

PRE-FEASIBILITY REPORT FOR THE PRODUCTION OF MAGNESIUM SULPHATE FROM MAGNESITE ORE

Name of the R&D Organization: PCSIR Laboratories Complex, Peshawar.
Name of contact person: Ms Shagufta Nasreen
Designation: Principal Scientific Officer
Address: PCSIR Laboratories Complex, Peshawar.
Phone: 091-9216240-42
Fax: 091-9216232
Mobile: -
Email shnasreen@yahoo.com

1. Introduction of Technology/Process/Product

Name of Technology/Process/Product:

Production of Magnesium Sulphate from Magnesite Ore

Summary:

Epsom salt or hydrous magnesium sulphate, a colorless to white, bitter tasting material occurring in a sparkling needle shaped crystals used extensively as an important industrial and agricultural chemical. Presently it is imported and a valuable foreign exchange is being spent on its import in spite of the fact that huge deposits of its raw material, i.e. magnesite ore are present in Pakistan.

A process has been developed to manufacture $MgSO_4 \cdot 7H_2O$ (Epsom salt) from Abbotabad Magnesite ore and commercial sulfuric acid. The prepared hydrous magnesium sulphate is 98.15% pure and is comparable with the A.R. grade, Epsom salt available in the market.

Project brief (*Local/International Perspective*)

Due to industrial growth of the country, demand of magnesium sulphate is increasing which is met through import. In 2008-2009, about 600 ton of Epsom salt was imported at the cost of Rs.300.00 million.

In order to save the valuable foreign exchange and to enhance the value added utilization of the mineral resources of the country, a process for the production of Epsom salt has been developed, which if, commercialized will surely be beneficial to both social and economic sectors of the country.

2. Main Parameters of Technology/Process/Product

Main Feature:

- Formula MgSO₄.7 H₂O
- Molecular weight 246.48
- Appearance Transparent crystal or white powder
- Odor Odorless
- Solubility Very soluble in water
- Hardness 2-2.5
- Density 1.67 g/ml
- pH 5.5

Input (Raw materials with specifications)

Magnesite ore:

SiO ₂	0.35%
Fe ₂ O ₃	0.30%
Al ₂ O ₃	0.39%
CaO	1.22%
MgO	44.62%
Na ₂ O	1.70%
K ₂ O	0.45%
Moisture	0.28%
<u>Loss on ignition</u>	<u>50.60%</u>
<u>Total</u>	<u>99.91%</u>

Sulphuric acid:

Commercial grade	
Purity:	98.00 %
Sp.gravity:	9.80

Output (Products, byproducts with specifications)

Product: Magnesium sulphate heptahydrate crystal ($\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$)

Parameter	Specifications
Insoluble matter	Traces
Fe_2O_3	0.05 %
CaO	0.35 %
MgO	16.43 %
SO_3	31.65 %
Cl	0.26 %
As	0.37 ppb*
H_2O	50.10 %
Yield	84.00 %

*ppb: parts per billion

Purity 97.30 %

Byproduct: Nil

Applications/Uses

1. Used in craft pulp bleaching process
2. Nourishing additive in cattle feed, fertilizer and other agricultural applications
3. Enriches outdoor lawns by increasing its chlorophyll content and improving its ability to synthesize food
4. Magnesium sulphate is a safe way to remove splinters and treat infections, insect bites, scraps and poison ivy
5. It is also used in leather industry/ tannery as a weighting agent and filler in the production of sole leather
6. It is also used for the manufacturing of high fructose products in food industry
7. In textile industries, magnesium sulphate is used as a bleach stabilizer for cloth; conditioning agent for cotton and wool, fixing agent or mordant in the dyeing of wool, antifelting agent for wool, spinning bath additive for rayon to produce a softer more silky fabric with less luster and to give fabric weight and body.
8. It is also used for titanium dioxide production, zinc processing, metal plating, latex & rubber processing, manufacturing of ABS resin, explosives, soap /detergents and in many other chemical industries. The less pure material is used extensively as sizing and as a fireproofing agent.

