Indore Institute of Science and Technology

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Report on Industrial Training

From

"Aditya Birla Grasim Industries Limited"

Chemical Division

Grasim Nagda

Madhya Pradesh

Poly Aluminium Chloride Plant

Submitted By:

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2nd year, 4th semester

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Bachelors of Technology

Chemical Engineering

Indore Institute of Science and Technology, Indore

Submitted To:

Dr. Samatha Singh

Head of Department

Chemical Department

Indore Institute of Science and Technology, Indore

DECLARATION

I Nitya Kasera, hereby declare that the report on internship at Aditya Birla Grasim Chemical Division, Nagda is prepared by me under the guidance of Mr. Manoj Birole Jain, Head of Department, PAC Plant, Grasim Industries, Chemical Division, Nagda (Madhya Pradesh).

I have undergone the internship for a period of 10 days. I further declare that this report is based on the original study undertaken by me and has not been submitted for the award of any degree/diploma from any other University/Institution.

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Nitya Kasera
Student

ACKNOWLEDGEMENT

I am extremely grateful to **GRASIM INDUSTRIES, CHEMICAL DIVISION, NAGDA** for actually considering me as an intern in the industry. This opportunity has proven to be a great help to me in my career and to enhance my knowledge as a student.

I cannot thank enough to Mr. Manoj Birole Sir, Head of Department of PAC Plant, Grasim Chemical Division, Nagda. He was my mentor throughout the training whose valuable suggestions, encouragement has motivated me a lot. He has not lacked at a single point in order to make me learn the whole process and to gain as much knowledge as I can throughout these days. I am grateful to Mr. Narendra Dubey Sir, and the whole team of the PAC plant who made me so comfortable in the environment of the plant that I could actually ask whatever questions I got.

I am very obliged to Mr. Kapil Sen Sir for letting me gain this opportunity to work as a trainee here in Grasim Chemical Division.
I perceive this opportunity as a big milestone in my career development. I will strive to use gained skill and knowledge in the best possible way, and will continue to work to improve myself
in the order to attain desired career objective, hope to continue cooperation with all of you in the future,
I would also like to thank Dr. Samatha Singh, Head of Department, Chemical Department, Indore Institute of Science and Technology, Indore and Professor Mr. Rahul Bhargava, Industrial Training Coordinator who gave me the opportunity to do this industrial
training which helped me a lot to learn practical knowledge.
I would also like to thank my parents and my friends for helping and encouraging me during my internship. Finally, I would like to thank for those who have helped me directly and indirectly in completing my internship.

X

Dr. Samatha Singh
Head of Chemical Department

Contents

About Grasim Industries

Grasim Industries Limited, a flagship company of the Aditya Birla Group, ranks amongst the top publicly listed companies in India. Incorporated on August 25, 1947. It started as a textiles manufacturer in India. Today, it has evolved into a leading diversified player with leadership presence across many sectors. It is a leading global producer of Viscose Staple Fibre and Viscose Filament Yarn, the largest Chlor-Alkali, Advanced Material, Linen Yarn and Fabrics producer in India. The company has made an entry into the paints business and setting up six plants across pan India locations. Through its subsidiaries, UltraTech Cement and Aditya Birla Capital, it is also India's largest cement producer and a leading diversified financial services player. At Grasim, there is an endeavour to create sustainable value for employees, 262,600+ shareholders, society, and customers. The company reported consolidated net revenue of ₹95,701 Cr. and EBITDA of ₹17,772 Cr. in FY 2022.

Introduction to the Industry

The company is an industrial conglomerate under the chairmanship of **Shri Kumar Mangalam Birla**.

The Aditya Birla Group is the world's largest producer of VSF, commanding a 24 per cent global market share. It is also the second largest producer of caustic soda (which is used in the production of VSF) in India. **Grasim Industries Limited** is an Indian manufacturing company based in Mumbai, Maharashtra. Grasim Industries was ranked 154th in a list of the world's best regarded firms compiled by Forbes. It was started in 1948 as a textile manufacturer. Since then, Grasim has diversified into Viscose Staple Fibre (VSF), cement, sponge iron, chemicals and Diversified Financial Services (NBFC, Asset Management and Life Insurance).

