PROJECT PROFILE

ON

COPPER SULPHATE

MONTH & YEAR
JULY 2011

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This publication is supported by

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COPPER SULPHATE

A.INTRODUCTION

Copper Sulphate appears as a crystalline substance, blue in colour and soluble in water.

On heating, it loses its water of crystallization finally giving a white powder, which regains its blue colour when moistened with a drop of water.

B. PRODUCT USES & SPECIFICATIONS

General details

Copper Sulphate finds application for Agriculture and Industrial purposes.

Grade	**Nature of use**
Technical (Tech) grade	Used in dyeing cotton and silk, preserving hides and woods, tanning leather, electric batteries, process engraving, destroying algae in pools, rot proofing of jute product, manufacture if green and blue pigments and fungicides (Bordeaux mixture).
Pure grade	Used in fine chemicals.

Agricultural Use.

Copper Sulphate is used as a fungicide. It is mixed with lime to give Bordeaux mixture which is used for spraying, potatoes etc.

The salt most commonly used as a fungicide is Copper Sulphate, often called “blue vitriol”, which is the chief component in such preparations

as Bordeaux and Burgundy mixtures. Copper Sulphate is sometimes used alone as a winter spray for trees, for the destruction of weeds or algae in ponds, and for killing snails in USA and Europe. Other copper compounds used as fungicides, but to as much smaller extent, include the carbonate, acetate, some cupro-ammonium compounds and cuprous oxide.

Most copper fungicides have but little effect alone on insect life, but copper acetoarsenite (known as Paris green, emerald green or schweinfurter green) is probably the most useful for this purpose. It is prepared by boiling together suspensions of white arsenic and basic copper acetate with a little acetic acid. Although Paris green is not now so widely used as an insecticides as formerly, it is very useful for the destruction of mosquito larve in stagnant pools. It is also used as poison bait for slugs and leather jackets.

Industrial Uses

Copper sulphate is used by mining companies in flotation processes, particularly for treating lead-zinc and gold ores. It is also used in some textile dyeing processess, in the manufacture of certain types of rayon fibres, in leather dressing, as a preservative for timber and in anti-fouling paints.

Copper Sulphate is also used in electroplating, electrotyping and electro refining of copper. It is also used in dyeing and calico-printing.

Other applications include in medicine and in the laboratory, for preparation of other copper compounds, detecting water and in the preparation of absolute alcohol.

Specification

Characteristics	Technical grade	Pure grade
Copper, percent by mass, Min.	24.7	25.1
Matter insoluble in water, percent by mass, Max	0.20	0.05
Soluble iron and aluminium compounds (as Fe), percent by mass, Max	0.30	0.15
pH value, not less than	3.0	3.5
Chloride (as Cl), percent by mass, Max.	-	0.01
Arsenic (as AS_2O_3), mg/kg, Max.	-	10.0
Lead and Zinc	-	to pass the test

C. MARKET POTENTIAL

Agriculture is the lynchpin of the Indian economy. Ensuring food security for more than 1.2 bn Indian population with diminishing cultivable land resource is a herculean task. This necessitates use of high yielding variety of seeds, balance use of fertilisers, judicious use of quality pesticides along with education to farmers and the use of modern farming techniques.

The production of Indian pesticides industry has almost remained stable at 85,000 MT during FY08-09. In value terms, the size of the Indian pesticide industry was estimated at Rs.98 bn for 2008, including exports of Rs.48 bn.

Per hectare consumption of pesticide is low in India at 381 grams when compared to the world average of 500 grams. Low consumption can be attributed to fragmented land holdings, lower level of irrigation, dependence on monsoons, low awareness among farmers about the benefits of usage of pesticides etc. India, being a tropical country, the consumption pattern is also more skewed towards insecticides which accounted for 62% of the total pesticide consumption in FY08. Rice is the highest pesticides consuming crop. Of the total pesticides consumption, 25.9% is consumed by rice. Andhra Pradesh is the highest pesticides consuming state (23%) followed by Punjab & Maharashtra.

India due to its inherent strength of low-cost manufacturing and qualified low-cost manpower is a net exporter of pesticides to countries such as USA and some European & African countries. Exports formed 49.5% of total industry turnover in FY08 and have grown at a Compounded Annual Growth Rate (CAGR) of 29.05% from FY04 to FY08.

