

OXALIC ACID

1. INTRODUCTION:

Oxalic acid is an organic compound with the formula $C_2H_2O_4$. It is a colorless crystalline solid that forms a colorless solution in water. Its condensed formula is $HOOC-COOH$, reflecting its classification as the simplest dicarboxylic acid. Its acid strength is much greater than that of acetic acid. Oxalic acid is a reducing agent [6] and its conjugate base, known as oxalate ($C_2O_4^{2-}$), is a chelating agent for metal cations. Typically, oxalic acid occurs as the dihydrate with the formula $C_2H_2O_4 \cdot 2H_2O$. Excessive ingestion of oxalic acid or prolonged skin contact can be dangerous.

2. PRODUCT & ITS APPLICATION:

Calcium oxalate is the most common component of kidney stones. Early investigators isolated oxalic acid from wood-sorrel. Members of the spinach family and the brassicas (cabbage, broccoli, brussels sprouts) are high in oxalate, as are sorrel and umbellifers like parsley. Rhubarb leaves contain about 0.5% oxalic acid, and jack-in-the-pulpit (*Arisaema triphyllum*) contains calcium oxalate crystals. Similarly, the Virginia creeper, a common decorative vine, produces oxalic acid in its berries as well as oxalate crystals in the sap, in the form of raphides. Bacteria produce oxalate from oxidation of carbohydrates. Plants of the *Fenestraria* genus produce optical fibers made from crystalline oxalic acid to transmit light to subterranean photosynthetic sites.

Applications:

About 25% of produced oxalic acid is used as a mordant in dyeing processes. It is used in bleaches, especially for pulpwood. It is also used in baking powder and as a third reagent in silica analysis instruments. Oxalic acid's main applications include cleaning or bleaching, especially for the removal of rust (iron complexing agent). Bar Keepers Friend is an example of a household cleaner containing oxalic acid. Its utility in rust removal agents is due to its forming a stable, water-soluble salt with ferric iron, ferrioxalate ion. Oxalic acid is an important reagent in lanthanide chemistry. Hydrated

lanthanide oxalates form readily in very strongly acidic solutions in a densely crystalline, easily filtered form, largely free of contamination by non-lanthanide elements. Thermal decomposition of these oxalate gives the oxides, which is the most commonly marketed form of these elements. Honeybee coated with oxalic acid crystals: Vaporized oxalic acid, or a 3.2% solution of oxalic acid in sugar syrup, is used by some beekeepers as a miticide against the parasitic varroa mite. Oxalic acid is rubbed onto completed marble sculptures to seal the surface and introduce a shine. Oxalic acid is also used to clean iron and manganese deposits from quartz crystals. Oxalic acid is used as bleach for wood, removing black stains caused by water penetration.

3. DESIRED QUALIFICATIONS FOR PROMOTER:

Graduate in any science. Promoter with high skill of chemical processing and having contacts with chemical and textile industries is advantage.

4. INDUSTRY LOOK OUT AND TRENDS

Oxalic acid is a colourless, crystalline substance with sharp, sour taste. Oxalic acid is at high concentration can be a dangerous poison. It's a part of carboxylic acid family. Oxalic acid is soluble in water, alcohol and ether. Oxalic acid is widely used as bleaching or cleaning agent. Oxalic acid is used as a mordant in dying process. Oxalic acid is used in pharmaceutical to purification or dilution purpose. Another important application of oxalic acid is to smelt rare earth. Oxalic acid is used as bleaching agent in textile and wood industry. Oxalic acid plays a vital role as rust-remover for metal treatment industry as well as water treatment. The estimated oxalic acid consumption was about 190 million metric tons at the end of 2009.

The exponential growth in pharmaceutical and rare earths industry is the major contributor to the growth of Oxalic Acid Market. The use of Oxalic Acid in bleaching and cleaning purpose at various industrial/household applications is a positive indicator in the expected growth of oxalic acid market. The growing concern towards sterilization in industry also drives the demand of oxalic acid market.

On the other hand, due to its toxic and corrosive nature, industrial as well as household use and handling might create restrain in the demand of Oxalic acid.

5. MARKET POTENTIAL AND MARKETING ISSUES, IF ANY:

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6. RAW MATERIAL REQUIREMENTS:

Oxalic Acid is manufactured by oxidation of sugar with help of Nitric Acid in presence of sulphuric Acid using Vanadium Pent oxide as catalyst. It is known that oxalic acid may be prepared by the oxidation of carbohydrates such as glucose, sucrose, starch, dextrin, cellulose and the like with nitric acid. Barks containing Oxalates obtained from forest Department.

