

Sodium Silicate

PRODUCT CODE	: 31337
QUALITY AND STANDARDS	: IS 381:1995 IS 6773:1978 IS 9601:1980
PRODUCTION CAPACITY	: Quantity: 2600 tonnes (per annum) Value : Rs. 1,23,50,000 (per annum)
MONTH AND YEAR OF PREPARATION	: March, 2003
PREPARED BY	: Small Industries Service Institute Rajajinagar Industrial Estate, Bangalore-560 044 Phone Nos.: 080-3351581, 3351582 Telex: 0845-2328 Fax: 080-3351583 E-mail: sisibng@bgl.vsnl.net.in

INTRODUCTION

Sodium Silicate is a colourless compound of oxides of sodium and silica. It has a range of chemical formula varying in sodium oxide (Na_2O) and silicon dioxide or silica (SiO_2) contents or ratios. It is soluble in water and it is prepared by reacting silica sand and sodium carbonate at a high temperature ranging from 1200 to 1400°C. Aqueous solution of sodium silicate is called water glass.

Sodium silicates are produced in the form of a variety of compounds ranging from $\text{Na}_2\text{O}.4\text{SiO}_2$ to $2\text{Na}_2\text{O}.\text{SiO}_2$ by properly proportioning the reactants. Sodium silicates varying in ratio from $\text{Na}_2\text{O}.1.6\text{SiO}_2$ to $\text{Na}_2\text{O}.4\text{SiO}_2$ are known

as colloidal silicates. These are sold as 20% to 50% aqueous solutions called water glass.

Sodium metasilicate has the ratio of $\text{Na}_2\text{O}.\text{SiO}_2$ and is a definite crystalline compound, which forms various hydrates. Substances having higher sodium oxide content are sodium squisilicate $1.5\text{Na}_2\text{O}.\text{SiO}_2$ and sodium orthosilicate $2\text{Na}_2\text{O}.\text{SiO}_2$. The more alkaline silicates including sodium metasilicate ($\text{Na}_2\text{O}.\text{SiO}_2$) are crystalline materials with definite structures and characteristic properties. These are used chiefly as cleaners and detergents. The more siliceous sodium silicates are glasses, typical non-crystalline solid solutions, which are important mostly for their adhesive and binding properties.

MARKET POTENTIAL

Sodium Silicate is used in soaps detergents and in the manufacture of silica gel. It is used as a cement, binder, filler and adhesive. And also used as a wall coating, in concrete, fire proofing material and as a sealant. It is also used to preserve eggs and wood. Sodium Silicate also finds use in textile and pharmaceutical industries. Neutral sodium silicate in liquid form is suitable for use in pharmaceutical and toilet preparations.

Sodium silicates of certain ratios are used for application over concrete floors for hardening making dustless concrete floors and protecting pervious building materials against the effects of moisture. Sodium silicate is also used in foundries and welding electrode industries.

In ceramic industries, sodium silicate is used as a deflocculant in the preparation of casting slips for keeping solid particles in suspension without settling. Sodium silicate is used in refractories industries as an air-setting bond for manufacturing refractory cements and mortars. In vitreous enamel industries, it is used for cleaning the metal, known as pickling, prior to enamelling.

BASIS AND PRESUMPTIONS

Efficiency: Since manufacture of Sodium silicate is a continuous process, it is envisaged that the unit will run 3 shifts a day continuously for 25 days in a month or 300 days in a year. 75 percent efficiency of machinery and manpower is considered.

Time Period: Full capacity utilization is expected to be achieved within 12

months of commencement of commercial production.

Labour Wages: Minimum applicable wages is considered.

Interest Rate: An interest rate of 14% per annum on the total capital investment has been considered.

Margin Money: Promoter is expected to bring in one-third of the total capital investment.

Pay Back Period: The project will have a payback period of about 4 years.

Land and Construction Costs: Land cost is considered at Rs. 250 per square metre, and Construction cost for office and stores at Rs. 2000 per square metre, and work shed at Rs. 1250 per square metre.

