RESERVED CHEMICAL AND ALLIED INDUSTRIES

SIRI

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PREFACE

Chemical industry has an important role in the present economy of the country. Today most of the important chemicals are being manufactured in India. Though there are number of manufacturers of different chemicals, there is still good scope for the manufacture of chemicals for fulfilling the indigenous need and promoting the export. Rapid growth of chemical industries in India diverted Govt's attention towards them.

According to new industrial policy announced on 23rd July 1980, by Govt. of India, definition of small, cottage and tiny industries have been changed. To develop it fast and decentralise the economy Government has reserved many chemical items under small, cottage and tiny scale sector.

It has been our experience that a number of industrialists & entrepreneurs are in the state of dilema when they have to decide about a particular industry, its scope, feasibility of it etc. In this book, an attempt has been made to give project profiles of reserved chemical industries *i.e.* Chemical & Chemical products, Organic Chemicals, Drugs & Drug Intermediates, Laboratory Chemicals and Reagents, Dyestuffs & Essential Oils etc.

The product profiles are given in nature of preliminary guideline for the selection of an item for manufacture and making initial assessment regarding the project viability. The book also presents uses, applications, market potentiality, process of manufacture, plant economics for every product described in the product.

The other chapters of the book include, machinery and equipment and directory section. The machinery and equipment chapter describes, about important machinery used in the manufacture of chemicals with their working and specifications which will help in selecting the machine while the directory section provides various addresses of suppliers and manufacturers of raw materials, plant & machinery.

Thus, it is the sincere hope of the author that the book will serve as a ready reference and guide to chemical engineers, chemist, manufacturers and new entrepreneurs connected with chemical industry. At last author wishes to thank all those who have helped him in the preparation of book.

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SECTION 1

Organic Chemicals, Drugs & Drug Intermediates

ALKYD RESIN

(From Linseed Oil & Soyabean Oil)

Introduction

Alkyd resins are a large group of synthetic low molecular weight polyester prepared from polybasic acids and polyhydric alcohols. Alkyd resins are the most important class of protective coatings, a ccounting for about 50% of the resins used in this application.

Classification

Alkyd resins are generally classified as :

(1) Short oil.

(2) Medium oil.

(3) Long oil.

(4) Very long oil, depending on the amount of aliphatic long chain fatty acid group incorporated in the resins.

Properties

The properties of Alkyd Resins based on linseed oil and soyabean oil are as follows :

1.	Acid value	20—28
2.	Solid content	80
3.	Solubility	Soluble in all common organic solvents.

Uses and Applications

Alkyd resins are used in both clear pigmented, industrial and trade sales coatings to protect and decorate a wide variety of substances.

Industrial Prospects

The alkyd resin being a modified synthetic resin has a very good market potential. It is widely used in industrial finishes and account for nearly 40% of the synthetic resins used in surface coating. There is also a good export market for it. Considering all these factors it can be understood that there is a good market potential for this industry.

Process of Manufacture

The alkyd resins can be manufactured by any of the following processes :

1. Fatty Acid Process.
2. Fatty Acid Oil Method.
3. Oil Dilutions Method.
4. Alcoholysis Method.
5. Solvent Process.

Solvent process is the main commercial process and includes the following steps :

(a) Charging of the raw materials.
(b) Regulating heat in flow with dowtherm flowing through the jacket of reaction.
(c) Condensing the solvent and refluxing.
(d) Thinning.
(e) Filtering.
(f) Testing and analysing.
(g) Packaging and marketing.

Formulation

Linseed oil	60
Soyabean oil	40
Pentaerythritol	40
Xylene	132.89
Pnthalic Anhydride	332.23
Turpentine oil	20

Process

All the raw materials are added in reaction kettle and agitation is started. The inert gas is sparged through the spare line. The vapours are condensed and recycled back to the kettle.

The reacted mass is dropped into a jacketed tank, containing the desired solvent. The cooled resin solution after thinning is

filtered in filter press and sludge is removed. It is lastly tested, packed and stored.

Cost Economics

For capacity of 150 M.T. the total capital required is estimated about Rs. 7,86.000/- in which fixed capital Rs. 3,86,000/- and working capital for 3 months Rs. 4,00,000/-. The expected return on the total capital is about 33%.

BENZYL BENZOATE

Introduction

Benzyl Benzoate is one of the important ester widely used in perfumery industry. Benzyl benzoate is extensively used in medicines, and is an effective repellent for chigger, a tropical flea burrowing into skin. Benzyl benzoate is also widely used in perfumery industry and is particulerly valuable as fixative and as a solvent for synthetic musks. At present seven eight units are manufacturing benzyl benzoate besides various small sector organisations. With the fast expansion and rapid growth of pharmaceutical and perfumery industry, the prospects of manufacturing this product are very bright in the near future.

Raw Material Requirement (Basis 200 Kgs. per day)

	Kgs.
Benzyl chloride	400
Sodium benzoate	200
Sodium hydroxide	100

Process of Manufacture

In manufacturing benzyl benzoate, benzyl chloride is reacted with appropriate acid salts followed by fractionation of the crude product.