7. MANUFACTURING PROCESS:

Initially molasses was preheated & temperature of it was increased from 37 degree C to 65.5 degree C. After that it was fed into a reactor. Simultaneously Nitric acid was

also fed into the reactor along with Vanadium Penta-oxide which acts as a catalyst. This mixture was mixed thoroughly & was allowed to react for 2 -3 hours. After 2 - 3 hours, Oxalic acid, un-reacted molasses, un-reacted Nitric acid, Nitrogen Oxide was formed. Oxalic acid along with un-reacted molasses, un-reacted Nitric acid & Vanadium Penta-oxide comes out from the bottom section of CSTR and undergoes further separation process. During this process Vanadium Penta-oxide gets first get separated out with help of a filter. Oxalic acid & mother liquor (un-reacted Nitric acid & molasses) is separated in a 2 stage process. In the first stage , solution that has been filtered is fed into a crystallizer in which oxalic acid crystals along with mother liquor comes out and further these are separated with help of a centrifuge. After Oxalic acid gets separated, to remove inclusion (process by which a solvent particles get trapped inside a crystal), it is re-crystallized by adding hot water inside a crystallizer containing these Oxalic acid crystals. After separating out the mother liquor again, Oxalic acid crystals are sent into drier to remove the moisture present on the surface of the crystals.

Nitrogen Oxide gas which comes out from the top surface of CSTR cannot be discharged directly to the atmosphere, as it can cause air pollution, so this gas was sent into a compressor to increase the pressure & to a steam heater to increase the temperature. After that this gas was sent to fluidized-bed reactor & in presence of Al₂O₃ catalyst, Nitrogen dioxide gas is formed. Al₂O₃ after this get separated by cyclone separator. After this process,

In an absorber, Nitrogen dioxide gas was allowed to react with water sprayed inside the absorber to produce Nitric acid & Nitrogen oxide gas. Nitric acid (20%) obtained which is less concentrated than the Nitric acid (95%) which was used as a feed can further be used in other industrial process and Nitrogen oxide gas can be recycled back to stream leading to fluidized bed reactor.

8. MANPOWER REQUIREMENT:

The enterprise requires 17 employees as detailed below:

Sr. No.	Designation of Employees	Salary Per Person	Monthly Salary ₹	Number of employees required				
				Year-1	Year-2	Year-3	Year-4	Year-5
1	Machine Operators	12,000	12000.00	1	1	1	1	1
2	Helpers	8,000	24000.00	3	3	4	5	5
3	Production supervisor	15,000	15000.00	1	1	1	1	1
4	Accounts/Stores Asst	12,500	12500.00	1	1	1	1	1
5	Office Boy	9,000	9000.00	1	1	1	1	1
	Total		72500.00	7	7	8	9	9

9. IMPLEMENTATION SCHEDULE:

The project can be implemented in 4 months' time as detailed below:

Sr. No.	Activity	Time Required (in months)
1	Acquisition of premises	1.00
2	Construction (if applicable)	1.00
3	Procurement & installation of Plant & Machinery	1.00
4	Arrangement of Finance	2.00
5	Recruitment of required manpower	1.00
	Total time required (some activities shall run concurrently)	4.00

10. COST OF PROJECT :

The project shall cost ₹ 33.56 lacs as detailed below:

Sr. No.	Particulars	₹ in Lacs
1	Land	3.00
2	Building	8.00
3	Plant & Machinery	6.20
4	Furniture, Electrical Installations	0.62
5	Other Assets including Preliminary / Pre-operative expenses	0.74
6	Working Capital	15.00
	Total	33.56

11. MEANS OF FINANCE:

Bank term loans are assumed @ 75 % of fixed assets. The proposed funding pattern is as under:

Sr. No.	Particulars	₹ in Lacs
1	Promoter's contribution	8.39
2	Bank Finance	25.17
	Total	33.56

12. WORKING CAPITAL CALCULATION:

The project requires working capital of ₹ 15.00 lacs as detailed below:

Sr. No.	Particulars	Gross Amt	Margin %	Margin Amt	Bank Finance
1	Inventories	8.00	0.25	2.00	6.00
2	Receivables	5.00	0.25	1.25	3.75
3	Overheads	2.00	100%	2.00	0.00
4	Creditors	-		0.00	0.00
	Total	15.00		5.25	9.75