The company is a subsidiary of Aditya Birla Group, which operates over 40 companies in 12 countries on four continents. Grasim is the world's largest producer of viscose rayon fibre with about 24% market share. Textile and related products contribute to 15% of the group turnover.

Objective

The main objective of this Industrial Training is to expose to actual working environment and enhance knowledge and skill.

It is also to help the students to know about the safety practices and regulations inside the industry and to instil the spirit of teamwork and good relationship between students and employees and co-workers. Enhance students' familiarity with the world of work and enable them to reflect constructively in issues related to work.

Assist students to evaluate and understand how to work experience relates their personal or career and future professional development.

Develop employability skills, intellectual skills, core of key skills, personal attributes and knowledge about how organizations work.

The purpose of this program is to instil the good qualities of integrity, responsibility and self-confidence.

Introduction to PAC

(POLY ALUMINIUM CHLORIDE)

Poly Aluminium chloride is a flocculant consist of various molecular weight anionic, non-ionic & cationic polymers. They are used to increase the efficiency of setting clarification, filtration and centrifugation.

Flocculation means a process in which individual particles of a suspension form aggregates in water treatment industry the term coagulation b& Flocculation imply different mechanisms.

It is one of the most efficient water treatment chemicals utilized today. It is widely used in both potable water and wastewater treatment because it provides high coagulation efficiency and it has the widest pH and temperature application ranges compared to other water treatment chemical.

General formula

$(Al_n(OH)_mCl_{(3n-m)})x$

We prepare different types of PAC powder safety consciousness and ensure that the employees are familiar with the general and special practices followed in the plant during working."

Liquid Poly Aluminium chloride is converted into powder PAC in a spray dryer. Hot air is generated in combustion chamber by burning Hydrogen Gas. In the main drying chamber PAC liquid is sprayed into very fine droplets and hot air for drying is supplied co-currently. Water is evaporated from liquid droplets and PAC powder obtained is collected in conical bottom. Air from drying chamber is exhausted by an exhaust fan through a cyclone separator (where powder carried with air is separated) and then to scrubber. The dried powder collected below drying chamber and cyclone separator is cooled and pneumatically conveyed to a bagging cyclone. From bagging cyclone power is collected in a hopper and filled into bags by means of weighing & bagging machine.

Poly Aluminium Chloride (Powder)
Liquid Poly Aluminium chloride is converted into powder PAC in a spray dryer. Hot air is generated in combustion chamber by burning Hydrogen Gas. In the main drying chamber PAC liquid is sprayed into very fine droplets and hot air for drying is supplied co-currently. Water is evaporated from liquid droplets and PAC powder obtained is collected in conical bottom.
Air from drying chamber is exhausted by an exhaust fan through a cyclone separator (where, powder carried with air is separated) and then to scrubber.
The dried powder collected below drying chamber and cyclone separator is cooled and pneumatically conveyed to a bagging cyclone. From bagging cyclone power is collected in a hopper and filled into bags by mean of weighing & bagging machine.

Use of PPE's:

PPE is equipment that will protect the user against health or safety risks at work. It can include items such as safety helmets, gloves, eye **protection**, high-visibility clothing, safety footwear and safety harnesses. It also includes respiratory protective equipment (RPE).

Making the workplace safe includes providing instructions, procedures, training and supervision to encourage people to work safely and responsibly.

Raw Materials used in the plant

Raw material for production PAC

Aluminia hydrate $AL(OH)_3$ or alumina trihydrate and hydrochloric acid HCL

The Alumina Powder is obtained from HINDALCO INDUSTRY

The HCL is obtained from membrane cell MC1&MC2 plant.

Production Process

The PAC production process lines in the batch etching reactions of alumina with an aqueous solution of hydrochloric acid the reaction takes place in a glass line reactor equipped with internal agitator during reaction the reactor temperature is controlled & at end of reaction product is maintained in agitation & non-reacted alumina and insoluble are separated by filtration.

