MANUFACTURING OF ZINC SULPHATE ($ZnSO_4$)

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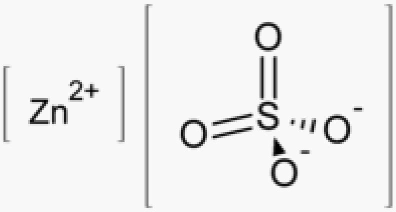
INTRODUCTION

Zinc sulfate is an inorganic compound. It is used as a dietary supplement to treat zinc deficiency and to prevent the condition in those at high risk.[3] Side effects of excess supplementation may include abdominal pain, vomiting, headache, and tiredness.[4]

Zinc sulfate



The Sulphate of zinc (ZnSO4,) 7H,O) is found in the nature as the hepta hydrate in the mineral Zincosite and qaslarite. Zinc Sulphate is also known as 'White Vitriol Zinc sulphate is prepared by roasting zinc blend, in a current of air and extracting the product with water which dissolves out the zinc sulphate or by bleaching zinc blende with concentrated sulphuric acid filtering out the residue and treating the clear liquid with zinc dust to remove heavy metals like cadmium. The clear liquid is evaporated, the crystals are centrifuged and dried zinc sulphate is also prepared from Scrap Zinc, zinc residuals and skimmings from galvanising plants by the above methods. For many purposes and particularly for the preparation of lithophone and pure zinc sulphate, zinc sulphate, solution is required in high purity. Purification methods are the same as employed in electrolytic manufacture of zinc

The salt is marketed in crystalline, blake and powdered forms containing respectively 22, 25.5 and 35% of zinc. Zinc sulphate has an acid reaction and is harmful when taken internally, zinc sulphate finds application in a wide range of industries such as rayon, agriculture textile, dyeing and printing, floatation reagents, glues, electrogalvanising manufacture of many zinc compounds. It is the starting material for many of the zinc compounds such as bromate, bromide, carbonate, chloride, iodide cleosterate, oxalate, perborate, peroxide and purate

SCOPE AND MARKETING POSITION:

It is the oldest zinc compound industry, now facing competition for superiority only from zinc oxide and zinc chloride industries. There are 3 units in the organized sector with an installed capacity of 4350 tonnes per year. The average annual production of these units in the last few years has been of the order of 500 to 600 tonnes. Thereare 25 to 30 units engaged in the manufacture of this choice in small scale sector annum. Their total production is about 15000 to 20000 tonnes per

Most of the small scale unit manufacture zinc sulphate by reaction of zinc waste materials like zinc ash, zinc doors, zinc residue and zinc sludge with the sulphuric acid. The demand of zinc sulphate is about 30,000 to 40,000 tonnes per annum more than the production of all the units Government of India has reserved zinc sulphate for the small scale section. There is good scope of starting this industry in small scale sector. The gap between the present production and demand indicates that there is bright future of this industry. As zinc sulphate finds varied use in number of industries the unit can be set up in any part of the country and the product would find a market. It is understood that in certain states lie U.P. A.P, Tamil Nadu and Haryana, there is a deficiency of zinc in the soil. To make up this deficiency, the demand of zinc sulphate in these states is rising manufacture in India. However enquiries in the retail and wholesale markets showed that there is a good demand of zinc sulphate of all the grades. Due to it's increased has recorded on increasing tendency

A study of production and consumption pattern indicates that ther would besubstantial shortage of zinc sulphate in country.

Considering amount of $ZnSO_4$, required by various industrial application is of high purity and analytical reagent grade (A.R. grade) Very few of zinc sulphate manufactures are engaged in manufacture of A.R. grade zinc sulphate, With the recent revolution in modern agricultural cultivation the use of technical zinc sulphate is bound to increase tremendously in the near future.

To make the project economically viable and technically feasible some standard equipment should be used for the production of zinc sulphate and the minimum economical unit is found to produce 300 tones of zinc sulphate of technical gradeper annum.

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Zinc importance in Agriculture

Zinc sulphate heptahydrate (Zn-21%) is recommended for soil application at the rate prescribed by the State Agricultural Universities / soil Testing Laboratories.

The dose varies across the states from 25 to 60 kg /ha depending on soil type , cropping intensity and crop productivity levels , to be applied once in two ye Zinc is naturally occurring mineral . Zinc is important for growth and for the development and health of body tissues. Zinc sulphate is used to treat and to prevent zinc deficiency. Zinc sulphate may also be used for pourposes not listed in this medication guide.

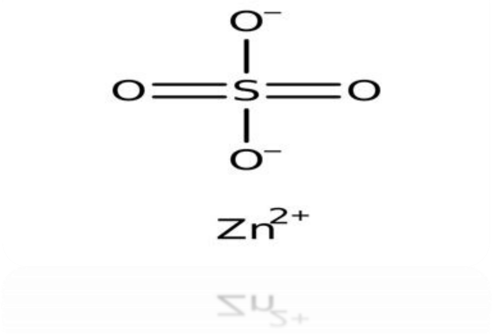
CHEMICAL FORMULA :-

Zinc Sulphate 33% : ZnSO4+H2O

Zinc Sulphate 21% : ZnSO4+7H2O

Zinc Sulphate 21% : ZnSO4 in Solution .

CHEMICAL STRUCTURE



CHEMICAL PROPERTIES :

Molecular weight	161.47 g/mol
Boiling point	740^0C
Melting point	680^0C

Global Zinc Sulfate Market Review 2015-2018 and Forecast to 2025 - ResearchAndMarkets.com

The Global Zinc Sulfate market is expected to grow with a significant rate during the forecast period 2018-2025 owing to increasing demand of applications of raw material for manufacturing latex products, pigment lithopone, desulphurization process and zinc sulphate is an herbicide typically used for moss control.

Zinc Fertilization: A Review of Scientific Literature - Ultra Yield ...

https://www.ultrayieldmicros.com › news_research

Density

3.54 g/ cm^3

by RB Lindenmayer · 2007 · Cited by 2 — The purpose of this literature review was to summarize ... Zinc sulfate (ZnSO4) monohydrate is produced by adding sulfuric acid to. ZnO (Zn ... Regression Equation for Dry Matter Production, Zn Concentration and Uptake (Gangloff et al, 2002)

Zinc Sulphate Manufacturers to Flourish across Emerging Markets: China and India to Maintain Lead in the Agrochemicals Segment, Fact.MR

Key Takeaways from Fact.MR's Zinc Sulphate Study

- By type, zinc sulphate monohydrate to generate nearly two-thirds of the total revenue
- Agrochemicals to remain principal application area, owing to increased uptake in developing regions to address zinc deficiency
- Uptake in dietary supplements and oral rehydration therapy for diarrhea to heighten applications in the pharmaceutical segment
- U.S to generate significant revenue, owing to increasing uptake as nutrient injections
- U.K to register high annual growth, attributed to a proliferation vegan population who require 50% more zinc
- Germany and France to experience strong growth, owing to the presence of a robust chemical industry
- Global zinc production hegemony renders China a lucrative zinc sulphate market, India, Japan & South Korea to also register high growth

The factory is located at Panambur, 9 km north of Mangalore City, in front of the New Mangalore Port. The plant is well connected, both by rail and road. The West Coast National Highway (NH-66) from Kochi to Mumbai separates MCF from the New Mangalore Port.

The New Mangalore Port is an all-weather port capable of handling ships up to 30 feet draft. Naphtha, Fuel Oil, Ammonia and Phosphoric Acid - the main raw material are obtained through the port.

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SPIC Zinc Sulphate (Hepta Hydrate)

SPIC Zinc Sulphate contains 21% zinc, an essential component of various enzymes systems for energy production, protein synthesis, and growth regulation. Zinc has the most obvious effect on photosynthesis. All flowering plants require zinc for flower production, fruit set and seed set. Almost half of Indian soils are deficient in zinc. Among all secondary and micro nutrients, deficiencies of zinc have a more devastating effect on cultivated crops.

Natural sources of zinc

Zinc exits naturally in rocks. The amount of zinc present in the soil depends on the parent materials of that soil. Sandy and highly leached acid soils generally have low plant available zinc. Mineral soils with low soil organic matter also exhibit zinc deficiency. In contrast, soils originating from igneous rocks are higher in zinc. Plants take up zinc as the divalent ionic form ($Zn2+$) and chelated-zinc

The role of zinc in the plant

Zinc is an important component of various enzymes that are responsible for driving many metabolic reactions in all crops. Growth and development would stop if specific enzymes were not present in plant tissue. Carbohydrate, protein, and chlorophyll formation is significantly reduced in zinc-deficient plants. Therefore, a constant and continuous supply of zinc is needed for optimum growth and maximum yield.