13. LIST OF MACHINERY REQUIRED:

A detail of important machinery is given below: Power Requirement: 200 HP

Sr. No.	Particulars	UOM	Qty	Rate (₹)	Value
					(₹ in Lacs)
	Plant & Machinery / equipments				
a)	Main Machinery				
i.	Reactor	NOS.	1	125000	1.25
ii.	wood chipper	Nos	1	45000	0.45
iii.	band saw	Nos	1	50000	0.50
b)	Ancillary machinery				
i.	baby boiler	Nos	1	100,000	1.00
ii.	scrubber, storage tanks, condenser, etc.	NOS.	1	150000	3.00
	<i>sub-total Plant & Machinery</i>				6.20
	Furniture / Electrical installations				
a)	Office furniture	LS	1	25000	0.25
b)	Stores Almirah	LS	1	15,000	0.15
c)	Computer & Printer		L. S.	22000	0.22
	<i>sub total</i>				0.62
	Other Assets				
a)	preliminary and preoperative				0.74
	<i>sub-total Other Assets</i>				0.74
	Total				7.56

All the machines and equipment are available from local manufacturers. The entrepreneur needs to ensure proper selection of product mix and proper type of machines and tooling to have modern and flexible designs. It may be worthwhile to look at reconditioned imported machines, dies and tooling. Some of the machinery and dies and tooling suppliers are listed here below:

- Kamdhenu Agro Machinery
Plot No. 6, Near Power House,
Wathoda Road, Wathoda
Nagpur - 440035
Maharashtra, India

- Future Industries Private Limited
Shed No. 15, Ambica Estate,
Corporation Municipal Plot,
Opposite Sadvichar Hospital,
Naroda, Ahmedabad - 382330,
Gujarat, India

- The Global Pharma Equipments
Star Industrial Estate,
D-32, Naik Pada,
Near Hanuman Mandir,
Opposite Dwarka Industrial Estate,
Vasai East, Vasai - 401208,
Maharashtra, India

14. PROFITABILITY CALCULATIONS:

Sr. No.	Particulars	UOM	Year-1	Year-2	Year-3	Year-4	Year-5
1	Capacity Utilization	%	60%	70%	80%	90%	100%
2	Sales	₹. In Lacs	36.00	42.00	48.00	54.00	60.00
3	Raw Materials & Other direct inputs	₹. In Lacs	29.26	34.14	39.02	43.89	48.77
4	Gross Margin	₹. In Lacs	6.74	7.86	8.98	10.11	11.23
5	Overheads except interest	₹. In Lacs	3.94	4.19	4.68	4.83	4.93
6	Interest	₹. In Lacs	2.52	2.52	1.68	1.26	1.01
7	Depreciation	₹. In Lacs	4.34	3.10	2.17	1.55	1.40
8	Net Profit before tax	₹. In Lacs	-4.06	-1.95	0.45	2.47	3.90

The basis of profitability calculation:

The growth of selling capacity will be increased 10% per year. (This is assumed by various analysis and study; it can be increased according to the selling strategy.)

Energy Costs are considered at Rs 7 per Kwh and fuel cost is considered at Rs. 65 per litre. The depreciation of plant is taken at 10-12 % and Interest costs are taken at 14 -15 % depending on type of industry.

15. BREAKEVEN ANALYSIS:

The project shall reach cash break-even at 30.20 % of projected capacity as detailed below:

Sr. No.	Particulars	UOM	Value
1	Sales at full capacity	₹. In Lacs	60.00
2	Variable costs	₹. In Lacs	48.77
3	Fixed costs incl. interest	₹. In Lacs	5.94
4	$BEP = FC/(SR-VC) \times 100 =$	% of capacity	52.87%

16. STATUTORY / GOVERNMENT APPROVALS

As per the allocation of business rules under the Constitution, labour is in the concurrent list of subjects. It is dealt with by the MOLE at the Central and Departments of Labour under State Governments in respective States / UTs. The MOLE has enacted workplace safety and health statutes concerning workers in the manufacturing sector, mines, ports and docks and in construction sectors.

Further, other Ministries of the Government of India have also enacted certain statutes relating to safety aspects of substances, equipment, operations etc. Some of the statutes applicable in the manufacturing sector are discussed below:

The Static and Mobile Pressure Vessels (Unfired) Rules, 1981

These (SMPV) Rules are notified under the Explosives Act, 1884. These rules regulate storage, handling and transport of compressed gases. These rules stipulate

requirements regarding construction and fittings, periodic testing, location, fire protection, loading and unloading facilities, transfer operations etc. in respect of pressure vessels whose water capacity exceeds one thousand litres. These rules are enforced by the Chief Controller of Explosives under the Ministry of Industry and Commerce, Govt. of India (PESO).

The Manufacture, Storage and Import of Hazardous Chemicals Rules (MSIHC), 1989

These MSIHC Rules are notified under the Environment (Protection) Act, 1986. These rules are aimed at regulating and handling of certain specified hazardous chemicals. The rules stipulate requirements regarding notification of site, identification of major hazards, taking necessary steps to control major accident, notification of major accident, preparation of safety report and on-site emergency plan; prevention and control of major accident, dissemination of information etc. These rules are notified by the Ministry of Environment and Forests (MOEF) but enforced by the Inspectorates of Factories of respective States / UTs in the manufacturing sector.