IMPLEMENTATION SCHEDULE

Sl. No.	Activity	Period (in months)
1.	Preparation of the project report, selection of site, provisional registration from DIC, availability of finance	3
2.	Construction of building, procurement of machinery and equipment availability of electrical power	4
3.	Erection and Commissioning, recruitment of manpower, trial runs and commencement of commercial production	2
	Total implementation period	9

TECHNICAL ASPECTS

Process of Manufacture

Silica sand and Sodium carbonate are the two principal raw materials used in the manufacture of sodium silicate. The proportions of these two raw materials will vary depending on the ratio of Na_2O and SiO_2 required in the final product. Processed quartz with a particle size distribution of -20 and +80 BS Sieve can also be used in place of natural silica sand. Sodium carbonate, also called soda ash, is available in two forms: dense and light. Only dense variety of sodium carbonate is used for manufacture of sodium silicate.

The raw materials are charged from a charging end, which is called a dog house, into a continuous glass-melting furnace operated at 1200°C to 1400°C . The exact melting temperature will depend on the batch constituents. There will be weight loss of approximately 10% in the weight of the charge to the weight of finished fused melt drawn from the furnace due to loss of gases and volatilization of alkali oxides.

The fused melt is drawn from the discharging end of the furnace continuously or periodically as a thin stream. This melt will be solidified by passage into a moving chilled conveyor of steel moulds, in which the melt cools to a semi-transparent solid.

If the hot melt is sprayed with a stream of cold water, it is shattered into fragments. The fragments are either charged into grinding and screening equipment to yield solid sodium silicate (granular) or are passed into a rotary dissolver. In the rotary dissolver, the solid material is dissolved by superheated (80 psi) steam.

Alternatively, the fused melt is directly passed into water, in which it is dissolved with steam. The resulting solution is clarified by settling in a tank and is adjusted to the desired specific gravity. Specific gravity of sodium silicates range from 22 to 69 Be with 40 Be being the most common.

Dry, powdered sodium silicates may be produced by taking liquors of proper specific gravity and forcing them through a very fine opening into a solidification chamber. The chamber is swept by a rapid current of cold air, which carries off the moisture. The desired sodium silicate is obtained by varying the ratio of the raw materials charged as well as the working up of proper solution.

Quality Control and Standards

a) Indian Standard Specifications

The Bureau of Indian Standards has published the following Indian Standard Specifications for Sodium silicate based on its use in various industries:

- i. IS 381:1995: Sodium silicate (Second Revision).
- ii. IS 6773:1978: Sodium silicate for use in foundries (First Revision) Re-affirmed 1991.
- iii. IS 9601:1980: Sodium silicate for cosmetic industries (Amendment No. 1) Re-affirmed 1991.
- iv. IS 14212:1995: Methods of test for sodium silicate and potassium silicates.

b) Grades and Types of Sodium Silicate

According to IS 381, both the solid and liquid form of sodium silicate are of two grades: (a) Neutral, and (b) Alkaline.

Further, the above standard also categorizes the liquid form of sodium silicates into the following types:

Liquid, neutral sodium silicates are of two types:

- i. Type 1: For use in pharmaceutical and toilet preparations.
- ii. Type 2: For use as an adhesive and other purposes.

Liquid, alkaline sodium silicates are of three types:

Type 1, Type 2, and Type 3: For use in soap, detergent, textile, welding electrode and cement industries.

Quality Requirements

The quality requirements according to the IS 381 are as follows:

Neutral sodium silicate shall be clear, free from dirt and other visible impurities. Liquid sodium silicate shall be thick, viscous, translucent mass of water white or slightly grey colour. Solid sodium silicate shall be in the form of glassy lumps of pale grey or green colour. The particle size shall be as mutually agreed to between the purchaser and the supplier to meet the special requirements. Other quality requirements for sodium silicate viz., matter insoluble in water, relative density, total soluble silicates, ratio of total alkalinity to total soluble silica, loss in mass on ignition, viscosity and limits for iron, chloride and sulphate contents are given in the IS 381.

Packing

The materials shall be packed in air-tight mild steel (MS) drums of capacity as mutually agreed to between the purchaser and the supplier.