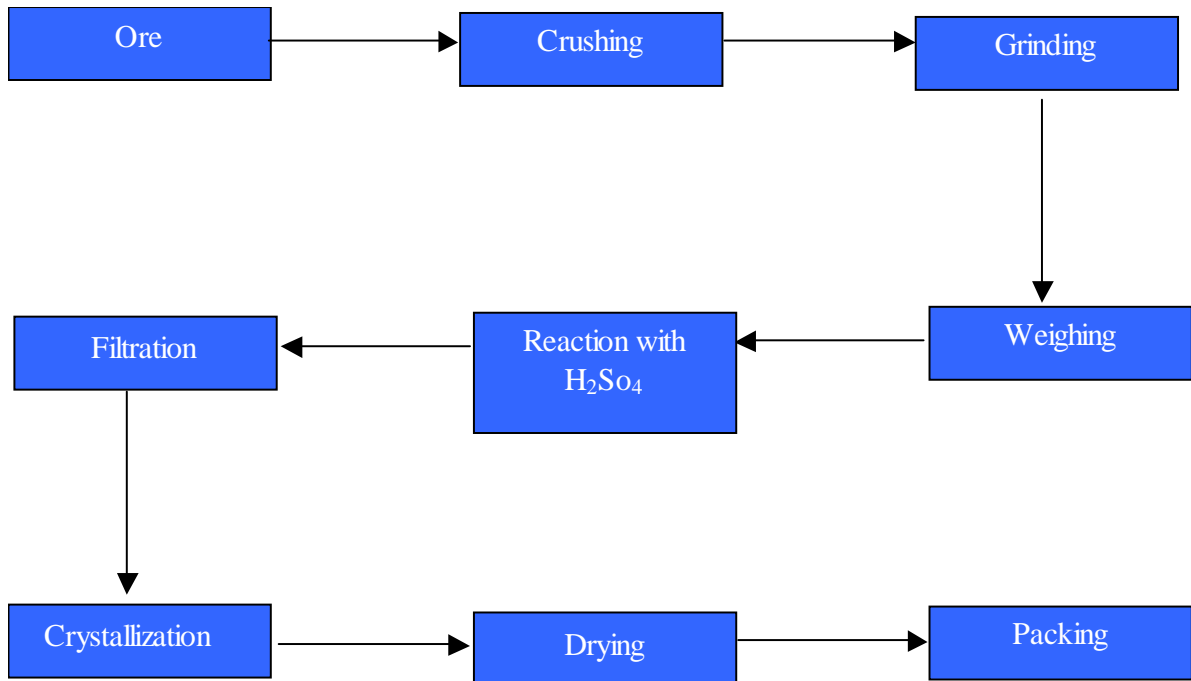
Trial Results:

Successful

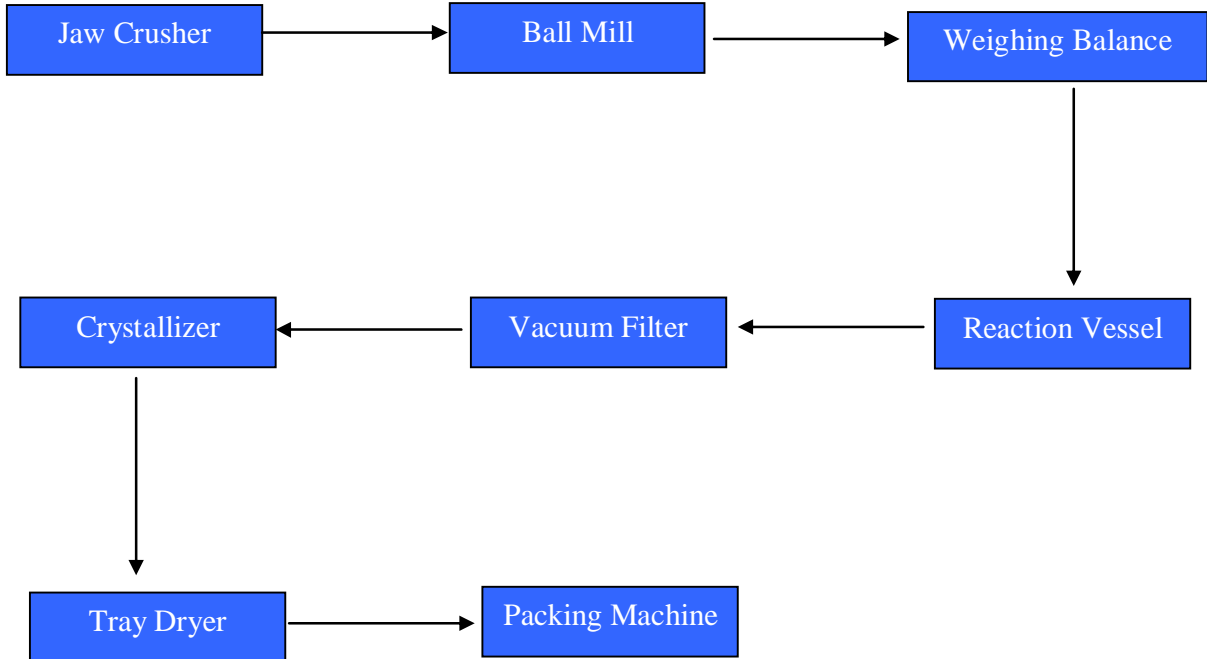
Technical Data (*Proposed capacity, Production time per batch, Packing size*):