The clarified product is transferred into vessel where the product is taken to standard specifications.

A venting system assures the collection of vent discharges for storage tanks and safety valves.

The liquid effluent, mainly acid water, are collected into a holding tank from which they are recycled to the Production plant. Using sulphuric acid inside instead of hydrochloric acid, Aluminium sulphate solution (Alum) can be produced with the same process.

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- **Batch reactor**

Powered alumina is taken from HINDALCO INDUSTRIES limited in a bag of 1.2 tons & then from hopper it is passed to a conveyor belt and after filtering it is passed to a reactor. Total 7 reactor are employed for liquid PAC production. Production capacity is 350 MT/ day on 10 bases.

The reactor is a jacket, MSGLR in order to prevent corrosion, the GL (glass lined) is used. Thickness of GLASS LINED is 1.2 to 2.1 mm the agitator driven by motor of 20Hp/ 1500rpm and the reactor are load cell mounted.

The whole process consists of 5 cycles:

- **Loading cycle-**

2.95 MT of Powdered alumina and 6.7MT of HCL is loaded in a reactor whole loading takes 30 minutes then it is mixed with an agitator.

- **Heating cycle -**

In the reactor at first, a low pressure (L.P) steam of 3kg / m3 is passed until attainment of 80°C is there and then. A heating pressure steam of 7 kg/m3 is passed until attainment of 160 °C is there to heat up the solution. Directly a high-pressure steam of 7kg /m3 Can't be passed as reactor is glass lined and a sudden increase in temperature could break the glass. Before precooling cycle 3 hours of isothermal heating (165°-170°C) is done to enhance the rate of reaction.

- **Precooling Cycle-**

Now the solution is allowed to cool by passing water at high of 140°C is passed in reactor the precooling takes 40- 45 minutes.

- **Cooling Cycle –**

Water at certain low temperature 35°-40°C is passed in jacket till reactor mass temperature reaches 90°C

Similarly, here also directly Low temperature water can't be passed as it could affect glass lining and break it.

- **Unloading Cycle –**

After completion of reaction Our products is ready in crude form tyen it is unload reactor in a rubber lined tank to prevent from corrosion.

SPRAY DRYING

Liquid Poly Aluminium Chloride is converted into powder PAC in a spray dryer. Hot air is generated in a combustion chamber by burning hydrogen gas ehich is used to heat air coming from atmosphere passing through feed pump after passing through strainer. Strainer is a Polypropylene mesh filter which is used to remove any dirt particle from liquid PAC . PAC liquid is sprayed into very fine droplet with atomizer and hot air for drying is supplied co-currently. Water is evaporated from liquid and powder / granules are obtained from conical bottom. Then air containing powder is passed through C.S where fine particles get separated and passed to scrubber through exhaust and collect powder after pneumatic cooling and conveying goes to the hopper for filing.

The electromagnetic/ pneumatic hammers are used to dislodge the powder which get settle near wall of drying particles is done with water and it is collected into scrubber tanks which are further used in liquid PAC plant and air is released into the atmosphere.

In dryer an integrated static fluid bed is there where air fluidizes the dried particles in the drying chamber so, PAC particles gets entered into the integrated fluid bed. Air from supply fans heated in a steam air heater is used to fluidize the product particles collected in the centre to from granules. These granules are then discharge through a rotary valve in the bottom of the drying chamber.

Pac spray dryer plant

1. Alfa laval 12TPD

2. L&T Niro 24 TPD

3. MOJJ 36 TPD

In this plant 3 spray dryer are there

Key equipment

❖ Atomizer

❖ Drying

❖ Hot air generator cyclone separation

❖ Fans

❖ Dehydration

Atomizer

Production droplet of specific size and surface area by atomization is the most critical steo in the spray drying conditions, controls the drying rate, & therefore the required particles residence time, & therefore the product size. The atomizer of spray dryer distributes the feed liquid to a mist of fine droplet with a high surface volume ratio essential for fast, accurate and gentle drying. Its design strongly influenced the final product properties in terms of particle size and size distribution, shape.