Marking

Each package shall be legibly and indelibly marked with name and grade of the material, source of manufacture, gross and net mass, year of manufacture and lot number.

Production Capacity (per annum)

Quantity : 2600 tonnes

Value : Rs 1,23,50,000.

Motive Power

25 HP.

Pollution Control

Both raw materials, silica sand and sodium carbonate are purchased in the ready to use powder form. Only mixing of these materials in appropriate proportions is done in the batch house in the plant. Hence, dust collectors and exhaust systems are recommended in the batch house. In the melting operation, chimney of sufficient height, say 60 to 75 feet, is recommended to exit the gases of combustion, carbon dioxide from the soda ash and also volatilization of alkali oxides.

Energy Conservation

Modern glass tank furnace is recommended using furnace oil, LDO or gas firing systems. Combustion systems, for example, burners, blowers, preheating of fuel will depend on the fuel selected. Care should be taken in selecting the type and design of the furnace, refractories to be used for construction of the furnace, proper thermal insulation of the furnace walls and crown. All these factors have a bearing on the thermal efficiency of the furnace and energy conservation achieved in the melting operation. Melting operation constitutes a significant cost factor in production of sodium silicate.

FINANCIAL ASPECTS

A. Fixed Capital

(i) Land and Building

Particulars	Sq. Meters	Rate (Rs.)	Value (Rs.)
Land	2,000	250	5,00,000
Built Area			
Office and Stores	100	2,000	2,00,000
Working Shed	400	1,250	5,00,000
		Total	12,00,000

(ii) Machinery and Equipments

Description	Imp/ Ind.	Qty. (Nos.)	Rate (Rs.)	Value (Rs.)
<i>Production Unit</i>				
Glass Tank Furnace, drawing capacity: 5 tonnes per day, melting area: 6 square metres	Ind.	1	12,00,000	12,00,000
Chimney of 60 to 75 feet height	Ind.	1	1,00,000	1,00,000
Combustion equipment for furnace oil firing, including burners, blowers, oil pipelines, preheating systems, etc.	Ind.	1 set	2,00,000	2,00,000
Oil storage tank, Capacity: 10 kilolitres	Ind.	1	25,000	25,000
Dissolving tanks and agitators	Ind.	2 sets	25,000	50,000
Bore well with pumpset	Ind.	1	25,000	25,000
Portable combustion analyzer	Imp	1	1,00,000	1,00,000
Mild Steel barrels of 200 litres capacity	Ind.	1000	400	4,00,000
Cost of erection, installation and electrification, at 10% of the above				210000
Cost of office equipment, furniture, etc.				1,90,000
			Total	25,00,000

(iii) Pre-Operative Expenses	(Rs.)
Project report cost, non-refundable deposits, etc	3,00,000
Total Fixed Capital	40,00,000

B. Working Capital (Per Month)

(i) Personnel (per month)

Designation	No.	Salary (Rs.)	Total (Rs.)
<i>Administration and Supervisory personnel</i>			
Manager	1	8,000	8,000

Designation	No.	Salary (Rs.)	Total (Rs.)
Supervisors	2	6,000	12,000
Salesman	1	6,000	6,000
Accountant	1	6,000	6,000
Clerk	1	4,000	4,000
Watchman	2	2,000	4,000
<i>Technical-Skilled and Semi or Unskilled Personnel</i>			
Skilled workers	5	4,000	20,000
Un-skilled workers	10	2,000	20,000
Perquisites: @ 15% of the above			12,000
		Total	92,000

(ii) Raw Materials (per month)

Particulars	Imp/ Ind.	Qty.	Unit	Rate (Rs.)	Value (Rs.)
Soda ash	Ind.	45	Tonnes	9,266	4,16,970
Silica sand	Ind.	80	Tonnes	1,000	80,000
Chemicals	Ind.	LS			5,030
				Total	5,02,000

(iii) Utilities (per month)

Sl. No	Particulars	Qty.	Unit	Rate (Rs.)	Value (Rs.)
	Furnace oil	12	Kiloliters	8,000	96,000
	Electrical power	2,000	kWh	4	8,000
	Water	200	Kilolitres	20	4,000
				Total	1,08,000

