional close-loop control, in process industry control valves are extensively used for controlling fluid flow as a final control element. But for fine accurate flow control of high pressure fluid, control valve is not an ideal final element. Therefore for the fine control of Teal and donor flow, we have got metering pump as a final control element. This metering pump has got a “pneumatic servo” unit which adjusts the stroke of metering pump and thereby controls the flow of Teal and Donor

**d. Integral Orifice flow transmitters**:

Just like micromotion flow meters and vortex flow meter, integral orifice flow meter is also a special type of flow meter which slightly differs from convention dP type flow meter. This flow meter has also got an orifice as flow sensor, but as an integral part of the flow meter which can be well understood by the following sketch of measuring unit.

HP SIDE DRAIN PLUG

LP SIDE

This type of flow meters are generally used for extremely low-flow rates in small diameter ducts. As shown in the figure transmitter is directly mounted on the pipe. Thus it measures low-flow accurately with fast response.

**CHAPTER – IX**

**HYDROGEN FACILITY**

**HYDROGEN FACILITY**

Source of hydrogen:

High purity hydrogen is available from PSA unit at cracker battery limit at 18 kg/cm2g pressure and ambient temp. The quantity available is 35 kg/hr. Hydrogen pressure at the inlet to hydrogen supply facility is fixed at 16.5 kg/cm2g minimum to take care of line pressure drop.

Requirement of Hydrogen

Specific consumption for different products are as follows:

LLDPE 2.5 Nm3/Ton

HDPE 20.0 Nm3/Ton

PP 0.5 Nm3/Ton

The total hydrogen requirement based on 11 T/Hr LLDPE in LLDPE train –1, 121 T/Hr HDPE in LLDPE train – 2 and 7.5 T/Hr PP shall be 271.25 Nm3/hr or 24.22 Kg/hr. The supply pressure and temperature of hydrogen to the two plants at their B/L are:

Ope. Pressure Ope Temp

LLDPE/HDPE 35 kg/cm2g Amb.

PP 50 kg/cm2g Amb

Description of Hydrogen supply facility:

(Refer the process flow diagram)

Hydrogen is stored at 100 kg/cm2g pressure in two bullets having a total capacity of 130 M3. By suitable piping connection to compressor, hydrogen from the bullets will be utilised upto 18 kg/cm2g bullet pressure. Thus, the quantity of hydrogen that is stored and can be utilized when the cracker/PSA unit are not operating will be 10,600 Nm3. This quantity will be sufficient to operate both LLDPE trains and PP Plant for 7 days.

During normal operation, the booster compressor will increase the pressure of hydrogen from 16.5 kg/cm2g at the suction to 38 kg/cm2g and will supply to the LLDPE Plant. Maximum flow rate will be 391.7 Nm3/hr by K802 and 500 Nm3/hr by K804. When the compressor fail or when there is no supply from PSA unit, pressure control valve PRV-4508/PICV-4554 maintains LLDPE plant supply pressure by drawing hydrogen from the bullets. When this happens due to failure of booster compressor (K-802/K804), the fall in the pressure of storage bullets due to withdrawal through PRV 4508/PICV-4554 is made up by manually starting up the make-up compressor (K-803). This compressor will then run till the booster compressor is attended.

During normal operation, PP Plant is supplied with hydrogen at 52 kg/cm2g from the bullets(s) through pressure control valve PRV-4506. Since the requirement is very low, the make up compressor will be started and stopped manually at periodic intervals to maintain the bullet pressure between say 95 to 100 kg/cm2g.

A provision is also provided to isolate bullets in such a way that one bullet,i.e. V805B(bagging side) will be dedicated for LLD-HD and V805A(cooling tower side) will be for PP’s use.

BOOSTER COMPRESSOR (K802/K804)

Make : Ingersoll-Rand

This is a single stage reciprocating compressor. The capacity is regulated by outside operated free air unloader on each inlet valve.

ROUTINE START UP:

Check the oil level in the frame sump and refill as required to bring the operating oil level to the line on the gauge glass. Do not overfill, as rotating parts may strike the oil surface which ca cause the oil to foam and result in a drop in oil pressure.

Refill the lubricator oil reservoir.

If the compressor has been shut-down for several days, it may be necessary to prime the oil pump.

Manually operate each lubricator pumping unit by pushing down on the plunger cap several times, to ensure an initial supply of oil to the cylinder bore and piston rod packing.

Manually turn the compressor through at least one revolution to be sure all moving parts are clear.