The type of atomizer not only determine the energy required to form the spray but also the size & size distribution of the drop &their trajectory & speed on which the final particle size depends. The chamber design is also influenced by the choice of the atomizer the drop size established the hot transfer surface available &thus the drying rate.

The rotary atomizer wheel uses the energy of a centrifugal forces for atomizing liquid to be spray dried into fine droplet. The centrifugal force required for atomizing the liquid is obtained by rotating the atomizer shaft with the hellp of a belt driven motor. The atomizing wheel is mounted on the shaft and is designed to drag the liquid Out to be the periphery. The liquid flow accelerates and ejects at very high-speed forming fine droplets. This droplet come in contact with hot air to convert liquid into fine powder by evaporating water from the liquid. Liquid is fed into the centre of a rotating wheel, moves to the edge of the wheel under the centrifugal force and is disintegrated at the wheel edge into droplets.

Drying Chamber–

Generally, the chamber design on the atomizer used depends on the air fluid contact system selected. The selection of atomizer and air fluid layout is determined by the required characteristics of the dry product and production rate. PAC liquid and hot air for drying is supplied co-currently in drying chamber. The temperature of final product from dryer in co-current mode is lower than of air inlet temperature.

The evaporation takes places in the drying chamber and the dried product is conveyed out a long with the exhaust/ spent air and water vapour to the cyclone where the product is separated from the exhaust air. The spent air carrying all the eater vapour and the product fines flows to the exhaust cleaning system and product recover system through the air outlet duct. Some of the features of the drying chamber are cylindrical shaped vessel with conical bottom provided with inspection doors sight glass, hammer and vacuum switch for chamber protection. Chamber is provided with suitable insulation and glass lined cladding. Static fluid bed integrated with drying chamber is working under negative pressure.

Hot air generator-

Director heaters may be used if the material can come into contact with product of combustion. Otherwise, indirect air heaters must be used. The type of heaters used depends on the required temperature of the drying air on the availability of the heat source.

Fuel used – hydrogen gas

Maximum available temperature ceramic fire block on brick lining. At inlet of HAG = 350 Celsius.

Cyclone separator –

Powder separator

Dry powder: Cyclone, bag filter

Wet powder: Wet scrubber

Powdered separator is used to separate dry product from the drying air at the highest possible efficiency and collect the powder. Dry separator is used for the dry product separation and collection; wet separator is used for the final air cleaning and hence are situated after dry collection

In a dry cyclone, centrifugal force is employed to move the particles towards the wall and separate them from the air core around the axis. Air and particle swirl in a spiral down the cyclone, where the particles collect and leave the cyclone. The clean air flows upward and leaves from the top. In a spray drying process a simple cyclone system is a multi-cyclone system may be used.

