**INTERNSHIP AT TRAVANCORE COCHIN CHEMICALS LTD**.

AN INTERNSHIP REPORT

Submitted by

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**CERTIFICATE**

*This is to certify that ASHMI TERESA ALFRED (721917106017) of the fourth semester Electronics and communication engineering of the Dhanalakshmi Srinivasan College of Engineering ,had undergone industrial training at Travancore Cochin Chemicals Ltd. Udyogamandal during the period 27-05-2019 to 10-06-2019(15 days).*

**TUTOR: HEAD OF DEPARTMENT:**

Place:Coimbatore

Date:

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**Contents**

ContentS

List of figures

**1 INTRODUCTION**

* 1. About TCC…………………………………………………………………………………………………………………………………5
  2. Cell plant……………………………………………………………………………………………………………………………………5
  3. History of the company……………………………………………………………………………………………………………..6
  4. Instrumentation…………………………………………………………………………………………………………………………7
  5. Function of instruments……………………………………………………………………………………………………………..7
  6. Functional elements of an instrumentation system……………………………………………………………………7

1. **PLANT DESCRIPTION**
   1. Process and related instruments………………………………………………………………………………………………..9
   2. Terms and description………………………………………………………………………………………………………………13
2. **INSTRUMENT DESCRIPTON**
   1. Variable are flow meter……………………………………………………………………………………………………………..14
   2. Coriolis flow meter…………………………………………………………………………………………………………………….15
   3. Differential pressure flow meter………………………………………………………………………………………………..16
   4. Turbine meter……………………………………………………………………………………………………………………………17
   5. Vortex flow meter…………………………………………………………………………………………………………………….19
   6. Magnetic flow meter………………………………………………………………………………………………………………..19
   7. Sight glass level indicator………………………………………………………………………………………………………….20
   8. Ultrasonic flow meters……………………………………………………………………………………………………………..21
   9. Ultrasonic type level measurement………………………………………………………………………………………….22
   10. Manometer…………………………………………………………………………………………………………………..22
   11. Radar gauge………………………………………………………………………………………………………………….22
   12. Bourden tube………………………………………………………………………………………………………………..23
   13. Bimetalic thermometer…………………………………………………………………………………………………23
   14. Thermocouple………………………………………………………………………………………………………………24
   15. RTD………………………………………………………………………………………………………………………………24
   16. LDR………………………………………………………………………………………………………………………………24
   17. Control valves……………………………………………………………………………………………………………...25
   18. Globe valves…………………………………………………………………………………………………………….…..25
   19. Diaphram valves………………………………………………………………………………………………………....25
   20. Butterfly valves…………………………………………………………………………………………………………….25
   21. Solenoidal valves………………………………………………………………………………………………………….26
   22. pH Measurement…………………………………………………………………………………………………………26
   23. PLC……………………………………………………………………………………………………………………………….27
   24. Control system…………………………………………………………………………………………………………….27

**4 CONCLUSION**

**List of figures**

3.1 Rotameter……………………………………………………………………………………………………………………………………………..

3.2 Coriolis flow meter………………………………………………………………………………………………………………………………..

3.3 Differential Pressure flow meter……………………………………………………………………………………………………………

3.4 Turbine meter………………………………………………………………………………………………………………………………………

3.5 Vortex flow meter…………………………………………………………………………………………………………………………………

3.6 magnetic flow meter……………………………………………………………………………………………………………………………..

3.7 Sight glass level indicator………………………………………………………………………………………………………………………

3.8 Ultrasonic flow meter…………………………………………………………………………………………………………………………….

3.9 Radar gauge…………………………………………………………………………………………………………………………………………..

3.10 Bourden tube………………………………………………………………………………………………………………………………………

3.11 Solenoidal valve…………………………………………………………………………………………………………………………………..

**Chapter 1**

**INTRODUCTION**

**1.1About TCC**

The Travancore cochin chemicals Ltd. Udyogamandal is a state public sector undertaking owned by government of Kerala .Reflecting the quality of commitment and excellence TCC has a good track of record of profitable operation and healthy industrial relations .A heavy chemical industry engaged in the manufacture and marketing of caustic soda ,chlorine and allied chemicals .TCC is accredited with ISO 9001:2008 certification.