Zinc deficiency

Research at the University of Minnesota as well as other universities has identified soil conditions where a response to zinc fertilizers is expected. These conditions are:

Soil Temperature: Cool soil temperatures in early spring can intensify the need for zinc. When soil temperature is low, mineralization of soil organic matter slows down resulting less amount of zinc being released in the soil solution. Root growth is also stunted by cool temperatures and reduces the plant's ability to find new sources of zinc in the soil profile

MANUFACTURING PROCESSES

The Zinc sulphate is prepared by the various methods. Zinc sulphate is also a by product of some process industries the few methods of preparation of zinc sulphate are given as below :

4.1. From Zinc Ore :

Zinc sulphate is usually prepared by leaching zinc ore concentrates with sulphuric acid solution and filtering out the residue other raw materials such as galvanizers . Skimming's are used in same cases. After purification to remove metallic impurities the solution may be evaporated and zinc crystals are separated.

4.2 Hydrothermal process :

_Synthesis or sulphides and sulphur salts from oxides by sulphur and water . The hydrothermal of sulfonation of oxides by sulphur and water under pressure, is described Experiment at different temperature and pressures were performed particularly with zinc oxide (Zno) and Zn (OH)2 . The process is practically quantatively in he presence of metal oxides and hydroxides of higher basicity according to following reactions.

$4\ Zno + 4S \rightarrow 3\ ZnS + ZnSO4$ and

$3\,ZnO + 4S + MgO \rightarrow 3\,ZnS + MgSO_4$

The above reactions are valid, in general also almost all the sulfosalts known in nature were prepared with similer methods sulfuration to thiogermanates and thiostannates is very interesting become GeO_2 and SnO_2 are not transfered into sulfides by general process but are sulfurated in the presence of metals able to orm sulfosalts.

4.3 Zinc Sulphate from Zns :

The oxidation of Zns to zinc sulphate by air in solution under pressure is accelerated by addition of cu salts to the reaction mixture. In an example 5 gm Zns containing 120 mg $CuCl_2$ and dispersed 150 ml water at10 atm pressure in a stirred autoclave at 100˚C was quantitatively converted to $ZnSO_4$ in 100 min

The decomposition of zinc ferrite by roasting ti in a

sulphur dioxide – oxygen – nitrogen atmosphere.

Zinc ferrite (1) is readially formed during the sulfatizing roasting of Zn oreas. Zinc ferrite is decomposed not in SO_2 gas but in the mixed gas of SO_2 . A quantitavely study of the dependence of partial pressure of SO_3 was made by adding N as a diluent. At lower temperature $Fe_2(SO_4)_3$ becomes unstable and zinc sulphate and only zinc sulphate is formed . The rate of sulfatiaztion in larger for zinc than ferrous (fe) The amount of solution of Fe compound decreases with the rise of roasting temperature.

4.4 Production of Zinc sulphate from copper containg Zinc oxide:

The usual process used with Zno dust containing small amount of Cuo (0.7 %) and consisting of precipitation of Cu with metallic Zn powder is prohibitive with Zno dust rich is Cuo . In this case the final acid leaching of cake exists only about half of Cu present in the form of Cu_2O which is decomposed according to fallowing reaction .

$$Cu_2O + H_2SO_4 \rightarrow CuSO_4 + Cu + H_2O$$

This difficulties call for a different of Zno containing upto 10% Cuo . The proposed scheme avoides the final acid extraction with excess H_2SO_4 and replaces it by heterogeneous to following reaction.

$$Cu + SO_4 + ZnO \rightarrow ZnSO_4 + CuO$$

i.e . extraction of Z_2SO_4 Reactor (i) which yields concentrated (35%) pure H_2SO_4 solution ready for evaporation and crystallization. The H_2SO_4 in the amount necessary to sulphate Zno; pho and cao ;but not cu and fe oxides . These distributed in a certain ratio between two reactor (i) and (ii). In the first reactor the solution in feed from Cu and in the second Zno is leached in neutral solution strict economy of amount of water used to leave the cake enables one of obtain in first a 42.3 % $ZnSO_4$ solution which needs no evaporation and can be crystallized directly on cooling to 15 – 20℃, The mother liquor containing 34.5 % Zinc sulphate is returned to reactor II. In lab scale tests. H2SO4 was districted between I and II in the ratio 2:3 to ensure a high concentration of unreacted Zno in I. The extraction of Zn in reactor IInd is increased markedly by temperature increases from 60 to 70^{0}C. Further increases to 85^{0}C give on significant advantages . As resulted in which at 50 – 70^{0}C the Cu content in the solution 97% precipitation decreased from 0.6 to 0.29 per litre in ½ hour and to 0.059 per litre in 3 hr.

Chemical formula :-

$$Zn + H_2SO_4 + 7H_2O \rightarrow ZnSO_4\ 7H_2O + H_2 \uparrow$$

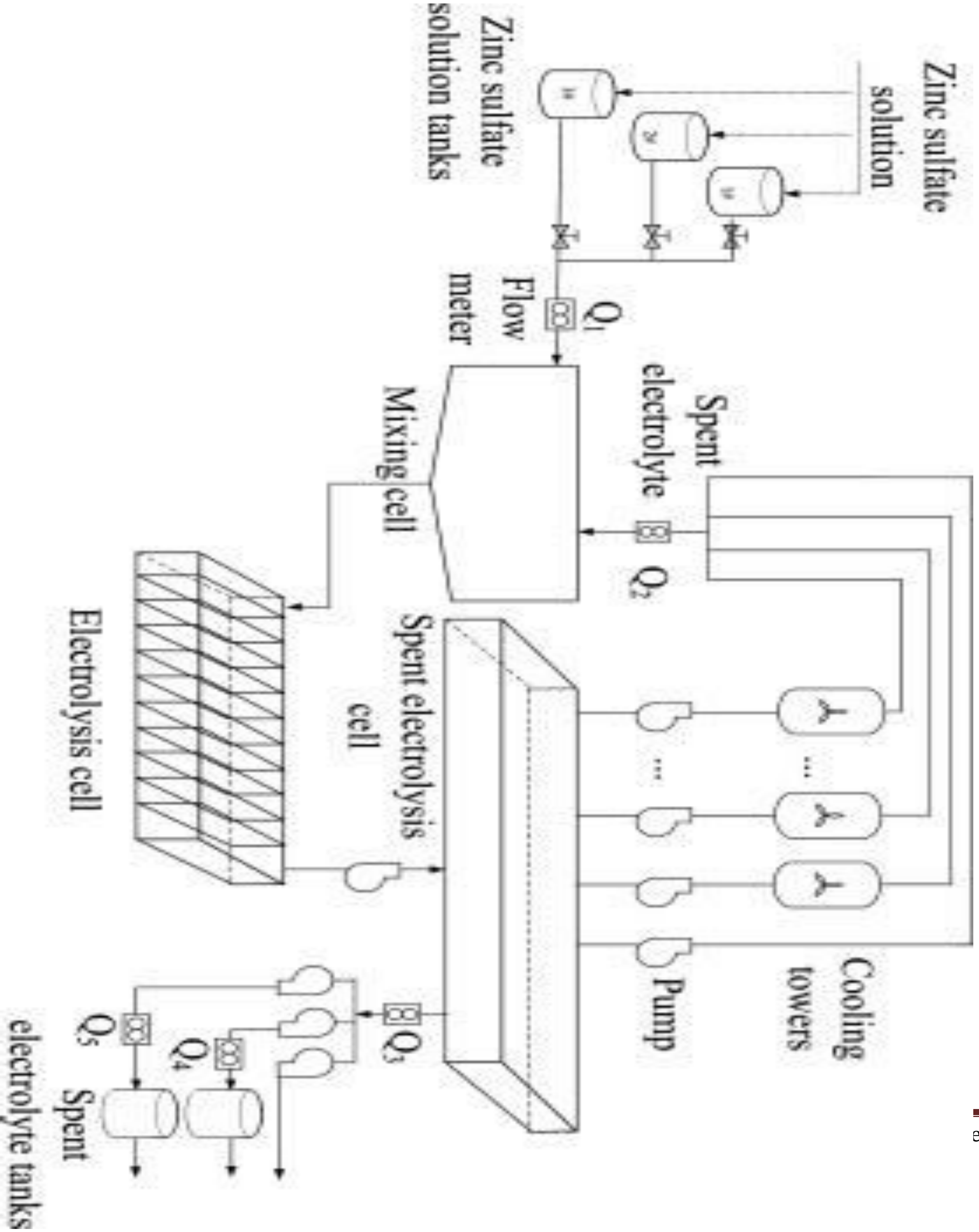
:-

PRODUCTION OF ZINC SULPHATE BY COLD PROCESS

chemical properties : (Zinc Sulfate Properties)