The Factories Act, 1948 and State Factories Rules

The Factories Act, 1948 is very comprehensive legislation dealing with the matters of safety, health and welfare of workers in factories. The Act places duties on the occupier to ensure safety, health and welfare of workers at work. Some of the salient provisions of the Act include:

- Guarding of machinery
- Hoists and Lifts; Lifting Machines and Appliances
- Revolving Machinery
- Pressure Plant
- Excessive Weight
- Protection of Eyes
- Precautions against dangerous fumes, gases etc.
- Explosive or inflammable dust, gas etc.
- Precautions in case of fire
- Safety of buildings and machinery

- Permissible limits of exposure of chemical and toxic substances
- Entrepreneur may contact State Pollution Control Board where ever it is applicable.

17. BACKWARD AND FORWARD INTEGRATIONS

Chemical companies often become integrated and undergo other activities outside the chemical industry. Increased competition prompts many companies to reduce supply chain costs by looking outside the chemical sector at suppliers and customers. While most companies within the chemicals sector primarily produce chemicals, some companies also conduct other manufacturing activities. The exact proportion of chemicals sector companies that are integrated with other sector activities is unknown, but many companies actively seek vertical integration. Many manufacturers pursue vertical integration to secure suppliers and customers for their products.

Mergers and acquisitions are a common way for companies to undertake new chemical ventures. By purchasing their chemical suppliers, some manufacturers secure future chemical feedstock for their products or other chemicals that they use in manufacturing. The company making the purchase obtains valuable expertise and equipment. Some mining and petrochemical production is more cost-effective when integrated within a chemical company.

Energy and feedstock costs are often a significant expense for chemical companies. Integrating chemical production with activities that secure supplies of chemical feedstock and energy is relatively common as chemical companies grow. Chemical companies are located near mines, oil fields, ammonia factories and water supplies. This reduces transportation costs and increases the reliability of supplies by reducing the distance between feedstock and the factory.

Some companies, such as Sino-Coking Coal and Coke Chemical Industries Incorporated, own their mines. BHP Billiton operates a broad range of mines and is primarily a mining company. It does, however, also produce petrochemical feedstock for the chemical industry and therefore operates within the chemical industry as well. These companies technically operate within both the chemical and mining industries in their normal business operations.

Integrating a chemical company with other activities provides several direct benefits for the company and is becoming increasingly common. High energy costs necessitate greater control of energy resources and minimal reliance on expensive transportation. Chemical companies experience volatile profitability due to fluctuations in feedstock and energy expenses. Some companies control this volatility through careful supply chain management and by charging supply surcharges. Actively researching and developing alternative feedstock and energy supplies helps the company reduce costs.

Vertical integration supports these activities by eliminating redundant activities at multiple companies and increasing efficiency. By consolidating activity among multiple, similar operations, chemical companies achieve cost savings that contribute to higher profitability. End products are often very profitable, and some chemical companies purchase their former customers to take advantage of the marked-up prices of products further along in the supply chain.

Integration may become more common for many chemical companies as competition strengthens and traditional feedstock becomes more expensive. Market demand for chemical feedstock increases as emerging market economies grow and result in increased consumer spending around the world.

18. TRAINING CENTERS AND COURSES

There is no such training required to start this business but, basic chemical bachelor's degree is plus point for enterpriser. Promoter may train their employees in such specialized institutions to grow up the business. There are few specialised Institutes provide degree certification in chemical Technology, few most famous and authenticate Institutions are as follows:

1. Department of chemical LD college of engineering
No.120, Circular Road, University Area, Navrangpura,
Opposite Gujarat University, Ahmedabad, Gujarat 380015
2. MIT College of chemical Engineering, Pune
Gate.No.140, Raj Baugh Educational Complex,

Pune Solapur Highway,
Loni Kalbhor, Pune – 412201
Maharashtra, India

Udyamimitra portal (link : www.udyamimitra.in) can also be accessed for handholding services viz. application filling / project report preparation, EDP, financial Training, Skill Development, mentoring etc.

Entrepreneurship program helps to run business successfully is also available from Institutes like Entrepreneurship Development Institute of India (EDII) and its affiliates all over India.

Disclaimer:

Only few machine manufacturers are mentioned in the profile, although many machine manufacturers are available in the market. The addresses given for machinery manufacturers have been taken from reliable sources, to the best of knowledge and contacts. However, no responsibility is admitted, in case any inadvertent error or incorrectness is noticed therein. Further the same have been given by way of information only and do not carry any recommendation.