Sodium benzoate is reacted with benzyl chloride in a glass reactor (Sodium benzoate is produced by adding sodium hydroxide to benzoic acid) and the temperature is maintained at 100°C. At the end of reaction the final product obtained is benzoate. It is washed to remove acids, so it is treated with sodium hydroxide and then fractionally distilled. The yield of benzyl benzoate is about 90—92%.

Equipment & Machinery

1. Reactor with glass lined fitted with motor (1 No.).
2. Steam distillation unit (1 No.).

3. Rectification column (1 No.).
4. Air compressor, pumps and motors.
5. Mini boiler 100 Kg/hr. at 50 psi. (1 No.).
6. Storage and mixing tanks (5 Nos.).

Cost Analysis

For a small scale unit producing 200 Kgs/day of benzyl benzoate the cost of equipment and machinery is estimated to be Rs. 2.5 lakhs. The covered area required is 400 square metres and the expected rate of return on total capital investment is 25%.

BENZYL CHLORIDE

Introduction

With the availability of coal tar chemicals of benzene, toluene, naphthalene etc., in our country it is possible to produce a variety of organic chemicals and intermediates which find use in various manufacturing activities. By chlorination of toluene under proper conditions, a number of benzyl chemicals can be produced.

Benzyl chloride is an important chemical used in the manufacture of dyes, pharmaceuticals, benzyl benzoate etc.

At present about ten units are manufacturing benzyl chloride in India. But the demand is more than the production. So at present bulk quantity of this chemical is being imported. In order to reduce imports and to fill up the gap between demand and production few more units in small scale sector should come up.

Raw Material Requirement (Basis 300 Kgs. per day)

	Kgs.
Toluene (Nitration Grade)	300
Chlorine	185

Process of Manufacture

Benzyl chloride is produced by passing chlorine into boiling toluene under controlled conditions. Toluene is heated in a glass reactor at a temperature of 80°C by passing steam. Now, chlorine is bubbled into the toluene through a rubber tube. Temperature is raised automatically due to exothermic reaction and maintained at 110°C throughout the reaction. After completion of the reaction the reaction products are distilled or rather separated by traditional distillation. Distillation is carried under vacuum. Benzyl chloride is distilled at a temperature between 176°C and 180°C. Benzyl chloride

and potassium carbonate are refluxed at a temperature of 180°C. Benzyl alcohol is extracted with solvent or otherwise and finally fractionally distilled. Benzyl alcohol give rise to many products such as benzyl acetate/benzyl benzoate by reacting with sodium acetate/ sodium benzoate.

Machinery & Equipment

1. M. S. Storage tank for toluene having capacity 1000 litres (1 No.).
2. Oil jacketted (1 No.).
3. Reactor with glass lined (1 No.).
4. Mini Boiler 100 kgs/hour at 50 psi (1 No.).
5. Aluminium tray.
6. Miscellaneous tools and equipments.

Cost Analysis

For a small plant manufacturing 300 kgs. of benzyl chloride per day, the covered area required is 250 square metres. The cost of equipment and machinery is likely to be 2.5 lakhs. The rate of return on total capital investment is likely to be 25%.

CHLORINATED PARAFFIN WAX

Introduction

Chlorinated Paraffin Wax is a cheap plasticizer extender mainly used for flexible PVC alongwith dioctyl phthalate. It may find use in fire mould and water proofing of canvas, ropes and other textiles. Other applications of chlorinated paraffin wax are as an antirot and insect impregnant for wood.

The present demand of this material is approximately 1300 tonnes per year. The demand is likely to go upto 18,000 tonnes by 1983-84.

At present, about ten firms are manufacturing this product in the country but the indigenous production is of the order of 4,000—5,000 tonnes per year only. As the indigenous production is not enough imports are allowed to fill the gap between demand and production. So there is some scope for creation of further capacity in view of the present scarcity experienced in this field.

Raw Material Requirement (Basis 500 kgs. per day)	Kgs.
Paraffin Wax	250
Chlorine	400
Sodium carbonate	100
Activated carbon	Small quantity

Process of Manufacture

About 250 kgs. of paraffin wax is melted into mild steel melter. Chlorine gas is then passed into the molten paraffin wax at a temperature of about 100°C; which is achieved by the heat of reaction in the presence of ultraviolet light for a period of eight to ten hours or more till the desired specific gravity is obtained. Alternatively the quantity of chlorine consumed is measured to find out the end point of reaction. After the reaction is complete air is blown through the mass to remove unreacted chlorine.

Hydrochloric gas is formed during the reaction, which is passed through absorber and is absorbed in water. The chlorine gas is recycled into the chlorinator. After required chlorination the product is cooled and air is passed through it to remove unreacted chlorine and HCl associated with the product. Any hydrochloric acid left in the form of residue may be neutralized with caustic soda. The product is finally filtered and packed in drums. Some stabilizers like epichlorohydrin or ethylene oxide, or some complex compounds of barium or cadmium are added to avoid decomposition of chlorinated paraffin wax.