Compound Formula	O_4SZn
Appearance	White powder
Melting Point	680°C (decomposes)
Boiling Point	740°C
Density	3.54 g/cm^3

Process fiow Diagram



Production of zinc sulphate by Cold process :

Zinc ash dross is suspended in small quantity of water in a lead lined tank and commercially sulphuric acid is added carefully and slowly. Alternatively the acids can be diluted separately and diluted acid added to the zinc ash in the tank. Zinc dissolved in sulphuric acid by evaluation of hydrogen gas hydrogen slows down the pH of the solution is to be checked . If it is in the acid range it could be considered that the reaction is complete. The solution is now transferred to setteling tanks. Adjustment of pH are also done to remove impurities particularly iron lead and aluminum. Potassium permanganate is added to participates Zon Zinc ash / Zinc dust can also be added to separate impurities are allowed to settle down and the solution is then transferred to the concentrator often filtration. The remain solution free from impurities is then concentrated till the density is 1.5 to 1.6 it is transferred to crystallizer . The solution is then centrifuged to remove the mother liquor. The centrifuged direct product is packed for marketing.

$$Zn + H_2SO_4 + 7H_2O \rightarrow ZnSO_4\ 7H_2O + H_2 \uparrow$$

In this process in crystallizer temperature of solution is decreased to -5 to -7^{0}C by chilling plant.

PRODUCTION OF ZINC SULPHATE BY hot PROCESS:-

Chemical Properties :-

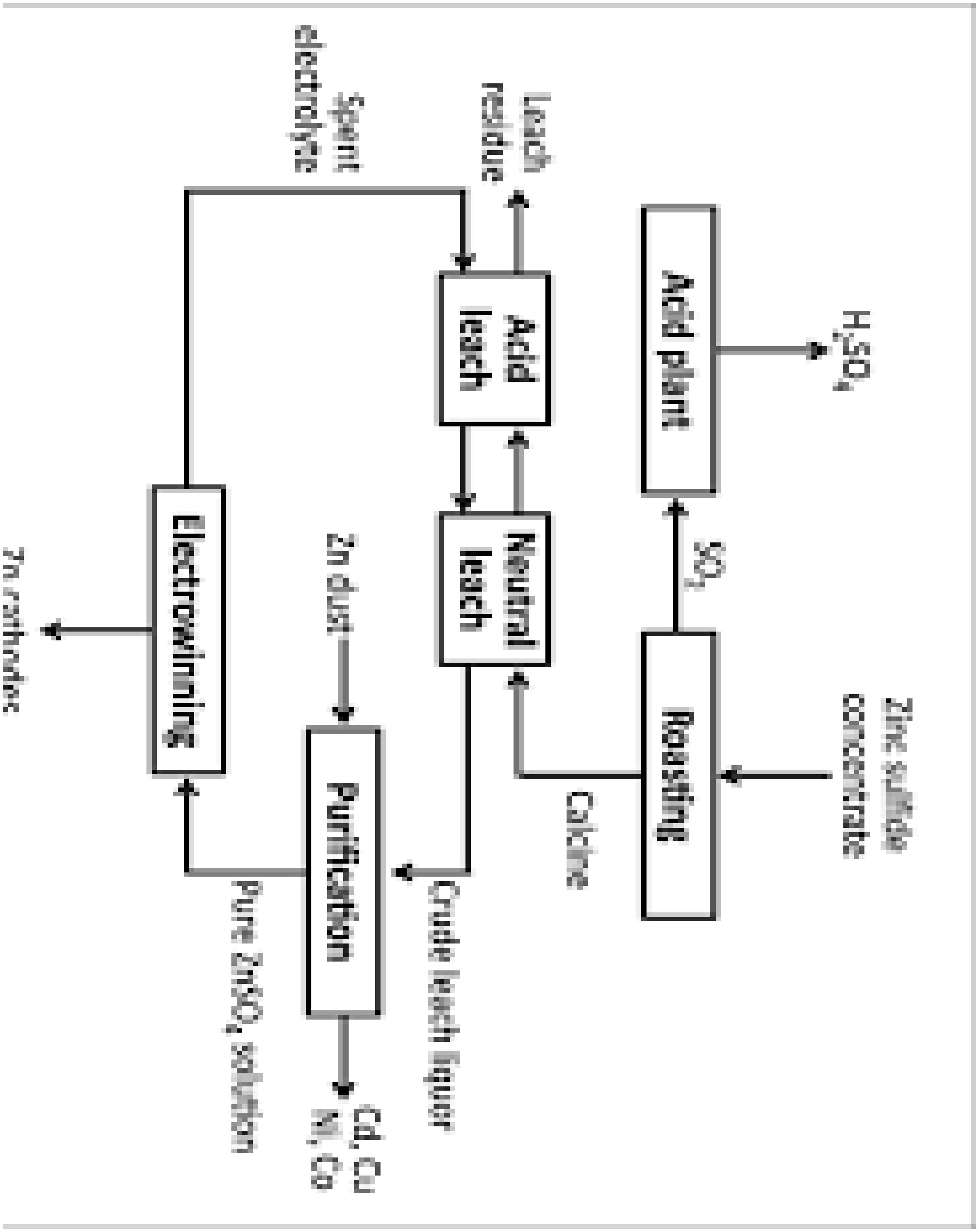
Compound Formula

Appearance

Melting Point

Boiling Point

y


Zinc sulfide concentrate
Roasting
SO_2
Acid plant
H_2SO_4
Calcine
Neutral leach
Acid leach
Leach residue
Spent electrolyte
Crude leach liquor
Zn dust
Purification
Cd, Cu
Ni, Co
Pure $ZnSO_4$ solution
Electrowinning
Zn cathodes

Production of Zinc sulphate by Hot process:-

This process is same as to cold process only different in few stages is as below.

Here in this process two reactors are used instead of one. In second reactor steam is provided at 100 – 105^{0}C to complete the reaction. Again after filtration $ZnCO_3$ is added in settling tank to maintain pH and Zinc sulphate is formed. After filter press clear solution is evaporated. In evaporator by providing steam of temperature 120^{0}C . It is then passed into crystallizer by circulation water. After centrifuge the product is dried I tray dryer at 50^{0}C and product crystals are packed for marketing.

Process Selection :-

There are process for manufacturing of zinc sulphate. These are given before some processes are completed. The pressure temperature condition is very high or in some process temperature reduced to -5 to-7^{0}C so far this chilling plant is necessary for same process the raw material is not readily available. In some processes it is a bi- product . We choose the following process for manufacturing of zinc sulphate.

The process starts from he raw material zinc ash which is available in India like Bihar, Kolkata , Bombay and from so many steel tube industries or form tin sheet unit.

In this process we save energy by using conservation technology. We can save the production time per batch.

From general observation and economics of out the process we found that process is more economical as compare to other process hence we have selected this process.

Process Description :-

Purified technical grade zinc sulphate is manufactured by zinc ash with dilute sulphuric acid.

$$Zn + H_2SO_4 + 7H_2O \rightarrow ZnSO_4\ 7H_2O + H_2\uparrow$$

For production of manufacturing of zinc sulphate raw material are used is zinc ash, sulphuric acid and water. The raw material zinc ash is available in India like Bihar state, Kolkata, Bombay and from many steel tube industries or from tin steel units. In this process sulphuric acid are required larger quantity than zinc ash and water. This zinc ash consists impurity are present total zinc ash is present total zinc ash is 100% but this consists.

Zinc	70%
Iron	5%
Metallic	25%
	Impurities
________	
100%	

When zinc ash is reacted with sulphuric acid in a lead lined reactor metallic like Fe, Cd, Ni, Al etc. are also dissolved in the acid while other insoluble impurities remain in the form of sludge. In this reactor we maintain temperature about at 40 to 50^0 C.

From the mixture reactor, zinc sulphate slurry along with impurities and insoluble sludge is transferred to another jacketed and reacted with diluted sulphuric acid and zinc ash into zinc sulphate. For this conversion temperature is maintain about at 100^0C to 500^0 C.