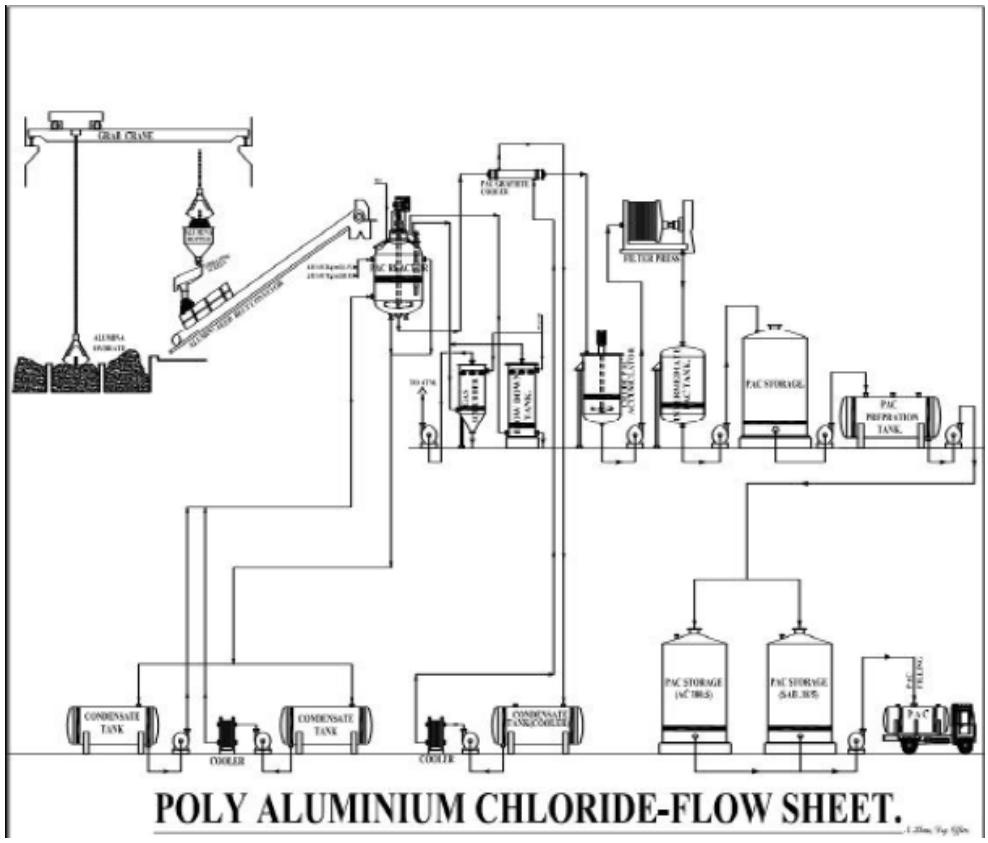
Scrubber

Wet scrubber is used following dry collectors The particles are separated from air by contacting it with a liquid usually water. The Venturi scrubber is preferred in spray drying system because it offers easy cleaning and maintenance. The air carrying fine particles flows through at the throat of the scrubber to form a spray. The Scrubbing liquid containing the product is separated out and discharge from the scrubber base for use in making PAC liquid the process drop over the scrubber is usually between 2000 and 5000 PA.