**1.2 Cell plant**

The Travancore Cochin chemicals ltd .TCC is one of the most leaders in chemical industries of Kerala ,mainly manufacturing chlorine ,caustic soda and hydrochloric acid. The caustic chlorine plant employs a cell unit, which equipped with mercury cell connected in series which are assigned for a maximum load of 180KA and for normal operation set 135.5A.

**1.3 History of the company**

The Travancore cochin chemicals Ltd, popularly known as TCC was established in 1950 . the idea of establishing the unit was conceived by M/s Sheshasayee Brothers the then managing agents of FACT. The venture was started as partnership concern in the name Travancore Mettur Chemicals with FACT and MCIC (Mettur Chemicals and Industrial Corporation) as partners. In 1951 the partnership was registered as a Public Limited Company, with the State Government contributing the major share of equity and the company was then named as TRAVANCORE COCHIN CHEMICALS LTD. M/s Sheshasayee Brothers continued to be the managing agents for the next 10 years. Commercial production of Caustic Soda from the first plant of 20 tpd capacity was started in 1954 January. TCC is the first unit in India to manufacture Rayon grade Caustic Soda.

**1.4 Instrumentation**

The technology of using instrumentation to measure control, physical chemical properties of materials is called instrumentation. When the instrumentations are used for measurement and control of the industries manufacturing, conversion, or to treating process, the term processinstrumentation is applied. And when the measuring and controllinginstruments arecombined so that measurement provides impulses of remote automatic action, the result is called control system.

The basic purpose of instrumentation in an industry is to obtain maximum output from the industry with minimum wage of raw materials , time energy, man power etc.

**1.5 Function of instrumentation**

1. Collecting and sending information about a measured variable.

2. display and recording information about a measured variable.

3. comparing what is happening (value of measured variable)to what should be happening (set point).

4. making a decision about what action should be taken to adjust for deviation for the set point.

5. initiating the alarm when the measured variable is either too high or too low.

**1.6 Functional elements of an instrumentation system**

The primary sensing element instrumentation is that which receives from the measured medium and produces an output depending in some ways on the value of the measured quantity. A variable conversion, element nearly converts the output signal of the primary sensing element into the more suitable variable or condition useful to the function of the instrument. A variable manipulation element manipulates the signal represented by some physical variable to perform the intended task of an instrument data transmission element translation function, such as the simple indication of the pointer moving area scale or the recording of a pen moving over a char. An example is given below. These elements are present in the pressure type of thermometers. The temperature change results in a pressure change with the bulb the liquid filled act as the primary sensor. This pressure converts pressure to displacement. This displacement is manipulated by the linkage and gearing to giving a large pointer motion. A scale and the pointer are used again for the data representation.

**Chapter 2**

**PLANT DESCRIPTION**

The process of manufacture of caustic soda chlorine and hydrochloric acid through ion exchange membrane process involve several steps. The parameters which are mainly measured in this process are level pressure, force, temperature, pH.

The process are:

1. Primary purification
2. Secondary purification
3. Electrolysis
4. Chlorine treatment
5. H2 treatment and HCL analysis
6. Continuous caustic fusion
7. Soda bleach preparation
   1. **Process and related instruments**

**1.Primary purification**

Primary purification consists of three stages. They are saturation, precipitation and filtration. When the instruments are used for measurement and control of the industrial manufacturing ,conversion or to treating process ,the term process instruments is applied.

* Saturation

Saturation process took place in the horizontal saturators .These are two saturators ,one is in the operation and other is a stand by the raw salt from the salt storage area is fed to the saturator of capacity 45m 3 from the top using a bucket elevator,pay loader and feed hopper process water is added to the saturator at a rate of about 5 to 6m3/hr.Then this brine is fed to the bottom of the saturator through a dip pipe for the removal of macro size suspended impurities .This brine solution then flows to the precipitation tank for precipitation process.