After the completion of reaction the slurry is pumped to a settling tank equiped with an agitator. This slurry are mixed with the help of agitator. Then sludge are passed out the bottom side of settling tank. This tank contains zinc sulphate are passed out the bottom of settling tank. This sludge contains impurity are present like Al, Cd, Ni etc. Upper sides of settling tank slurry of zinc sulphate are passed through the purification tank. This tank contains zinc sulphate's pure slurry are formed and iron impurity are removed bottom side by addition of $Kmno_4$. Then zinc sulphate slurry is passed filter press. This contain cake are separated and solution of zinc sulphate are filter.

Finally zinc sulphate solution is sent to a settling tank equipped with an agitator and a pH meter. This contains pH of solution are maintained in this tank $ZnCO_3$ is added to zinc sulphate solution. This solution containing unreacted sulphuric acid is present. This $ZnCO_3$ is reacted to sulphuric acid then following reaction are takes place…..

$$ZnCO_3 + H_2SO_4 + 6H_2O \rightarrow ZnSO_4 . 7H_2O + CO_2\uparrow$$

CO_2 formed escaped out of tank while $ZnCO_3$ is itself recovered as zinc sulphate.

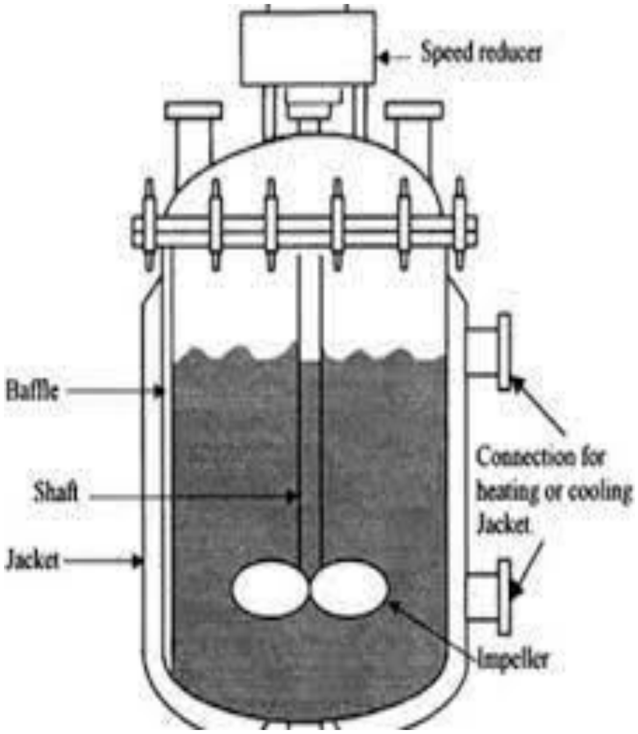
During addition of zinc carbonate, purpose for neutralization. pH of solution is carefully noted till the pH meter indicates no acid in solution of zinc sulphate (i.e. pH is observed as 7). Then solution is feed to open pan type evaporator with mild steel steam jacketed. In this temperature is maintain at 120 to 125^0C the dillute solution of purified zinc sulphate is concentrated to a viscous solution (from 1.48 to 1.6 density) cooling of hot concentrated zinc sulphate solution result in crystallization of $ZnSO_4 . 7H_2O$.

The slurry containing zinc sulphate crystals is feed to stainless steel centrifuge to separate the crystals from mother liquor which is recycled to the evaporator.

INSTRUMENTATION &PROCESS CONTROL

Process may be controlled more prescribley to give more uniform and higher quality product by the application of automatic control. Automatic control is beneficial in certain remote, hazarder routine operation.

9.1 REACTOR:-



For a reactor the continues input are solvent, reactant, and catalyst and products are dissolved in the solvent. Coolant circulated the cooling coils and reactor jacket maintains temperature.

The production rate of product is proportional to the best generated by the reaction and can be controlled by catalyst rate adjustment.

9.2 crystallizer:-

Crystallization is the unit operation that is best suited to the recovery of dissolved substance from solution. If can be achieved by cooling, evaporation vaccum and reaction. The choice of method depends upon feed liquid, composition product, specification solubility curve of the product.

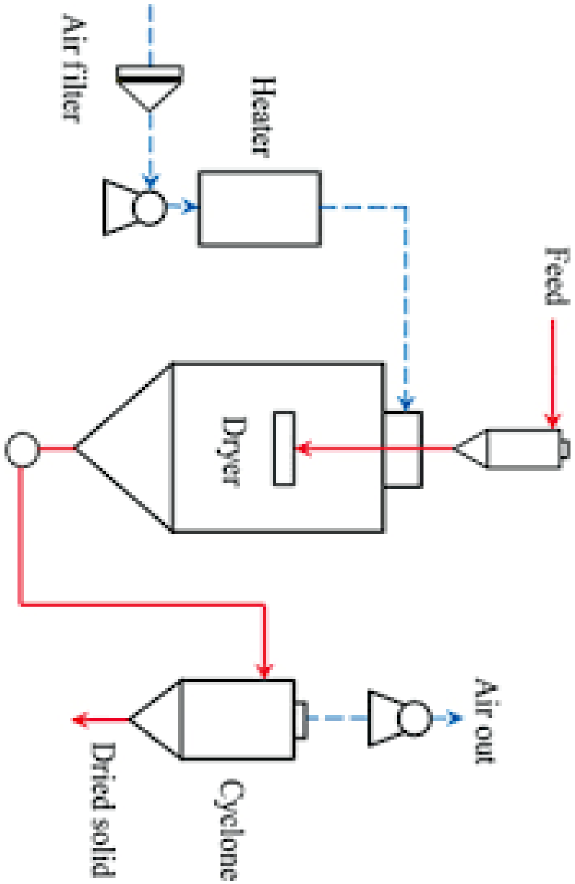
Crystallization can be achieved only it same degree of super saturation or cooing have been achieved. The 3 steps in crystallization.

1). Achieving super saturation

2). Formation of nuclei.

3). Growth of nuclei into crystals.

9.3Centrifuge:-



Centrifuge are used for separation of liquid or liquid solid separation. It is formed that if a minimum head of 10 feet or 3 m is available gravity flow is adequate for controlling feed enters the unit at a predetermined rate and is continuously clarified. The accumulated sludge is periodically ejected. The interlock system needs at least one studge is periodically ejected. The interlock system needs at least one sequencer timer and 3 or more working contacts to control values on the following lines feed, sludge and pure water.

9.4 Drier:-

Dryer the function of dryer is to remove water from wet solid or from slurries by evaporation. The process involves heat transfer and diffusion.

The control of drying operation is often difficult because on line direct measurement of product quality or drying effectiveness is difficult therefore the drying process must be controlled from the measurement of environmental condition. When an off line or laboratory analysis indicates the need.

Fig.of dryer

POLLUTION

10.1 Air Pollution:-

In zinc sulphate ($ZnSO_4\ 7H_2O$) industry production of zinc sulphate consist water, sulphuric acid, zinc are used. This process consists hydrogen gas are removed this hydrogen gas are dangerous for human being but all hydrogen are not mixed with environment. Remaining hydrogen as are react with oxygen gas & forming water.

Again reaction contains first reaction remaining excess amount of sulphuric acid this sulphuric acid react with zinc carbonate &water then forming zinc sulphate. This reaction contains carbon dioxide are involved. This carbon dioxide very dangerous to human body. This is used for environment. This carbon dioxides are effect on human respiratory system.

10.2 Water Pollution:-

In water pollution consist water are pollutant. In production of zinc sulphate process consist outside wastage or removing impurity this sludge or impurity of iron, Ni, Al etc are outside industry. The wastage material are flowing in the river and rivers water are automatically polluted. This water are being used for drinking purpose of human, therefore this waters is may diseases are improved to human body.

10.3 Soil pollution:-

For proper growth of plant zinc sulphate is applied to soil at rates 2 to 10 pounds per area with nitrogenous fertilizer or sprays. This zinc sulphate consists of from impurity. This zinc sulphate mix with water. Then reactor are polluted. This water are perculation process through boil &well water other's water are polluted.

In zinc sulphate process consist sulphuric acid are used this acid are concentrated. This is handling by following precautions are taken.

10.4 Sulphuric Acid:-

The following general handling should precautions should be observed:

Do not get in eyes, on skin, on clothing, wear chemical goggles, face shield, rubber gloves and full protective clothing whenever there is danger of exposure. Wash thoroughly after handling.

Avoid breathing mist or vapors. Handle only is areas with sufficient ventilation to prevent irritation, or wear a suitable respirator.

Kee contains closed. Do not allow water to enter containers because of violent reaction. When diluting, add the acid slowly with agitation to the surface of the aqueous solution to avoid violent spattering, boiling, and eruption.