Unload the compressor.

Turn on the cooling water supply.

Start the motor. Run the compressor few minutes with no load for few minutes to warm up the unit. Listen for any unusual sound.

Check the oil pressure. It should be between 1.1 to 2.8 kg/cm2g.

Load the compressor.

ROUTINE STOPPING

Unload the compressor.

Stop the motor.

Shut off cooling water supply.

MAKE-UP COMPRESSOR (K803)

The make up compressor will run intermittently to maintain hydrogen pressure in the bullets. The design data are given as following:

Make Burton – Corblin, France

Type Diaphragm type.

Stage 2

Suction pressure 17.5 kg/cm2abs

Suction temp. 45 0C

Discharge pressure 101 kg/cm2 abs

Capacity 392 Nm3/hr

Speed 400 RPM

Absorbed power 61.2 KW

Motor Power 75 KW

Cooling water flow 12.4 M3/hr

Diaphragm crack

detection system Yes

Description

The crankcase assembly of the diaphragm compressor is essentially a crankshaft driven, piston type hydraulic pump. The piston reciprocates beneath the hydraulic fluid which transmits an oscillating movement to the metallic diaphragm. The diaphragm is clamped at its periphery between two dished plates.

The lower plate, the perforated plate is concave on its upper surface through which the hydraulic fluid passes. Thus the reciprocating movement of the piston is transmitted to the oil and through the holes in the perforated plate to the diaphragms.

The upper plate, the gas plate is concave on its lower surface and outlet valves. Thus, the movement of the diaphragm between gas plate and perforated plate displaces the gas controlled by the inlet and outlet valves.

A plunger pump, the compensating pump, returns hydraulic fluid that passes the piston back above the piston thus ensuring complete travel of the diaphragm during the compression stroke.

Excess fluid is released after each stroke and returned to the sump through an adjustable spring loaded control valve, the pressure limiter.

Both lubrication and compression system take oil from the compressor sump.

The lubrication circuit consists of a crankshaft driven oil pump and an oil cooler. The oil pump is a gear pump which provides lubrication for the connecting rod small end, big end and the crosshead. The lubricating oil pressure is controlled by a spring loaded overflow valve mounted on the pump. The normal working pressure is 2.4 bar G.

The compressor is filled with a diaphragm crack detection system. The system uses 3 diaphragm sandwiched together. If a diaphragm either on the oil or the gas side cracks, then the pressure between the intermediate diaphragm and the cracked diaphragm will rise. A pressure switch is connected to sense the rising pressure and after the set limit, it shuts the compressor.

To cool down the compressed gas, the compressor is fitted with intercooler and after cooler.

To remove the heat generated by the compression of the gas, the compressor is cooled by a cooling water circuit.

ROUTINE START UP:

Start the cooling water circulation.

Start the motor and check direction of rotation.

After 8 to 10 seconds the compressor oil pressure and cooling water flow will have established. The oil pressure switch and cooling water flow switch are kept in bypass during start up.

Open the gas inlet and discharge valve.

Close the vent/drain valve on the discharge side, if open.

Check oil and gas pressures and temperature, noise and vibration.

ROUTINE STOPPING

Stop the compressor drive motor.

Close the gas discharge valve and inlet valve.

Open the gas vent/drain valve.

Purge the compressor system with dry nitrogen if the compressor is to remain idle for along time.

TRIPS IN THE COMPRESSOR UNIT:

1. FSL 4505 Low cooling water flow – 7 m3/hr

2. PSH 4507 High diaphragm oil pressure for Ist stage –0.5 kg/cm2g.

3. PSL 4509 Low oil pressure – 1.5 kg/cm2g

4. PSL 4504 Low suction gas pressure 10 kg/cm2g

5. PSH 4505 High discharge gas pressure – 110 kg/cm2g

6. TSH 4504 High Ist stage discharge temperature – 65 0C

7. TSH 4502 High 2nd stage discharge temperature – 65 0C

8. PSH 4508 High diaphragm oil pressure for 2nd stage –0.5 kg/cm2g.

V 805 B

V 805 B

V 805 A

V 805 A

PRV4507

PRV 4508

PRV 4506

PV4554

HYDRGEN TO PP, 52 KG/CM2

PV4510

HYDROGEN TO LLD-HD , 35 KG/CM2

SDV4510

PV4501

K803

K802 K804

SDV4511

HYDROGEN FROM G.C. 18 KG/CM2 **HYDROGEN AREA PROCESS FLOW DIAGRAM**