* Precipitation

BaCo3,Na2CO3 are fed to the precipitation tank .In the precipitation tank the sulphate in the brine solution is precipitated as CaCo3.The outlet from the precipitation tank is fed fed to the mixer tank where caustic soda lime is added in order to precipitate Magnesium as Mg(OH)2.Barium from the mixer tank is taken to a stainer where it is mixed with fleucant is Sodium Poly Acrylate.It is pumped from the setting of precipitated and enhances the set of precipitate setting is due to the gravity.90% of the precipitation is settled as sludge and its removed from the clarifier bottom.

* Filtration

The brine from the clarifier is pumped to the four authentic filters connected in series .When the two filters will be on in service .The outer two are kept stand by. These filters consist of anthracite arranged in packed bed in there different layers the packed bed in the filter is back washed using filtered brine solution for the purpose of regulation. The validity of anthracite is one year.

**2.Secondary purification**

The secondary brine purification system consist of our ion exchange filters .The primary purified Brine is pass through the ion exchange filters where it undergoes ion exchange process .Ion exchange materialsare insoluble acids and bases ,which when converted to salt remain insoluble.

These ion exchange materials are used in columns in which the solutions containing ionic impurities like calcium and magnesium rein contact with the resin bed. Brine in the membrane cell process is very important as it affected the performance and life of the membrane.

**3.Electrolysis**

The secondary purified brine is passed through a heat exchange, fed to brine head tank and is admitted to the anode compartment of the electrolysis. Dematerialized water is also admitted to the cathode compartment of the electrolysis .Direct current supply is connected to the anode and cathode .During electrolysis caustic soda lye’s produced at cathode which is 32% concentration. Hydrogen gas is also formed at the cathode clamber. Chlorine is formed in the anode where the depleted brine solution comes out. Caustic soda is pumped into storage tank and hydrogen and chlorine gas goes to their respective treatment section .

**1.Chlorine treatment**

Chlorine treatment involves cooling, washing filtration, drying, compression liquefaction ,storage and liquid chloride filling in the cylinders ,the chloride from anode chamber of the electrolysis is first cooled at 30 degree Celsius with the cooling tower water. Final traces of salt is removed by using a wet chlorine filter , it is then again cooked using chilled water. After this the chlorine gas is divided into two streams for the HCL synthesis and for liquefying. The chlorine for liquefaction is dried using acid ring compressors. The compressed chlorine gas turns into liquid chlorine storage tanks. Chlorine for the HCL synthesis unit is fed by using chlorine blower.

**2.H2 treatment and HCL analysis**

Hydrogen gas from the electrolyze is washed with water in washing chamber ,cooled using tower water and admitted directly to hydrogen gas is used for HCL synthesis and also fuel in the CCF plant.Hyrogen for HCL synthesis and is fed to the oven using hydrogen blowers. Here it is burned in the presence of chlorine .The resulting HCL gas is absorbed in the water flowing down the oven to produce 31% commercial HCL gas .

**3.Continous caustic fusion**

It is done in CCF.CCF plant is mainly for concentrating 32% NaOH lye and then to 98%-99% NaOH melts which is converted as flakes.The 32% NaOH lye is stored in the main storage tank , as a part of which goes for sale .The remaining part of 32% lye is passed through three evaporators Ev1,Ev2,Ev3.In the first evaporator the caustic soda lye is heated using vapours generated in Ev2 and Ev3.The steam generated in Ev1 is then drawn by a vaccum at 70-80 degree Celsius.The outlet from Ev1 is 40% caustic soda lye which passed through Ev2 where it is evaporated to 50% caustic soda lye using 9kg/-cm2 steam from boiler .A portion of 50% caustic soda lye cooled ansold.

The remaining portion of 50% caustic soda lye is pumped to Ev3 where it is heated using heatbtransfer salt which is a mixture of 53% potassium nitrate, 40% sodium nitrate and 7% sodium nitrate. In Ev3 the 50% caustic soda lye is concentrated to 98%-99% caustic soda melt which is converted as caustic soda flakes in a flakers drum.