Handling containers and pipelines also requires special precautions. An emptied container retains vapor and product residue. Observed all labeled safeguards until the container is cleaned, reconditioned or destroyed. Drums should be periodically vented to prevent accumulations of hydrogen explosions when welding, any vessel that has contained sulphuric acid must be thoroughly purged and tested for explosive conditions before welding commences. In dismantling lines and equipment, in should always be assumed that a spray of acid may occur and suitable precautions taken. Iron or other solid surface may plug lines or retain pockets of acid. Tightening flange bolts on pipes filled with acid is dangerous because of the possibility of mechanical failures.

In case of spill or leak, keep people away and upwind of the spill. If it is necessary to enter the spill area, wear self – contained breathing apparatus and fill protective clothing including boots. Dike the area with sand of earth to obtain the spill. Remove acid by vacuum truck, and flush the spill area with water. Neutralize washings with lime or soda ash. Notify pollution – control authorities of any runoff into streams of sewers and of any air pollution incidents.

Safety showers, protected against freezing and with deluge hands, should be readily available at appropriate locations in any plant producing or using sulphuric acid.

SITE SILECTION AND PLANT LAYOUT

11.1 Site Selection:-

Site selection has an important bearing on the future progress of an organization. Location of a unit plays an important part in the design of a product and the production method applied. The following are the important factors while determine the location of an industry.

1. Availability of raw material :
   If the raw material is heavy, bulky, difficult to carry or losses of weight in transportation, such industry should try to locate its unit near the sources of the raw material. For example iron and

steel industry. Such industries are called as raw material oriented industries.

2. Nearest to the market :

In case of the raw material is not heavy or bulky and easy for transportation, such industry should try to locate near the market they are called market oriented industries. For example industries dealing with production of consumable goods should try to locate near the market.

3. Suitable climate :

An industry should be located where climatic conditions are suitable. This problem is not however, considered every serious because of the development of air – conditioning techniques. Which of course require extra investment.

4. Transportation facility :

It is necessary to consider the transport cost before finalizing a site for any production unit. Cost on transport which also forms a part of the cost of production should be fairly small in proportion to the total cost. A lot of money is required production. The cost of transportation plays an important role in the decision of the location of the plant.

5. Availability of Labour :

The most important factor of production after raw material is labour. The right kind of labour in required number is another important factor having a bearing on deciding the location of a site. Labour is also required at reasonable rates with a proper aptitude towards work. The aim of management is to obtain labour at the least cost per unit of output.

6. Availability of power :

It is necessary that electrical power should be available without a break and in proper quantity at the least cost. This factor also plays an important role in deciding the cost of production thereby location of site.

7. Availability of Capital :

Finance is the breath of industry. The place where financial instructions are ready to consist industry exist, becomes a centre of great attraction. Cites like Bombay, pune etc. are the centers of industry, give special acids as loans seed money, machinery, built – up sheds, etc. to attract industries.

8. Availability of water :

Water supply should be available in good quality and it should be good quality as it is required for drinking, processing and sanitary purposes. Some of the industries like paper and chemical industries need water in huge quantities, which should be easily available at least cost. This factor is also an important one while making a decision about the location of such as industry.

9. Land :

Topography, area shape and location of the site, cost of the land, availability of draining facilities, etc. influence the selection of a site

10. Community attitude:

The success of any organization much depends on the attitudes of the people in the location, that is whether they wish to work or not and whether they would be co-operative with the incoming entrepreneur or otherwise.

11. Momentum of early start:

An industry cannot happen to start at a particular locality.

The example of pioneering industries is followed by others in that area. In this way, the industry becomes established I that area.

12 . Other factors :

A part from the factors earlier discussed certain other factors

Such as existence, of complementary or related industries,

11.2 Locational Economics:_

A new entrepreneurs would like to begin a new unit of industry, in a place where there are similar industries already in existence. Trained labour too counts as the greatest facility. That's why new industrialist flock to old established industrial centers. Plants accessories and raw material can be conveniently bought. Financial agencies are also established in the course of time and they are of valuable help to the main industry . Technical information is easily available which is found to be useful by the industrialist. Entrepreneurs associations safeguard and promote their interest. Means of communication and transport become specialized and is adopted to the needs of the industry. All the factors help the industrialist. In an all together new place, they will find even ordinary and easy problems difficult. Above all, there is something like industrial inertia which once established at a certain place, they will not like to move out.

11.3 Plant layout:-

The layout of a plant means the arrangement of various machines work areas, transport, storing and process of manufacturing different parts in the best possible manner. It can be defined as, locating different machines and plant services within the factory so that the greatest possible output of high quality, at the lowest possible total cost could be obtained. The main aim of layout is as mentioned below :-

- The layout should be such that it should hive a better quality product.
- There should be maximum utilization of floor area so that the internal transport cost can be reduced to maximum.
- There should be proper lighting facilities.
- The layout should be such that there would be last wastage.
- The layout should be such that there would be less chances of accident.
- If should have better working conditions for workers and supervisory staff.
- The neatness in layout bring down the per unit cost of production.
- The speed in production can be achieved, if the layout is proper.

11.4 Principles of Plant Layout:-

1. There should be an overall integration of men, material, machinery, money and other supporting activities.
2. The distance between the various operating units should be minimum.
3. The best layout in one which arranges the work area for each operation in the same order or sequence that forms, treats or assembles the materials.
4. Layout should be such that it untitled in the best possible manner the space, both vertical and horizontal.
5. The layout should be such that the best care of workers and makes their work pleasant.
6. The layout should be arranged at minimum cost and with the least inconvenience.

UNIT NO:6

MATERIAL BALANCE

Material balance:-

The process of manufacturing of a desired product from a given raw materials involves a series of steps where in a whole physical and chemical changes take place. The step where in chemical change takes place i.e. where in raw materials undergo chemical reaction / reaction to produce a desired product is a heart of the process as it decides the economics of the process as a whole material balance of the process wherein chemical reaction takes place are very important from the design point of view of chemical reactor.

Basis:-

1000 Kg production of $ZnSO_4 . 7H_2O$ product contain

$ZnSO_4 . 7H_2O$ = 75.0%

Zn = 20.0%
Iron = 0.5%
Metallic impurities = 3.5 %
Free moisture = 1.0%
----
100 %

Raw Material:-

Zinc ash contain

Zinc – 70%

Iron – 5%

Metallic Impurities – 25%

100%

Required Quantity:-

Zinc ash = 520 Kg.

H_2SO_4 (100%) = 265 Kg.

Water (H_2O) =530 Kg.

Kmno$_4$ = In negligible small quantity.

ZnCo$_3$ = 32 Kg.

Material Balance across reactor:-

$$Zn + H_2SO_4 + 7H_2O \rightarrow ZnSO_4 . 7H_2O + H_2 \uparrow$$

Molecular weight:-

Zn = 65.37
H_2SO_4 = 98
$7H_2$ = 126
$ZnSO_4\ 7H_2O$ = 287.54
H_2 = 2

We required total 750 Kg of $ZnSO_4 .7H_2O$ in final product.
Some of these 73.29 Kg forms in pH maintain tank. Now here we required to form 676.71 Kg ZnSO4 $7H_2O$.
Total forms of ZnSO4 $7H_2O$ in reactor is with 1.5 % losses = 687Kg

Zinc required:-

Zn	Zn ash
287.54 Kg	65.37 Kg
687 Kg	?

Zinc required $=\frac{687 \text{ X } 65.37}{287.54}$=156.18 Kg

But we have required with 2% losses = 363.31 Kg

Zinc ash required:-

Zn	Zn ash
70 Kg	100 Kg
363.31	?

Zinc ash requirement $=\frac{100 \text{ X}363.31}{70}$

= 520 Kg.

H_2SO_4 Required:-

$ZnSO_4. 7H_2O$ H_2SO_4

287.54 Kg	98.08 Kg
687 Kg	?

H_2SO_4 (100%) required = $\frac{687 \times 98.08}{287.54}$

= 234.33 Kg

Total H_2SO_4 required = 234.33 + 25 = 259. 33 Kg

Overall loss of H_2SO_4 is process 2%

Actual H_2SO_4 (100%) required = 265 Kg

Water required:-

$ZnSO_4.7H_2O$	$7H_2O$
287.54	126.14
687	?

Water required for reaction in reactor $= \frac{687 \times 126.14}{287.54}$

= 301.37 Kg.