Copper sulphate is a very versatile chemical with as extensive a range of uses in industry as it has in agriculture. It is generally used as insecticide in agriculture & wood industry. Up to a generation or so ago about its only uses in industry were as a mordant for dyeing and for electroplating, but today it is being used in many industrial processes. The synthetic fibre industry employs it in the production of their raw material. The metal industry uses large quantities of copper sulphate as an electrolyte in copper refining, for copper coating steel wire prior to wire drawing and in various copper plating processes. The mining industry has found its application as an activator in the concentration by froth flotation of lead, zinc, cobalt and gold ores. The printing trade takes it as an electrolyte in the production of electrotype and as an etching agent for process engraving. The paint industry uses it in anti-fouling paints and it plays a part in the coloring of glass. These are just some of

the examples of usages of copper sulphate. Today there is hardly an industry that does not have some small use for this man-made chemical.

Fungicide sector

Of the 70,000 tonnes per annum copper in compounds used in agriculture, almost 75% is used in the control of fungi. The first reference to the use of copper as a fungicide dates to 1761 (83) where copper sulphate was used on wheat seed for the control of bunt. In 1807 (84) the discovery of copper as fungicide was made and the discovery of Bourdeaux mixture (Copper Sulphate plus lime) followed in 1882.

In order for copper to have any persistence as foliar fungicide, it must be rendered insoluble so that it would not be washed off the leaf surface during rainfall. Copper compounds have been used successfully since the latter 1880s on fruit, vegetables, nut crops, and ornamentals. Copper is an effective broad-spectrum fungicide, although its action is more prophylatic in nature.

Whereas copper is not as effective as some organics against specific pathogens, pathogen resistance to copper has been minimal in the >100 year usage. Many organic fungicides are used less often then copper compounds because of residue tolerance, or for regulatory reasons. Use of copper compounds as fungicides has seen a resurgence in the latter part of the twentieth century.

Plant and Animal Nutrient Copper is one of seven micronutrients that has been identified as essential to the proper growth of plants. Cereal crops are by far the most affected by copper deficiency. Greenhouse studies have shown yield increases from 38% to over 50% for wheat, barley, and oats using copper supplementation. A tenfold increase in the yield of oats was reported in France. Symptoms of copper deficiency vary

depending on species, but often it is accompanied by withering or chlorosis in the leaves that is not amenable to iron supplementation. In high concentrations, particularly in low pH soils, copper can be toxic to plants.

Copper sulphate is by far the most common algaecide. Other copper-containing algaecides for use in domestic applications such as swimming pools are usually chelated to prevent hydrolysis and precipitation of the copper.

Bordeaux mixture

Alternate names Bordeaux mixture is an aqueous suspension of flocculant, blue, slowly settling amorphous precipitate possessing great tenacity when freshly prepared. It is mainly used on crop plants at stages of growth freshly prepared. It is mainly used on crop plants at stages of growth on which its phytotoxic action is small.

It consists of basic Copper Sulphate with an admixture of gypsum. It is prepared from Copper Sulphate and hydrated lime. The quality of the mixture depends on the concentration of the solutions of Copper Sulphate and lime milk taken for its preparation, and also on the way of mixing. It is important that the Copper Sulphate react with the lime in an alkaline medium. In this case, mainly finely dispersed particles (3-4 um) of basic Copper Sulphate are formed.

$$4CuSO_4 + 3Ca(OH)_2 = CuSO_4.3Cu(OH)_2 + 3CaSO_4$$

Such a suspension is sufficiently stable, has good adhesiveness and tenacity on the surface of plants, and a high fungicidal activity. Bordeaux

mixture is used in concentrations of 1-4% at a rate of from 600 to 1200 litre/ha (the Copper Sulphate is used at a rate of 6-60 kg/ha).

Dyestuff sector

Coppre Sulphate is used in some textile dyeing processess.

Mineral flotation

Copper sulphate is used by mining companies in flotation processes, particularly for treating lead-zinc and gold ores.

Pharmaceutical sector

Copper sulphate is used in the pharma industry.

Consolidated sectorwise demand for Copper sulphate

Sector	Demand in tonnes per annum
Fungicide	9000
Dyestuff	2500
Mineral flotation	2000
Pharmaceutical	800
Total	13300

Growth rate in demand

Considering the above figures, the average growth rate in demand Copper Sulphate can be considered as follows.

The major demand for Copper Sulphate is as an agrochemical. However, there is substitution feasibility for the product particularly with copper oxy chloride.