**4.Soda bleach preparation**

Excess of waste chlorine can’t be disposed as a waste gas.But it has to be absorbed in dilute caustic soda lye to produce soda bleach .Thus the soda bleach plant serves also a pollution control system.

A part of 32% caustic soda lye, chlorine is used for the preparation of soda bleach .The excess chlorine at the time of plant shutdown or startup and also from cylinder filling station goes for soda bleach preparation ,32% caustic soda lye is diluted using de-mineralised water .The solution is passed through two absorbing towers ,where it reacts with chlorine gas as to produce soda bleach.

**2.2 Terms of description**

1.PRESSURE

One of the basically measured parameter is pressure. Pressure is definedas the force applied on a unit area of cross section

2. ATMOSPHERIC PRESSURE

It is at any place is due to the weight of the air column above that place. This pressure is measured by barometer. In engineering problem the atmospheric pressure is approximately 100 KN/m that is 1 bar

3. GAUGE PRESSURE

Pressure of liquids measured by instruments called gauges. This pressure is always above atmospheric pressure known as gauge pressure.

4. VACCUM PRESSURE

If actual pressure is below atmospheric pressure the ordinary gauge fail to measure pressure. In such case pressure is measured by vacuum gauges.

5. FLOW

Flow is generally measured inferentially by measuring velocity through a known area.

**Chapter 3**

**INSTRUMENT DESCRIPTION**

**3.1 Variable area flow meter**

A rotameter is a device that measures the flow rate of liquid or gas in a closed ube . it belongs to a class of meters called variable area meters,which measure flow rate by allowing the cross sectional area. The fluid travels to vary causing some measurable effect.

Rotameter are popular because they have liner scales, a relatively large measurement ranges ,and low pressure drop , and are simple to install and maintain.Rotameter are a subset of meters called variable area flow meters that measure the flow rate by allowing the fluid to travel through a tapered tube where the cross-sectional area of the tube gradually becomes greater as the fluid travels through the tube.The flow rate inside the rotameter is measured using a float that is lifted by the fluid flow based on the buoyancy and velocity of the fluid opposing gravity pulling the float down.For gasses the float responds to the velocity alone,buoyancy is negligible.

The float moves up and down inside the rotameter’s tapered tube proportionally to the flow rate of the fluid.It reaches a constant position once the fluid and gravitational forces have equalized.Changes in the flow rate cause rotameter’s flow to change position inside the tube.Since the float position is based on gravity it is important that all rotameters be mounted vertically and oriented with the widest end of the tube.Since the flot position is based on gravity it is important that all rotameters be mounted vertically and oriented with the widest end of the taper at the top.It is also important that if there is no flow the float will sink to the bottom of the rotameter due to its own weight.

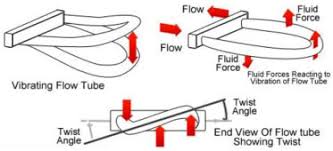
The operator reads the flow from a graduated scale on the side of the rotameter,which has been calibrated to a specific fluid with a known specific gravity.Specific gravity or the weight of the fluid has a great impact on the rotameter’s accuracy and reliability.All of global Water’s rotameters have been calibrated using water as the standard fluid with a specific gravity of 1.0



Rotameters can be calibrated for other fluids by understanding the basic operating principles.Rotameter accuracy is determined by the accuracy of pressure ,temperature and flow control during the initial calibration .Any change in the density and weight the flow will have impacts on the rotameters flow reading .Additionally any changes that would affect the fluid such as pressure or temperature will also have an effect on the rotameters accuracy .Given thi , rotameter should be calibrated yearly to connect for any changes in the system that may have occurred.