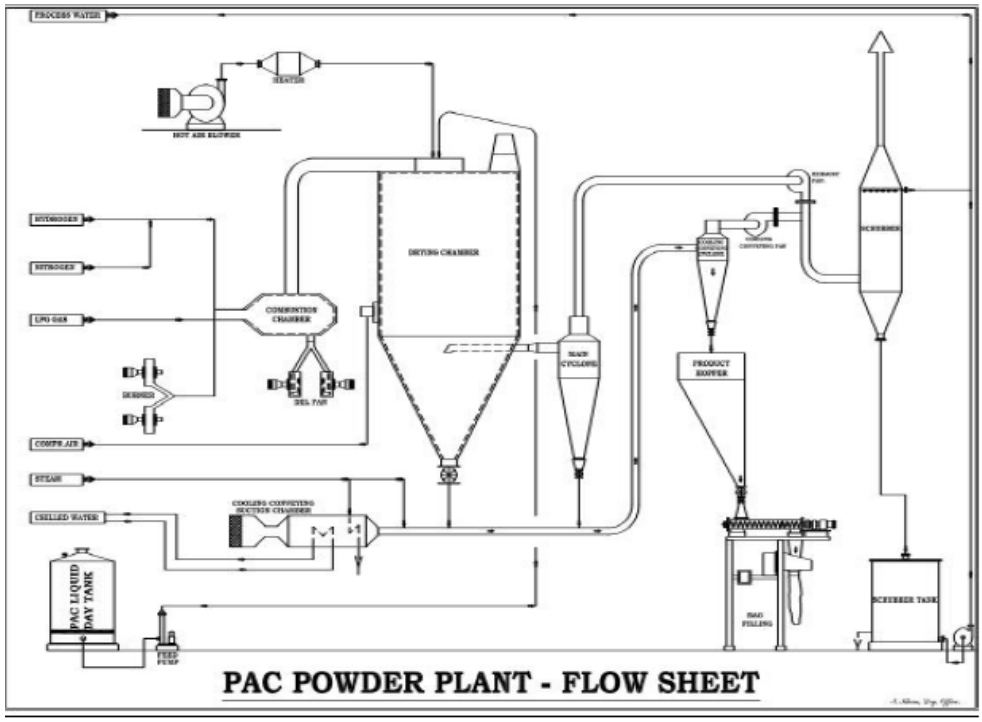
Fans-

In a spray drying process, high flow rates of drying air are generally obtained by the use of centrifugal fans. Usually, a two-fan system is used the main fan situated after the powder recovery equipment and supply fan located in the inlet duct to the drying chamber. Two fans enable better control of the pressure in the chamber. The operating pressure in a drying chamber determine the amount of powder in the exhaust air and hence the capacity of the cyclone and their collection of efficiency. In special cases, more fans may be used in a drying process, for example a centrifugal fan for the powder pneumatic transport or small fans for blowing cooler to potential hot spots in the drying chamber and atomizer. In this plant exhaust fans used for transportation of air from the drying chamber to the open and for cleaning the exhaust air for fine particle carried over. Supply fans with filter are used for air supply into the hot air generation section/combustion section and into integrated fluid bed hydrogen blower, forced draft blower, conveying blowers etc. are also used in this plant conditions.

Flow sheet –



Poly Aluminium Chloride (liquid) process flow sheet



Poly Aluminium Chloride (powder) process flow sheet

Chemical handling in PAC plant

Alumina Hydrate	Al (OH)3
Hydrochloric acid	HCl
Caustic lye	NaOH
Sodium Aluminate	$NaAlO_2$
LPG (Mixture of propane &Butane)	C3H8 &C4H10.
Non ferric Alum	Al2 (SO4)3.18HO
Hydrogen	H2
Nitrogen	N2
Sulphuric	H_2SO_4
Poly Aluminium Chloride	(Aln(OH)mCl(3n-m))x

PAC Production of specification –

PAC	Al_2O_3%	Cr%	SO4%	Basicity %	NTU%	Sp Gravity
SAB18	**16.5-17.5**	**20-23**	**Nil**	**35 min**	**<100**	**1.35-1.39**
AC100S	**9.5-9.9**	**12.5 max**	**2.7 max**	**35min**	**<100**	**1.18-1.22**
SAB18/5	**12.5-13.5**	**22-24**	**Nil**	**NA**	**NA**	**1.32-1.35**
ARYA	**10.2-10.5**	**10.5 max**	**2.5 max**	**64 min**	**<100**	**1.20-1.22**
AQUA CURA - IWT	**8.0-9.0**	**20-22**	**Nil**	**NA**	**NA**	**1.24-1.26**

Application –

1414AQUA monitoring of extracts is primarily accomplished by characterizing the final product with various analytical methods. ALK has defined four quality parameters that should be monitored throughout the manufacturing process.

Safety and precautions –

1) No toxicological action from PAC

2) It is entirely harmless to the aquatic life up to concentration of 200 mg/litre expressed as Al_2O_3.

3) It is recommended to use the gloves, protection Google's and or visor

Hazards –

This is non-flammable material, can react with many metals such as iron, to produce hydrogen gas, corrosive in most condition.

CONCLUSION

The industrial training that I had already gone through for 4 Weeks at GRASIM INDUSTRIES is very interesting, instructive and somehow challenging for someone that has zero-working experience. It gave me lots of benefit and positive changes that enable me to enter the working environment. Through this training I was able to gain new insights and more comprehensive understanding about the real industry working condition and practice. The 4 weeks of training has provided me the opportunities to develop and improve my soft and functional skills. All of this valuable experience knowledge that I have gained were not only acquired through the direct involvement in task given but also through other aspect of the training such as work observation, interaction with the staffs and local people. I learned about pumps, couplings, shafts, etc.