Material Balance across pH maintain :-

For Neutralization we add $ZnSO_4$ substance

$Znco_3 + H_2SO_4 + 6H_2O \rightarrow ZnSO_4 .7H_2O + CO_2$

Molecular Wt:-

$Znco_3$ =125.44

H_2SO_4 =98

$6H_2O$ =108.12

$ZnSO_4$ $7H_2O$ =287.54

CO_2 =44

Assuming that 25 Kg of H_2SO_4 unreacted coming to tank with inlet.

Zinc sulphate forms:-

H_2SO_4	$ZnSO_4$ $7H_2O$ Kg
98	287. 54
25	?

Zinc sulphate forms = $\frac{25 \times 287.54}{98}$ = 73.29Kg.

Water required:-

$ZnSO_4$ $7H_2O$ Kg	H_2O Kg
287.54	108.12
73.29	?

Water required $= \frac{73.29 \times 108.72}{287.54}$

= 27.56 Kg.

$ZnSO_4$ required	$ZnCO_3$ Kg
287.54	125.44
73.29	?

$ZnCO_3$ required $= \frac{73.29 \times 125.44}{287.54}$

= 31.97 Kg.

CO_2 removed:-

$ZnCO_3$ Kg	CO_2 Kg
125.44	44
31.97	?

CO_2 required $\frac{31.97 \times 44}{125.44}$ = 11.22 Kg.

Material Balance:-

Solubility of $ZnSO_4$ at 120^0C = 45%

Solubility of $ZnSO_4$ at 40^0C = 38%

Molecular Wt:-

Zn SO_4 = 161.44

$ZnSO_4.7H_2O$ = 287.54 Kg

Unhydrated	Hydrated
Zinc sulphate	Zinc sulphate
161.44	287.54 kg
45	?
38	?

Hydrated zinc sulphate:-

Required $= \frac{45 \times 287.54}{161.44}$

At 120^0C = 80.15 Kgs.

At $40^0C = \frac{38 \times 287.54}{161.44}$

= 67.68 Kgs.

Hydrate water =Hydrate _ Unhydrated

Zinc water zinc sulphate

At 120^0C or initially = 80.15 – 45

= 33.15

Finally = 67.68-38

=29.68 Kgs.

Excess water = Total water – hydrated water

Initially =55 – 35.15

= 19.85

Final = 62-29.68

= 32.32

Hydrate per 100 parts excess water Kg

19.85 Kg	80.15 Kg hydrates
100	?

$\frac{100 \times 80.15}{19.85}$ = 40.77Kg hydrates

32.32 Kg H_2O	35.15 Kg hydrates
100Kg	?

Finally $= \frac{100 \times 35.17}{32.32}$ = 108.75 Kg

	Total Water kg	$ZnSO_4$ Kg	$ZnSO_4.7H_2O$ Kg	Hydrate water	Excess water	Hydrate 100 parts
Initial	55	45	80.15	35.15	19.85	403.77
Final	62	38	67.68	29.68	32.32	108.05

In cooling form the initial to final temperature the excess water is not effected and is therefore, a valid basis for comparison.

The figures in the last column may be subtracted to obtain the yield which is = 403.77 – 108.75 = 295.02 Kg.

This obtained forms sufficient 45% solution to contain 100Kg excess water.

403.77 + 100 = 503.77Kg solution

Total solution required -

295.02 kg crystals 503.77 kg solution

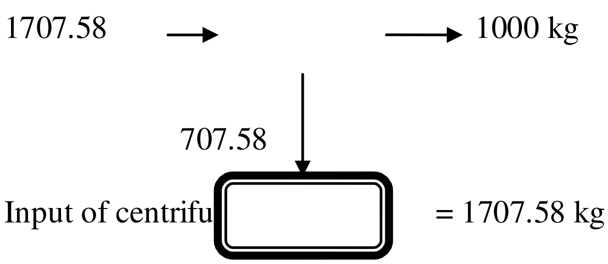
100 kg crystals ?

$$\frac{1000 \times 503.77}{295.02} = 1707.58 \text{ kg solution required}$$

Output of crystallizer = 1707.58 kg

Input of crystallizer = 1707.58 kg

<u>Material Balance across centrifuge:-</u>



Input of centrifu = 1707.58 kg

Output of centrifuge crystals = 1000 kg

Total water required = water required + water required in reactor in a pH maintain tank

+ water evaporated in evaporator

= 301.37 + 27.6 + 175.78

= 514.72

Water losses 3% overall process

Water required = 530 ltr.

	Inlet	Outlet
Zinc ash	520.00	1312.54 kg
Sulphuric acid	265.00	5 kg
Water	530.00	514.72 kg

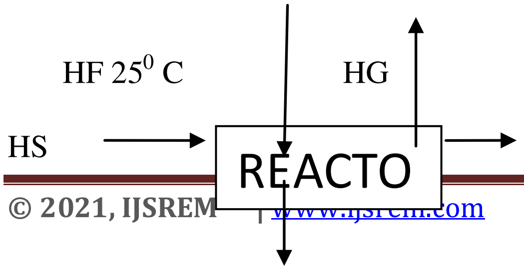
ENERGY BALANCE

Energy Balance:-

Energy is defined as a capacity a material object possesses for doing work. Industrially thermal or (indirectly) electrical energy is produced by combustion of solid liquid or generous fuel. One has to be very continues during the production and utilization of energy as its wastage leads to reduce profits. During design of a process we must account for energy flowing into and out of operations and must determine overall energy requirement of the process as a whole.

Reactor:-

Feed consisting of zinc ash, sulphuric acid (100%) and water enter the reactor and the reaction in the reactor is assumed to be 103^0C at a atmospheric pressure. The reaction product and gases leaves the reactor at 103^0C. Also a steam used for complete reaction.



QS

Let,

HF = Enthalpy of the entering stream in the reactor

= HF (Zinc ash) + (H_2SO_4) + HF (H_2O)

QF = Heat evolved in the formation of zinc sulphate

HG = Enthalpy of gases leaving the reactor

Hs = Heat supplied by steam

Qs = Heat capacity of outlet solution (product)

From energy balance

$$HF + Hs = HG + QS + QF$$

7.2.1

1) Heat evolved in the formation of zinc sulphate

QF = - 735.6 Kcal/ g mol

= -735.6×10^3 Kcal/Kg mol

For 687 kg of $ZnSO_4$. $7H_2O$ i.e. 2.4 kg moles of $ZnSO_4$ $7H_2O$

Heat evolved = $-735.6 \times 10^3 \times 24$

= 1765.44×10^3 Kcal

7.2.2

2) Enthalpy of gases leaving the reactor

For 5kg of H_2 gas i.e. 2.5 kg mole of H gas

From specific heat data

CP = 6.892 cal/ G mole ^{0}C

= 6.892 Kcal/ kg mol^{0}C

Enthalpy of gases leaving reactor = M . CP. ΔT

H = 6.892 X 2.5 X (103-25)

HG = 1343.94 Kcal

3) Heat capacity of outgoing solution.

i.e. ($ZnSO_4$ $7H_2O$ + H_2SO_4 + H_2O + Zn + Impurities)

From specific heat data

CP of $ZnSO_4$.$7H_2O$ = 92.9 Kcal/kg mol

CP of H_2SO_4 = 32.2Kcal/ kg mol

CP of H_2O = 18.0 Kcal/ kg mol

CP of Zn = 6.07 Kcal/ kg mol

Average CP of impurity = 6.17 Kcal / kg mol

Or sludge

Composition of outdoing solution :

$ZnSO_4$.$7H_2O$ = 53%

H_2SO_4 = 2.3%

H_2O = 10%

Zn = 15.8 %

Impurities = 18.9%

Average specific heat of the outlet is –

C =Xici

= (xc) $ZnSO_4$.$7H_2O$ + (xc)H_2SO_4 + (xc) H_2O

+ (xc) Zn + (xc) impurities

= (92.9 X 0.53) + (33.2 X 0.023) + (18.02 X 0.1)

+ (6.07 X 0.158) + (87.96 X 0.189)

= 53.93 Kcal / gm mol

Average molecular Wt. of the outgoing solution is

= (287.54 X 0.53) + (98.08 + 0.023) + (18.02 X 0.1)

+ (65.37 X 0.158) + (87.96 X 0.189)

= 183.4 kg/ kg mol.

From material balance outing solution i.e. product = 1312.54 Kg

Heat capacity of outgoing solution is

Qs = M Cp (mix)

$=\frac{1312.54}{183.4}$ X 53.93 X (103.25)

= 30103.79 Kcal.

From energy balance equation –

HF +HS = QS +HG + QF

HS = 30103.79 +1343.94 +(-1795.44 X 10^3)

Heat supplied by stem

HS = 1733923 K cal.