**3.2 Corolis flow meter**

Coriolis mass flowmeter measure the force resulting from the acceleration caused by mass moving toward a center of rotation.This effect can be experienced when riding a merry-go-round,where moving toward the center will cause a person to have “lean into” the rotation so as to maintain balance .As related to flow meters ,the effect can be demonstrated by flowing water in a loop of flexible house that is swung back and forth in the front of the body with both hands.Because the Water is flowing toward and away from the hands , opposite forces are generated and cause the hose to twist.In a coriolis mass flowmeter , the “swinging” is generated by vibrating the tubes in which the fluid flows.The amount twist is proportional to the mass flow rate of fluid passing through the tube.Sensors and Coriollis mass flowmeter transmitter are used to measure the twist and generate a linear flow signal. This flowmeter can be applied to sanitary,cryogenic ,relatively clean,and corrosive liquids and gases in pipes smaller than



6-12 inches. General applications are found in the water , waste water , mining , mineral processing ,power,pulp and paper, petroleum,chemical,and petroleum industries.Coriolis mass flowmeters have also been developed for specialized applications such as for custody transfer of high pressure natural gas .While Coriolis mass flow meters are versatile and can handle many applications. Coriolis mass flow meters are not a universal flow meter tht can handle all applications.

Materials of construction are generally limited to stainless steel and Hastelloy C. Straight tube designs are available to measure some dirty and abrasive liquids.Single path designs are available to measure fluids where plugging can occur. Many applications for Coriolis mass flow meters are found in chemical processes where fluids can be corrosive and otherwise difficult to measure .In addition ,the relative insensitivity to density allows coriolis mass flow meters to be applied in applications where physical properties of the fluid are not well known. These flow meters can also be used in chemical feed system found in most of the industries.

**3.3 Differential pressure flow meters**

Differential pressure flow meters use Bernoulli’s equation to measure the fluid in a pipe .Differential pressure flow meters introduce a constriction in the pipe that creates a pressure drop across the flowmeter.When the flow increases ,more pressure drop is created.Impulse piping route the upstream and downstream pressures of the flow meter to the transmitter that measures the differential pressure to determine the fluid flow.

Bernoullis equation states that the pressure drop across the construction is proportional to the square of the flow rate. Using this relationship ,10 percent of full scale flow produces only 1 percent differential pressure. At 10 percent of full scale flow ,the differential pressure flow meter accuracy is dependent upon the transmitter being accurate over a 100:1 range of the differential pressure. Differential pressure transmitter accuracy is typically degraded at low differential pressures in its range ,so flow meter accuracy can be similarly degraded .Therefore ,this non-linear relationship can have detrimental effect on the accuracy and turndown of differential pressure flow meters.

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**3.4 Turbine meter**

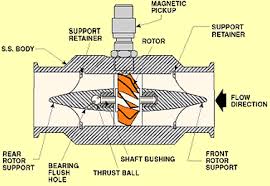
The Turbine flow meter transalates the mechanical action of the turbine rotating in the liquid flow around an axis into a user-readable rate of flow.(the turbine tends to have all the flow travelling around it.

The turbine wheel is a set of the path of a fluid stream. The flowing fluid impinges on the turbine blades, imparting a force to the blade surface and setting the rotor in the motion. When a steady rotation speed has been reached ,the speed is proportional to the fluid velocity.

Turbine flow meters are used for the measurement of natural gas and liquid flow. Turbine meters are less accurate than displacement and jet meters at low flow rates ,but the measuring element doesn’t occupy the entire path of flow. The flow direction is straight to the meter ,allowing for higher flow rates and less pressure loss than the displacement type meters. They are the meter of choice for large commercial users, fire protection ,and as master meters for the water distribution system. Strainers are generally required to be installed in front of the meter to protect the measuring element from the gravel that could enter the water distribution system.

Turbine meters are generally available for 4 to 30cm .Turbine meter bodies are commonly made of bronze , cast iron , or ductile iron . Internal turbine elements can be plastic or non corrosive metal alloys.They are accurate in normal working conditions but are greatly affected by the flow profile and fluid conditions.

Fire meters are specialized type of turbine meter with the approvals for the high flow rates required in fire protection system.They are often approved by underwriters laboratories or factory mutual or similar authorities for use in fire protection. Portable turbine meters may be temporarily installed to measure water used from a fire hydrant. The meters are normally made of aluminum to be lite weight, and are usually 7.5 cm capacity. Water utilities often requires them for the measurement of waste used in construction, pool filling ,or where a permanent meter is not installed.