Any increased demand would take place due to greater level of usage of product by more application and not necessarily by more area of crop. Under the circumstances, the compounded growth in demand for micronutrients can be considered to be in the region of 5-6% per annum, on an average

Agrochemical industry	5 to 6% per annum
Other miscellaneous sector	10 to11% per annum

D.TECHNICAL ASPECTS

1. INSTALLED CAPACITY

The production capacity of Copper Sulphate is estimated at 1 Tonne per day on 3 shift basis and the capacity for the year is calculated at 300 Tonnes.

2. PLANT & MACHINERY

Steel reactors equipped with a reflux condenser and jacket for steam heating.
Air circulated steam heated coiled tray drier, with vacuum drying system.
Demineralised water plant
Storage tanks
Boiler
Filtration unit
Pulveriser

Laboratory equipments (Spectrophotometer, Thin layer chromatography Centrifuge, oven and other laboratory glassware and equipments
Pollution control equipment

The machines are variable at a cost of about Rs.55.00 lakhs on turnkey basis.

3. MANUFACTURING PROCESS

So far, Copper Sulphate has been manufactured by and large from copper scrap only. Recently its production has started also from and indigenously available ore, namely, Chalcopyrite. While preparing this revision it has been ensured that specification fir technology grade of the material would apply also to Copper Sulphate produced from Chalcopyrite.

Copper sulphate is prepared by spraying dilute Sulphuric acid on copper scrap or turnings placed in a reactor, while a current of air is passed up from below

The dilute solution is re-circulated until a sufficient concentrations of Copper sulphate is obtained

$2Cu + 2H_2SO_4 + O_2 \text{ ----------} \rightarrow \square\ 2CuSO_4 + 2H_2O$

Copper scrap would be reacted with sulphuric acid at strength of around 70% in a lead lined reactor. The reactor would be cylindrical, vertical tank with conical bottom and flat top provided with paddle type of agitator.

The reaction would be yield Copper Sulphate heptahydrate.

After the reaction, the solution would be subjected to the filtration to remove the unreacted copper scrap material.

The solution then would be the subjected to evaporation in the oper reactor, when the Copper Sulphate heptahydrate crystal would be formed. The crystal would be separated from the solution by filtration to produce the finished product.

4. RAW MATERIAL REQUIREMENTS AND AVAILABILITY

Raw Material requirements

Basis: One tonne of Copper Sulphate heptahydrate. CuSO4 5H2O

Sulphuric acid (98%): 0.420 tonne

Copper scrap : 0.290 tonne

Production – Per annum 300 MTs

Raw material required

	Per MT	Qty MTs	Rate Rs	Value Rs lakhs
Sulphuric acid	0.42	126	22500	28.35
Copper scrap	0.29	87	410000	356.70
Water	2500.00	750000	0.10	0.75
				385.80

5. LAND AND BUILDING

Land requirement-Half an acre –Cost Rs.5.00 lakhs

Building area required-3000 sq.ft cost Rs.24.00 lakhs

6. UTILITY

Power:

The total power requirement of the unit will be 75 H.P.

Fuel: 80 litres per day

Water:

Water: 2500 litres per tonne

Man Power Requirement:

Category	Nos.	Monthly Salary	Total monthly Salary
Supervisor	3	9000	27000
Skilled	3	7000	21000
Helpers	6	5000	30000
Clerk	2	6000	12000
			90000
Add : Benefits	20%		18000
Total			108000

Total wages per annum [Rs.lakhs] Rs.12.96 lakhs

7. IMPLEMENTATION SCHEDULE

After making arrangement for the finance the project can be implemented in six months period.

8. ASSUMPTIONS

Installed capacity per annum	Copper sulphate-300MTs per annum
Capacity utilization-Year -1	60%
Year-2	70%
Year-3	80%
Selling price per unit	Rs.170000 per MT
Raw materials at 100%	Rs.385.80 lakhs
Consumables /Packing materials	Rs.2200 per MT
Power and Fuel-100% (Rs.lakhs)	Rs.24.85 lakhs at 100%
Wages & salaries -100% (Rs.lakhs)	Rs.12.96 lakhs
Repairs & Maintenance- p.m.	Rs.20000
Depreciation	Written down value method
General & administration Expenses per month	Rs.30000
Selling expenses	3% on sales value
Interest on term loan and Working capital finance	14% per annum
Income tax provision	34 % on profit

LIST OF MACHINERY SUPPLIERS

Reactors	Chemitherm Plants & Systems P. Ltd., 30, Anandha Street Alwarpet, Chennai-600 018 Texel Fabricators Pvt. Ltd., 335, Sidco Industrial Estate,