At 1 atm pressure 1kg steam = 644.89 Kcal.

Mass of steam = $\frac{HS}{644.89}$

M = $\frac{1733992.3}{644.89}$

=2688.8 Kg steam

Amount of steam required in reactor = 2688.8 Kg.

7.3 Energy Balance across crystallizer:-

Product (120^0C)
Cooling water (at 25^0C)

Cooling water

Out (35^0C)

Qso (Mother liquor + crystals) 40^0C

Let,

Heat loss by solution product Heat gain by water

MaCpT
McPwT

MS = Mass of solution Mc = Mass of Water

CP = Average SP. Heat CPW = specific heat of water

Of solution

Composition of product –

$ZnSO_4$ $7H_2O$ = 75%

H_2O = 1%

Zn = 20%

Impurities = 4%

Average specific heat of the outlet solution product –

CP = Xi Ci

= (xc) $ZnSO_4H_2O$ + (xc) Zn + H_2O + (xc) impurities

= (92.9 X 0.75) + (6.07 X 0.20) +

(6.17 X 0.04) + (18 X 0.01)

= 71.31

Average mol. Wt = (287.54 X 0.75) +(6.07 X 0.20)+

(18.20 X 0.01) + (87.96 X 0.04)

=232.42

Heat loss by product = Heat gain H_2O

$$\frac{1707.58}{232.42} \text{ X } 71.31\ (120-40) = M\ (18)\ (35-25)$$

Mass of water required M = 232.84 kg mole.

Pass of water requirement = 232.84 X 18.0 = 4191.29 kg

REACTOR DESIGN

8.1 Manufacturing of Zinc Sulphae:-

($ZnSO_4\ 7H_2O$) is batch process after 12 hours operation, the batch is drawn from reactor and then fed to next operation unit. The volume of reactor depends on the volume occupied by the mixture of batch.

Generally the material used for reactor is mild steel or low carbon steel coated with lead linings because $ZnSO_4\ 7H_2O$ solution is corrosive in nature.

During the reaction liquid head plus internal pressure act on the bottom head. Also the internal pressure and pressure due to gas formed during reaction act on the top head of reactor therefore torrispherical Head are used at top and bottom.

8.2 Volume of Reactor (minimum):-

Minimum volume of Reactor = (volume occupied by zinc ash)

+ (volume occupied by H_2SO_4)

+ (volume occupied by H_2O)

$$V = V_1 + V_2 + V_3$$

Total composition of raw material in $ZnSO_4 7H_2O$ production is –

	Reactant	Mass	Density (kg/m^3)
1)	Zinc ash	520	7450
2)	H_2SO_4	265	1831.8
3)	Water	530	1000

Volume is calculated by fallowing formula is –

$$\text{Volume} = \frac{\text{Mass}}{\text{Density}}$$

1) Volume of Zinc ash = $\frac{\text{Mass of Zinc Ash}}{\text{Density of Zinc Ash}}$

$$V_1 = \frac{M1}{D1} = \frac{520}{7450} = 0.0698 \text{ m3}$$

Volume of occupied by zinc = 0.0698 $m^{3.}$

2) Volume occupied by sulphuric acid –

Mass of H_2SO4

Volume of H_2SO_4 = ------------------------

Density of H_2SO_4

$$V_2 = \frac{M2}{D2} = \frac{265}{2831.8} = 0.1446\ m^3$$

$$=0.1446\ m^3$$

3) Volume occupied by water –

Mass of H_2O

Volume of H_2O = ----------------

Density of Water

$$V_3 = \frac{M3}{D3} = \frac{530}{1000} = 0.51m^3$$

$$= 0.51m^3$$

Therefore minimum volume of reactor-

$$V = V_1 + V_2 + V_3$$

$$=0.0698 + 0.1447 +0.53$$

$$= 0.7445m^3$$

To find out the volume of cylinder position –

According to designs criteria 20% extra.

Volume is provide in the cylindrical part of reactor –

∴ Volume of cylindrical part of vessel,

=(1.20) × minimum volume of rector

$$= 1.2 \times 0.7445$$

$$= 0.8934\ m^3$$

Thus,

1) Minimum volume of Reactor = 0.7445 m^3

Volume of cylinder portion of reactor = 0.90 m^3

8.3 To find out Diameter of Reactor:-

We will have to fix the length to diameter (L/D) ratio selecting the valve of L/D ratio such that it reduces the material lost and also increases the area available for heat transfer. We select this ratio as 1:5 therefore,

L = Length of cylindrical portion of reactor

D =Internal diameter of vessel.

$$L/D = 1.5$$

Diameter of Reactor can be find out from volume of reactor as we know.

Volume = (Area) × (Length)

Area of Reactor = 1.74 ×D^2

$$\therefore\ V = 1.74 \times D^2 \times L$$

$$0.90 = 1.74 \times D^3 \times (1.5)$$

$$D^3 = 0.764\ m^3$$

$$D = 0.914\ m \qquad = 0.92$$

As L = 1.5 D

$= 1.5 \times 0.92$ m

L = 1.38 m

8.3 Height:-

Bottom head used is torrispherical head.

Approximate volume of torrispherical head as per Brownell and young is –

$V = 0.000049\ D^3$

V = Volume in ft^3

D_1 = Internal diameter in inch

Where, V = 0.000049

$(3.28)\ V = 0.000049 \times \left[\frac{92}{2.54}\right]$

$V = 0.0659\ m^3$

Volume of torrispherical bottom = $0.0659\ m^3$

The height of cylinder

$$H = \frac{Volume\ of\ mixture - volume\ of\ torrispherical\ head}{area\ of\ cylinder}$$

$$H = \frac{0.7445 - 0.0659}{74 \times (0.92)2}$$

H = 1.02 m

$$\boxed{H = 1.02\ m}$$

8.5 To find Shell Thickness:-

Date:-

1. Internal Diameter of shell = 0.92m = 92 cm = 920 mm
2. Jacket internal Diameter = 1020 mm
3. Width of jacket = 50 mm
4. Internal pressure of vessel = 1 atm = 1.033 kg/cm^2
5. Pressure in jacket = 1.6362×10^5 N/m ^{2} at 144^0C
   Steam pressure from steam table = 1.66 of kg/ cm^2
6. Allowable stress = 950 kg/ cm^2
7. Young's modulus = (E) = 20 X 10 kg/cm^2

8.6 Thickness of Shell:-

$$Ts = \frac{PDi}{zfi - p}$$

Where,

Ts = thickness of shell

P = Internal design pressure.

$= 1.1 \times 1.033$

= 1.136 kg/cm^2.

D = Internal diameter of vessel.

F = Allowable stress.

J = Joint efficiency = 0.85

$$ts = \frac{1.136 \times 92}{2 \times 950 \times 0.85 - 1.136}$$

= 0.0648 cm = 0.640 mm

But for the satisfactory design, we take thickness as

4 mm ts = 4 mm

8.7 Thickness of Jacket:-

Internal design pressure, P = 1.1 × 1.688

= 1.835 kg/cm^3

$$tj = \frac{PDi}{2fi - P}$$

where,

tj = thickness of Jacket

P = Internal design pressure of jacket.

Di = Inside diameter of jacket

I = joint efficiency = 0.85

$$ti = \frac{1.835 \times 102.0}{2 \times 950 \times 0.85 - 1.835}$$

= 0.116 mm

But we use 3 mm thickness for satisfactory design.