**3.5 vortex flow meter**

Another method of flow measurement involves placing a bluff body in the path of the fluid . As the fluid passes this bar ,disturbances in the flow called vortices are created . The vortices trail behind the cylinder, alternately from each side of the bluff body . This vortex trail is called the Von Karman Vortex street after the Von Karman’s 1912 mathematical description the phenomenon . The frequency at which the Vortices alternate sides is essentially proportional to the flow rate of the fluid . Inside , a top or downstream of the shedder bar is a sensor for measuring the frequency of the vortex shedding. This sensor is often a piezoelectric crystal, which produces a small but measurable voltage pulse every time a voltex is created. Since the frequency of such a voltex pulse is also proportional to fluid velocity a volumetric flow rate is calculated using the cross sectional area of the flow meter. The frequency is measured and the flow rate is calculated by the flow meter electronics using the equation f=SV/L where f is the frequency of the vortices L is the characteristic length of the bluff body V is the velocity of the flow over the bluff body and is the Strouhal number S which is essentially a constant for a given body shape within its operating limits.

**13.6 Magnetic flow meter**

The third most common flow meter behind differential pressure and positive displacement flow meters is the magnetic flow meter also technically an electromagnetic flow meter or commonly just called a mag meter. A magnetic field is applied to the metering tube which results in a potential difference proportional to the flow velocity perpendicular to the flux lines. The physical principle at work is electromagnetic induction. The magnetic flow meter requires a conducting fluid for example water that contains ions and an electrical insulating pipe surface for example a rubber lined steel tube.

Usually electrochemical and other effects at the elctrodes make the potential difference drift up and down making it jard to determine the fluid flow induced potential difference. To migilate this the magnetic field is constantly reversed cancelling out the static potential difference. This however impetuses the use of permanent magnets for magnetic flow meters. Magnetic flow meters often called mag meters or electromagnets use a magnetic field applied to the metering tube which results in a potential difference proportional to the flow velocity perpendicular to the flux lines. The potential difference is sensed by electrodes aligned perpendicular to the flow and the magnetic field. The physical principle at work is Faraday’s law of electromagnetic induction . The magnetic flow meter requires a conducting fluid and a no conducting pipe liner . The electrodes must not corrode in contact with the process fluid; some magnetic flow meters have auxiliary transducers installed to clean the electrodes in place. The applied magnetic field is pulsed , which allows the flow meter to cancel out the effect of stray voltage in the piping system.

**3.7 Sight glass level indicator**

The model LGG sight glass indicator serves as a direct display for fluids and can be fitted with reflex or transparent sight glasses , or with mica . For light dark contrast , the refraction principle is used . For pressure under 25 bar , a glass tube display is used . The model LGG sight glass indicator consists of a core in a glass holder, also known as a backplate . Incrporated into this backplate are the fluid channel and the seating face for the integral sealing and sightglasses.

The glasses and /or mica discs as well as the seals are fitted , secured and sealed with the aid of screws and a cover . Glasses are used in accordance with DIN 7081 , meaning to max . Temperature of 243 deg C for steam , up to 300 deg C for other media , to 450 deg C in special circumstances.

For the sight glass plates , for glass quality , only borosilicate glass is used . Outside of these operating conditions the natural material mica is used .

The connection to the process is generally made with valve heads with single or double isolation .Drain valves enable the sight glass indicator to be emptied and are fitted to the lower flame face. If necessary , avent valve can be fitted at the top.



**3.8 Ultrasonic flow meters**

An ultrasonic flow meter is a type of flow meter that measures the velocity of a fluid with ultra sound to calculate volume flow .Using ultra sonic transducers , the flow meter can measure the average velocity along the path of an emitted beam of ultra sound , by averaging the difference in measured transit time between the pulses of ultrasound propagating into and against the direction of the flow or by measuring the frequency shift from the Doppler effect. Ultrasonic flow meters are affected by the acoustic properties of the fluid and can be impacted by temperature , density , viscosity and suspended particulates depending on the exact flow meter . They vary greatly in purchase price but are often inexpensive to use and maintain because they do not use moving parts , unlike mechanical flow meters.