(iv) Other Contingent Expenses (per month)

Particulars	Value (Rs.)	
Postage and stationery	1,000	
Telephone	1,000	
Consumable stores	5,000	
Repairs and maintenance	5,000	
Transport charges	5,000	
Advertisement and publicity	2,000	
Insurance	2,000	
Taxes	2,000	
Sales expenses	5,000	
Miscellaneous expenses	2,000	
	Total	30,000

(v) Total Recurring Expenditure (per month) 7,32,000

(vi) Total Working Capital (on 3 months basis) 21,96,000

C. Total Capital Investment

Rs. 61,96,000

MACHINERY UTILIZATION

Machinery utilization of 75 percent has been considered in the project.

FINANCIAL ANALYSIS

(1) Cost of Production (per year)

Description	Value (Rs.)	
Total recurring cost	87,84,000	
Depreciation on building @ 5%	35,000	
Depreciation on Machinery and Equipment @ 10%	90,000	
Depreciation on Furnace @ 20%	2,40,000	
Interest on capital investment @ 14%	8,67,440	
Depreciation on office equipments and furniture @ 20%	38,000	
	Total	1,00,54,440

(2) Sales Turnover (per year)

Item	Qty.	Unit	Rate (Rs.)	Value (Rs.)
Sodium silicate liquid	2600	Tonnes	4750	1,23,50,000

(3) Net Profit Before Tax

Rs. 1,23,50,000 - 1,00,54,440 = Rs. 22,95,560

(4) Net Profit Ratio

$$= \frac{\text{Net Profit per year} \times 100}{\text{Sales Turnover per year}}$$

$$= \frac{22,95,560 \times 100}{1,23,50,000}$$

$$= 18.58\%$$

(5) Rate of Return

$$= \frac{\text{Net Profit per year} \times 100}{\text{Total Capital Investment}}$$

$$= \frac{22,95,560 \times 100}{61,96,000}$$

$$= 37\%$$

(6) Break-even Point

Fixed Cost (per year)

Description	Value (Rs.)	
Total depreciation	4,03,000	
Interest on total capital investment	8,67,440	
Insurance	24,000	
40% of Salaries and wages	4,41,600	
40% other contingent expenses	1,34,400	
	Total	18,70,440

$$\begin{aligned}
 \text{B.E.P.} &= \frac{\text{Fixed Cost} \times 100}{\text{Fixed Cost} + \text{Net Profit}} \\
 &= \frac{18,70,440 \times 100}{18,70,440 + 22,95,560} \\
 &= 44.89\%
 \end{aligned}$$

Addresses of Machinery and Equipment Suppliers

1. M/s. Glass Plant Construction Cor.
13, Km Stone,
Chandigarh-Ambala Road,
Bishanpura,
P.O. Dhankoli, Via Mubarakpur,
District. Patiala, (Punjab)
2. M/s. United Works Pvt. Limited
7-8, Mahalakhmi Bridge,
Mumbai-400 011
3. M/s. Maul Eastern Limited
157, Maker Chambers-VI,
14th Floor, 220, Nariman Point,
Mumbai-400 021
4. M/s. Wesman Group of Companies
1/2, Allenby Road,
Kolkata-700 020
5. M/s. Simplicity Engineers Pvt. Ltd.
B-99, Mayapuri, Phase-I,
New Delhi-100 064

6. M/s. Nevco Engineers Pvt. Ltd.
90-A, 2nd Floor, Amrit Puri
B, Main Road,
East of Kailash,
New Delhi-110 065

Raw Material Suppliers

1. M/s. Gujarat Heavy Chemicals Limited
B-309, 7th Main,
Peenya Industrial Area,
Bangalore-560 058
2. M/s. Bangalore Mines and Minerals Products
21, Tavarakere Cross,
Audugodi,
Bangalore-560 029
3. M/s. Sanjay Minerals Private Limited
30-A, 2nd Phase,
Peenya Industrial Area,
Bangalore-560 058
4. M/s. Usha Mine Chem Industries
147, Industrial Suburb,
Yeshwanthpur,
Bangalore-560 022