- Proposed capacity: 1000 kg/ shift (8 hr)
- Production time per batch: 4 hrs
- Packing size: 1kg

Production Process/Flow diagram:



Equipment Layout diagram:



Machinery required with specifications:

S. No	Item	Description	Qty	Cost (Million Rs.)
1.	Jaw crusher	Capacity: 500 kg/hr Feed size: 2 –10 inches Product size: less than 250 mm	01	0.70
2.	Ball mill/Grinder	Capacity: 500 kg/hr	01	0.70
3.	Balance	200 kg	01	0.01
4.	Reaction vessel	800 liter	01	1.0
5.	Filtration unit	800 liter /hr	01	0.60
6.	Open pan Crystallizer/Evaporator	800 liter	02	0.60
7.	Tray dryer	500 kg	01	1.00
8.	Packing Machine	Automatic or semi automatic Packing size of product: 1 kg		0.40
9.	Storage tank	500 liter	02	0.50
10.	Pumps, burners etc	-	04	0.10
11.	Miscellaneous items including office equipment, spares, accessories, tools etc	-	-	0.50
			Total	6.11

Standard specifications & test methods:

Standard specifications	Test methods
MgO, SO ₃ , Cl	Standard Methods of Chemical Analysis by W.W SCOT and W. H FURMAN
Arsenic	Atomic Absorption spectrophotometry
pH	Digital pH meter

Quality control equipment with specifications:

S. No	Item	Quantity	Cost (Million Rs.)
1.	Oven (temperature upto 300 °C)	01	0.50
2.	Specific gravity measurement apparatus	01	0.20
3.	Furnace (temperature upto 1400 °C)	01	0.50
4.	Digital balance (digital)	01	0.15
5.	pH meter (digital)	01	0.20
6.	Glassware and chemicals	-	0.50
Workshop Item			
7.	Transformer and generator	01 each	2.00
8.	Lath Machine	01	0.40
9.	Welding Plant	01	0.10
10.	Cutting Machine (fixed and movable)	01 each	0.10
11.	Drill Machine (fixed and movable)	01 each	0.20
Total			4.85

Environmental impact:

Magnesium sulphate is an environmentally safe chemical. It is not hazardous to environment but it is harmful if swallowed.

Potential health effects:

Inhalation: Dust may cause slightly irritating sore throat or coughing.
Skin contact: No adverse effect on skin may cause minor skin irritation
Eye contact: No adverse effect, dust may cause mechanical irritation

Availability of technical support:

Available

Availability of Brochures/Pamphlets:

Available

Status of registration/Patent/Trade Mark:

Nil

3. Estimation of Fixed Capital Investment (PKR)

Land:

Area required: 0.25 acre (land cost is varied depend upon the area)

Building:

Rs. 10.00 million

Furniture and Fixture:

Rs. 0.25 million

Plant & Machinery:

Sr. No	Description	Cost (In million Rs)
1.	Machinery/Equipment	6.11
2.	Installation and Erection cost @ 6%	0.36
3.	Piping cost @ 2 %	0.12
4.	Instrumentation and Control @ 5 %	0.30
5.	Services facilities including designing, consultancies etc @ 5 %	0.30
6.	Transformer, generator, quality control and mini workshop equipment	4.85
	Total	12.04

Technology Transfer Fee:

Rs. 5.00 million

Total Fixed Cost of the Project:

Sr. No	Description	Cost (In million Rs)
1.	Land (when land is available)	-
2.	Building	10.00
3.	Furniture and fittings	0.25
4.	Plant & Machinery	12.04
<i>Total Fixed cost of the Project</i>		22.29

Total Project Cost

Sr. No	Description	Cost (In million Rs)
1.	Total Fixed cost of the Project	22.29
2.	Working capital	2.25
	<i>Total Project Cost (excluding land)</i>	24.54

4. Marketing Aspects:**Total industry and annual growth:**

Nil

Current demand:

600 ton/year

Local production facilities:

Nil

Imports:

Rs. 300.00 million per year

Major users:

Textile, paper, tannery, leather, food and chemical industries

Marketing strategy:

- Supply of samples to SMEDA for marketing
- Distribution of brochures among stakeholders
- Display of the samples at various chambers of commerce and industry
- Publicity through electronic and print media
- Holding of seminars and exhibitions

5. Details of Cost:

Sr. No	Description	Cost (Rs)
1.	Direct Production Cost	30/kg
2.	Raw materials cost per unit	20/kg
3.	Direct wages cost per unit	Nil
4.	Production overheads cost per unit	1.40/kg
5.	Manpower including expenses (admin, selling, salaries and benefits)	175,000/month
6.	Utilities charges per month	75,000/month
7.	Communication expenses per month	5,000/month
8.	Other expenses per month (depreciation)	50,000/month
9.	Publicity, advertisement and packing expenses per month	25,000/month