Ultrasonic flow meters measure the difference of the transit time of ultrasonic pulses propagating in and against flow direction. This time difference is a measure for the average velocity of the fluid along the path of the ultrasonic beam .By using the absolute transit.



**3.9 Ultrasonic type level measurement**

The ultrasonic level indicator is a low cost , non contact and easy to install measurement device. It is able to meet the every day needs of commercial production , as well serving a more specialized role in the technologically advanced aero space industry , thus placing it firmly in the category of high level measurement technology .Unlike other level indicators with limited uses , the easy to install ultrasonic level indicator is a highly accurate device with enough specialized uses to ensure that the needs of the customer are met.

**3.10 Manometer**

A manometer is an instrument that uses a column of liquid to measure pressure or vacuum .The SI unit for pressure is the Pascal , equal to one Newton per square meter. This special name for the unit was added in 1971.

**Types**

1.u-tube manometer

2. inclined manometer

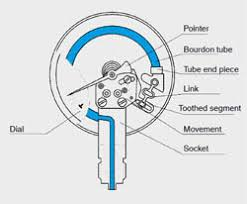
**3.11 Radar Gauge**

The level of the liquid is measured by radar signals from the antenna at tank top . After the radial signal is reflected by the liquid surface the echo is picked up by the antenna . As the signal is varying in frequency the echo has a slightly different frequency compared to the signal transmitted at the moment . The difference in frequency is proportional to the distance to the liquid ,and can be accurately calculated. This method is called FMCW (Frequency Modulated Continuous wave).



**3.12 Bourden Tube**

Bourden Tubes are known for its very high range of differential pressure measurement in the range of almost 100,000 psi.It is an elastic type pressure transducer . The device was invented by Eugene Bourdon in the year 1849. The basic idea behind the device is that , cross sectional tubing when deformed in any way will tend to regain its circular form under the action of pressure . The bourdon pressure gauges used today have a slight elliptical cross-section and the tube is generally bent into a C shape or arc length of about 27 degree.



**3.13 Bimetalic Thermometer**

Bimetal thermometers have a lineqr dial . There are equal parts during any given set of ranges . Dial ranges are also available to meet higher temperature measurement needs .Ranges of upto 1000F.In the four selected ranges , a set of giving Fahrenheit and Celsius readings . Bimetal thermometer economic . There is no need for the trated movement or a reducer.

**3.14 Thermocouple**

A Thermocouple is a temperature measuring device consisting of two dissimilar ductors that contact each other at one or more steps , where a temperature differential experienced by the different conductors. It produces a voltage when the temperature of one of the spots differs from the reference temperature of other parts of the circuit. Thermocouples are widely used type of temperature sensor for the measurement and control and can also convert a temperature gradient into electricity.

**3.15 RTD**

Resistance thermometers also called resistance temperature detectors are sensors used to measure temperature by correlating the resistance of the RTD element with temperature .Most RTD elements consist of a length of fine coiled wire wrapped around a ceramic glass core. The element is usually quite fragile,so it is often placed inside a sheathed probe to protect it.

**3.16 LDR**

A photoresistor or light dependent resistor is a light controlled variable resistor . The resistance of a photoresistor decreases with increasing incident light intensity ; in other words , it exhibits photoconductivity . A photoresistor can be applied in light sensitive detector circuits.

**3.17 Control valves**

Control valves are valves used to control conditions such as flow , pressure , temperature , and liquid level by fully or partially opening or closing in response to signals received from controllers that compare a “set point” to a “process variable” whose value is provided bysensors that monitor changes in such conditions .A control valve consist of three main parts in which each part exist in several types and designs.

1. Valve’s actuator
2. Valve’s positioner
3. Valve’s body

**3.18 Globe valves**

A globe valve ,different from ball valve is a type of valve used for regulating flow in the pipeline , consisting of movable disk type element and stationary ring seat in a general spherical body.