	Ambattur, Chennai-600 098, Tamil Nadu
Evaporator	Excel Industrial Services White House, D-111/8,Ist Main Road, Anna Nagar (East), Chennai-600 102 Alfa Laval Saunders (India) Ltd., No.18, Gill Nagar, Fist Street Chennai-600 094
Centrifuge	Hydrabad Met Chem. Pvt. Ltd., 34, C.I.E., Phase II, Gandhinagar, Opp. IDPL Colony Hyderabad-500 037 Spark Engineers Pvt. Ltd., 5/332, State Bank Colony II, Salem-636 004
Air compressors	ELGI Equipments Ltd., Elgi Industrial Complex III, Trichy Road, Singanallur, Coimbatore-641 005 K.G. Khosla Compressors Ltd., 19.8 KMS, Delhi-Mathura Road, Faridabad-121 003, Haryana Kaeser Kompressoren India 9 & 10, Symphony `C' Bldg.,

	Range Hill Road Shivaji Nagar, Pune-411 020 V.P. Engineering Plot No.25/8, MIDC, Opp. Hindustan Petroleum, Turbhe, Navi Mumbai-400 705
Crystalliser	Febchem Engineering Works Plot No.A/2, Sector A, Sanwer Road, Industrial Area, Indore – 452 003 Kalina Engineering Pvt. Ltd., 34, Surya Kirti Industrial Estate, No.2, Village Ghokiware, Chinch Pada, Vasai (E), Dist. Thane

LIST OF RAW MATERIAL SUPPLIERS

Copper scrap can be procured from copper scrap dealer

Name of the raw material	Name of the producer
Sulphuric acid	EID Parry (India) Ltd., Tamil Nadu Tanfac Ltd., Cuddalore, Tamil Nadu

FINANCIAL ASPECTS

1. COST OF PROJECT

	[Rs.lakhs]
Land	5.00
Building	24.00
Plant & Machinery	55.00
Technical know how fees	1.50
Other Misc. assets	5.00
Pre-Operative expenses	15.00
Margin for WC	9.30
	114.80

2. MEANS OF FINANCE

Capital	51.80
Term Loan	63.00
	114.80

3. COST OF PRODUCTION & PROFITABILITY STATEMENT

[Rs.lakhs]

Years	1	2	3
Installed Capacity (MT)	300	300	300
Utilisation	60%	70%	80%
Production/Sales (MT)	180	210	240
Selling Price per MT	Rs.170,000		
Sales Value (Rs.lakhs)	**306.00**	**357.00**	**408.00**
Raw Materials	231.48	270.06	308.64
Packing materials	3.96	4.62	5.28
Power & fuel	14.91	17.40	19.88
Wages & Salaries	12.96	13.61	14.29

Repairs & Maintenance	2.40	2.64	2.90
Depreciation	8.98	7.65	6.53
Cost of Production	274.69	315.98	357.52
Admin. & General expenses	3.60	3.78	3.97
Selling expenses	9.18	7.14	8.16
Interest on Term Loan	8.82	7.72	5.51
Interest on Working Capital	5.84	5.84	5.84
Total	302.13	340.46	381.00
Profit Before Tax	3.87	16.54	27.00
Provision for tax	1.32	5.62	9.18
Profit After Tax	**2.55**	**10.92**	**17.82**
Add: Depreciation	8.98	7.65	6.53
Cash Accruals	11.53	18.57	24.35

4. WORKING CAPITAL:

	Months Consumptions	Values	%	Margin Amount	Bank Finance
Raw Materials	1.00	19.29	25%	4.82	14.47
Finished goods	0.25	5.72	25%	1.43	4.29
Debtors	1.00	25.50	10%	2.55	22.95
Expenses	1.00	0.50	100%	0.50	0.00
		51.01		9.30	41.71

5. PROFITABILITY RATIOS BASED ON 80% UTILISATION

Profit after Tax / Sales	=	17.82 / 408.00	4%
Profit before Interest and Tax / Total Investment	=	38.35 / 156.51	25%
Profit after Tax / Promoters Capital	=	17.82 / 51.80	34%

6. BREAK EVEN LEVEL

Fixed Cost (FC):

	[Rs.lakhs]
Wages & Salaries	14.29
Repairs & Maintenance	2.90
Depreciation	6.53
Admin. & General expenses	3.97
Interest on TL	5.51
	33.20

Profit Before Tax (P) 27.00

$$BEL = \frac{FC \times 100}{FC + P} = \frac{33.20}{60.20} \times \frac{80}{100} \times 100$$

44% of installed capacity