COST ESTIMATION

12.1 Total income / sales :-

Total product 300 Tons / year
Sailing price Rs. 12.5 kg of product.
Total income = 30000 × 12.5
= 3750000

12.2 machinery and Equipment cost :-

Sr No	Equipment	No Equipment	Price	Total value
1.	Reactor	2	3,05,000	6,10,000
2.	Settling tank	3	24,000	72,000
3.	Filter paper	1	2,0,5000	2,05,000
4.	Evaporator	1	1,45,000	1,45,000
5.	Crystallizer	1	90,000	90,000
6.	Centrifuge	1	52,000	52,000
7.	Dryer	1	1,48,000	1,48,000
8.	Storage tank	1	17,000	17,000

9.	Boiler	1	1,24,000	1,24,000
10.	Centrifugal pump	2	1,750	3,500
11.	Motor (3 HP)	2	5,800	5,800
12.	Miscellaneous fixed cost			27,700
			TOTAL =	15,00,000

12.3 Fixed Capital cost = Direct cost + Indirect cost

- Direct cost:

Rs

1. Purchased equipment 15,00,000
2. Building 6,25,000
3. Site Development 10,000

4. Land (6% of equipments) 90,000 Total - 22,25,000

- Indirect cost:-

1. Engineering and supervision (8% Direct cost) 1,78,000
2. Construction expenses and contractors fees 89,000 (4% of direct cost)
3. Contingencies' 8,000

Total 2,75,000

Fixed Capital = Direct cost 22,25,000 + indirect cost 2,75,000

Total 25,00,000

12.4 Working Capital investment 1,10,000

12.5 Total capital investment

Fixed capital investment 25,00,000

\+ Working Capital Investment 1,10,000

Total 26,10,000

12.6 total product Cost:-

12.6.1. Manufacturing cost = Direct production cost + first Charges + Plant overhead

12.6.1.1 Direct Production Cost Rs / Year

1). Raw material 5,37,300

2). Personnel 2,14,560

3).Utilities 2,14,560

4).Maintenance & Repair 75,,000

5). Operating supplies 7,500 (10% maint. & Repairs)

6). Laboratory charges 10,728 (5% of personnel)

Total 11,07,888

12.6.1.2 Fixed Charges

1). Depreciation (10% Fixed Capital & Equipt) 1,50,000

(2% of buildings) 12,500

2). Local Taxes 2.5 % of fixed Capital 62,500

3). Insurance (0.5% on Fixed Capital) 12,500

Total 2,37,500

12.6.1.3 Plant Overhead

(50% of person eel, maint. & Repairs) 1,44,780

MFG. COST 11,07,888+2,37,500+1,44,780 =`14,90,168

- General Expenses –

	Administrative Cost (15% of personnel, maint.)	43,434
i	Distribution &selling cost	1,43,570
ii	R & D (2% sales)	75,000
i	Initial interest (10% of total capital)	2,61,000
	Total =	5,23,004
	Total product cost =	
	Manufacturing cost	14,90,168
	General Expenses	5,23,004
	Total =	20,13,172

12.7 Gross Earning:-

Total income	37,50,000
Total product cost	20,13,172
Total	17,36,828

12.8 net profit:-

Gross earning	17,36,828
Income Tax (48% ross earning)	8,33,675
Total	9,03,150

12.9 Pay back Period –(in years):-

$$= \frac{\text{Depreciable fixed capita}}{\text{Avg.profit per year} + \text{Avg.Depreciation per year}}$$

$$= \frac{25,00,000}{9,03,150+1,62,500}$$

= 2.34 years.

12.10 Break even point:-

At B.E.P. Total Product cost = total income

Total production cost / tone = $\frac{22,25,000}{37,50,000/300}$

= 178

Fixed charges + Overhead + General Express

= 9,05,284 + 178n = 300n

n = No. of units for B.E.P.

n = 7420 unit / year.

$$= \frac{n}{\text{Production cost/unit}}$$

$$= \frac{7420}{3,50,000\ /300}$$

= 59% of present plant operating capacity

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RESULT AND DISSCUSION

The cradle-to-gate life cycle inventories for selected flows associated with zinc concentrate and SHG zinc production are presented in Table 2. The table includes results for energy and elemental zinc as inputs and emissions to air and freshwater as outputs. Although not shown here, the study produced a full inventory of inputs and outputs, with flows corresponding to the international life cycle data system (ILCD). Zinc is a naturally occurring mineral. Zinc is important for growth and for the development and health of body tissues. Zinc sulfate is used to treat and to prevent zinc deficiency. Zinc sulfate may also be used for purposes not listed in this medication guide

Zinc sulfate is produced by treating virtually any zinc-containing material (metal, minerals, oxides) with sulfuric acid. Specific reactions include the reaction of the metal with aqueous sulfuric acid:

$$Zn + H_2SO_4 + 7\ H_2O \rightarrow ZnSO_4{\bullet}7H_2O +$$

Conclusions:-

To summarize all of the above research and literature, the key to successful Zn fertility is water-solubility. The water solubility of the Zn source will determine how effective it will be in meeting plant needs (Amrani et al, 1999; Gangloff et al, 2002; Mortvedt, 1992; Liscanso et al, 2000; Slaton et al, 2005; and Westfall et al, 2005). Water solubility allows the Zn to move short distances in the soil and to be absorbed by the plant roots from the soil. It has been shown that ZnEDTA is the most effective source of Zn on the market. When ZnEDTA was used as a reference material on a plant uptake basis by Gangloff et al (2002), ZnSO4 had a Relative Availability Coefficient (RAC) of 23%, followed by Zn lignosulfonate at 22%. All other sources are less effective with Zn oxysulfate compounds ranging from 0.5 to 12% and the organic complex Zn sucrate with an RAC of 5%. Therefore there is a significant difference between ZnEDTA and all other sources, no significant difference between ZnSO4 and Zn lignosulfonate, and a significant difference between the Zn oxysulfates and Zn sucrate when compared to all the other sources in plant uptake (Gangloff et al, 2002). Generally speaking, a Zn source must be 40-50% water-soluble to be an efficient Zn fertilizer (Amrani et al, 1999; Liscanso et al, 2000; and Slanton et al, 2005). Finally, any claims of RAC different from the above would go against decades of research and the physical principles that are known to govern Zn availability in the soil and to the plant. Concerning application methods, applying the above Zn sources alone as powders, granules, or in liquid solution or suspension to the soil in a broadcast or banded application and then incorporating them into the soil are effective means of Zn amendment.

As a general rule, broadcast applications usually call for 10 lbs. Zn/ac and band application or application of chelate sources usually require only 1/3 to 1/5 of that 11 Zn rate, but always base application rates on soil test Zn levels (Ext. Bull.

E-2567,Nov.2000 http://www.ag.ndsu.edu/pubs/plantsci/soilfert/sf882w.htm). Foliar and sidedressing methods are less effective (McNall, 1967) and seed as well as seedling treatments, which have seen little success (Rassmusen and Bowan, 1969 and Giordano and Mortvedt, 1973). It should be again emphasized that the only manners in which Zn fertilization rates can be reduced is through band applications or the application of a true chelate of Zn, such as ZnEDTA. When applying Zn with an NPK fertilizer for the convenience, consider the carrier. Nitrogen fertilizers affect Zn availability less than P fertilizers (Mortvedt and Giordano, 1969a). When powders of Zn are applied as a coating on an NPK granule there is little evidence to suggest that they would perform any better than a granule of Zn (Ellis et al, 1965 and Giordano and Mortvedt, 1972) because it is a matter of spatial distribution in the soil and not difference in water-solubility. Additionally, the pH of the fertilizer carrier should be between 4.6 and 6.1 for highest availability (Jackson et al, 1962). Also, liquid fertilizers have been shown to outperform solid carriers (Mortvedt and Giordano, 1967). If a solid carrier is used, ensure that the granule size is matched to the size of the NPK granule it will be applied with to avoid segregation during handling and application (Silverberg et al, 1972). Finally, consider the limited mobility of Zn in the soil (Giordano and Mortved

REFRERENCES

- Badger walter J. Banchero julis T, Introduction to Chemical Engineering, McGraw Hill interational book company page – 523 (1955)
- Bhatt B.I & vora S.M. stichometry, Tata McGraw Hill publishing Co., New Delhi, 2nd edition 106 – 109 P.P. 264 – 267 (1984).
- Chiltion C.H. cost Engineering in process industries, McGraw Hill Publication N.York P.P. 159 – 160.
- Hougen salf A, Waston Kenneth M, Ragate Roland A, ChemicalProcess Engineering principles Jhon Wiely &Sons, 2nd edition, P.P. 196 – 238
- Kirk – othmer,encyclopedia of chemical technology,john wiely& sons3rd edition vo.1 p.p.171-174 (1978)
- Mckatta jhon J.encyclopedia of chemical processing &design Marcle Dekker,Inc vol.1 P.P.209-226(1981).
- Peater Max S. Timmehars Klans D., Plant design & economic for chemical engineering's. McGraw Hill Book Co., 3rdedition, P.P.61, 147, 171 (1981).
- Mellar, 'Comprehensive treatise on inorganic and theoretical chemistry – 4 P. P. 56-58 (1975).
- Hand book of industrial chemicals by SIRI Board of consultant & Engineerings P.P. 172 – 173 (1985).
- Bhattacharyya B.C. chemical equipment design, (BC Publishers & Distributors P.P.. 172 – 173 (1985).

- Brownell E. young Edwin H, Process equipment design, wiely Eastern Ltd., P 76-79 (1985)

- M.V. Joshi process equipment design, Mc-million Indian Ltd. 2nd edition P.P. 209 – 226 *(1981)*