Globe valves are named for the spherical body shape with two halves of the body being separated by an internal baffle . This has an opening that forms a seat onto which a movable plug can be screwed in to close the valve . The plug is also called a disk or disc . In globe valve the plug is connected to a stem which is operated by screw action using a handwheel in manual valves .Typically automated globe valves use smooth stems rather than threaded and are opened and closed by an actuator assembly.

**3.19 Diaphram valves**

Diaphram valves consists of a valve body with two or more ports , a diaphragm and a weie or saddle or seat upon which the diaphragm closes the valve . The vlave is constructed from either plastic or metal . Diaphram valves can be manual or automated . Their applications is generally as shut-off valve in process systems within the industrial , food and beverage , pharmaceutical and biotech industries.

**3.20 Butterfly valves**

A butterfly valve is a valve which can be used for isolating or regulating flow. The closing mechanism takes the form of a disc . Operation is similar to that of a ball valve , which allows for quick sgut off . Butterfly valves are generally favored because they are lower in cost to other valvr design as well as being lighter in weight , meaning less support is requires . The disc is positioned in the center of the pipe , passing through the disc is rod connected to an actuator on the outside of the valve . Rotating the actuator turns the disc either parallel or perpendicular to the flow . Unlike a ball valve , the disc is always present within the flow , therefore a pressure drop is always induced in the flow , regardless of valve position.

**3.21 Solenoid valve**

A solenoid valve is an electromechanical operated valve .The valve is controlled by an electric current through a solenoid: in the case of a two-port valve flow is switched on or off ; in the case of a three –port valve , the outflow is switched between the two outlet ports . Multiple solenoid valves can be placed together on a manifold . Solenoid valves are the most frequently used control elements in fluidics , Their tasks are to shut off , release , dose , distribute or mix fluids . They are found in ,any application areas . Solenoids offer fast and safe switching , high reliability , long service life , good medium compatibility of the materials used , low control power and compact design.

Besides the pluger- type actuator which is used most frequently , pivoted-armature actuators and rocker actuators are also used.



**3.22 pH Measurement**

A very important measurement in many liquid chemical processes is that of pH: the measurement of hydrogen ion concentration in a liquid solution . A solution with a low Ph valve is called an “acid”,while one with a high pH called a “’caustic”. The common pH scale extends from 0 to 14 ,with 7 in the middle representing pure water: pH is defined as follows : the lower case letter “p” in pH stands for the negative common logarithm , while the uppercase letter “H”stands for the element hydrogen. Thus pH is a logarithmic measurement of the number of moles of hydrogen ions per liter of solution.

**3.23 PLC**

A programmable logic controller , PLC or programmable controller is a digital computer used for automation of typically industrial electrochemical processes , such as control of machinery on factory assembly lines , amusement rides . PLC are used in many machines , in many industries . PLC are are designed for multiple arrangements of digital and analog inputs and outputs , extended temperature ranges , immunity to electrical noise , and resistance to vibration and impact. Programs to control machines operation are typically stored in battery backed up or non volatile memory. A PLC is an example of a “hard” real-time system since output results must be produced in response to input conditions within a limited time , otherwise unintended operation will result .

**3.24 Control system**

A control system is a device , or set of devices , that manages , commands , directs or regulates the behavior of other devices or systems . Industrial control systems are used in industrial production for controlling equipment or machines

There are two common classes of control systems , open loop control system and closed loop systems . In open loop control system output is generated based on inputs . In closed loop control system current output is taken into consideration and corrections are made based on feedback .A closed loop system is also called feedback control system.

An automatic sequential control system may trigger a series of mechanical actuators in the correct sequence to perform a task .For example various electric and pneumatic transducers may fold and glue a cardboard box , fill it with product and then seal it in an automatic packaging machine .

**Chapter 4**

**CONCLUSION**

The experience at Travancore Cochin Chemicals (TCC) was an excellent contribution to my engineering life .I got familiarized to different instruments used in TCC. The time period in the industry was really good and knowledgeable .The inplant training in TCC has improved my practical knowledge about several instruments ,mechanism of instrumentation ,control systems , different stages of production , the uses of products and total industrial process.