Equipment & Machinery

For a 500 kgs./day plant the equipment and machinery required is :

1. Wax melter, M.S. jacketed vessel fitted with agitator and motor (1 No.).
2. Glass lined reactor with accessories (1 No.).
3. Hydrochloric acid absorber fitted with rasching ring (1 No.).
4. Mini steam boiler 50 kgs./hour at 100 psi (1 No.).
5. Storage and mixing tanks (3 Nos.).
6. Chlorine cylinders (6 Nos.).
7. Filter press (1 No.).
8. Air compressor (1 No.).
9. Miscellaneous tools and equipments, such as pipes, motors, pumps, valves, instruments.

Cost Analysis

For a small scale unit producing 500 kgs. of chlorinated paraffin wax per day the cost of equipment and machinery is likely to be Rs. 2,25,000. The covered area required is 300 square metres and the expected rate of return on total capital investment is likely to be about 25%.

2-4-DICHLOROPHENOL

Introduction

2-4-Dichlorophenol is a white, low melting point solid, having a boiling point 210°C and melting point 45°C. It has a flash point 237°F. It is highly combustible. It is soluble in water, alcohol and carbon tetra chloride.

At present three four big companies are engaged in manufacturing this product, besides few small scale units. So there is good scope to manufacture this product in small scale sector. It is mainly used in organic synthesis. Most important use of this chemical is in the manufacture of 2-4-D (2-4-dichlorophenoxy acetic acid) and its derivatives.

Raw Material Requirement (Basis 500 kgs. per day).

	Kgs.
Phenol	1250
Chlorine	400

Process of Manufacture

It is prepared by continued chlorination of phenol, with gradual elevation of the temperature above the setting points of the intermediate chlorophenol until pentachlorination has been effected.

The chlorination is carried out in a steam jacket glass lined steel reactor equipped with an agitator and condenser. Phenol is charged into the reactor from the charging aperture on the top of the reactor and chlorine gas is bubbled through molten phenol. Chlorine gas can be controlled from the bottom of the reactor, and bubbling continues until weight of reaction mixture increases by 36 : 50 for every gram of phenol added. The time required for chlorination is about 4-5 hours. The product is then distilled in a fractionating column. The fraction boiling between 210-215°C is collected. The fraction readily crystallizes upon cooling. Finally the product is packed in drums and sent to different consumers.

Equipment & Machinery

1. Steel reactor (glass lined) with agitator and motor (1 No.).
2. Condenser (1 No.).
3. Distillation tank (1 No.).
4. Boiler (1 No.).
5. Liquid chlorine storage tank (1 No.).
6. Mini boiler 100 kgs./hour at a pressure of 150 psi (1 No.).
7. Miscellaneous tools and equipments.

Cost Analysis

For a small scale unit manufacturing 500 kgs. per day, 2-4-dichlorophenol, the covered area required is about 250 square metres. The cost of plant and equipment is likely to be 2.25 lakhs. The expected rate of return on total capital investment is likely to be 25% per annum.

DI-METHYL SULPHATE

Introduction

Dimethyl Sulphate is an important intermediate used in the manufacture of dyes and pharmaceuticals. It is colourless liquid, soluble in alcohol, ether and water. It has specific gravity 1.3516, m.p. (—26.8°C) ; Boiling Point 18°C. Flash Point 182°F. It is highly toxic ; absorbed by skin. It is obtained in various grades like technical, pharmaceutical.

It is also used as methylating agent for amines and phenols. At present six/seven units in our country are producing this intermediate, however due to the growth potential of drugs and pharm ceutical industries, and dye stuff industries—the demand of dimethyl sulphate is readily increasing.

Raw Material Requirements (Basis 200 kgs. per day)

	Kgs.
Methanol	115
Sulphur trioxide	400
Catalyst	Small quantity

Process of Manufacture

The manufacturing process involves mainly two stages of the reaction.

First of all methanol is converted to di-methyl ether and then counter current mixing of the reactants in an aluminium tower charged with reaction product at 40°C. Cooling is done from outside. Dimethyl sulphate formed overflow through an apparatus to test the specific gravity. The product is slurried with anhydrous sodium sulphate and distilled under vacuum. Dimethyl sulphate obtained is of 99% purity.

Machinery & Equipment

1. Methanol vapouriser, mild steel jacketed (1 No.).
2. Separator stainless steel having capacity of 750 litres (1 No.).

3. Stainless steel reactor, capacity 1,000 litres (3 Nos.).
4. Storage tank capacity 40 tonnes (1 No.).
5. Receiver mild steel capacity 40 tonnes (1 No.).
6. Vacuum distillation unit with pump, capacity 4,000 litres (1 No.).
7. Mini boiler oil fired, 150 kgs./hour evaporation capacity, complete with chimney, pipe lines, overhead feed tank and pump (1 No).
8. Refrigeration plant (1 No.).
9. Storage tanks (one for methanol and one for sulphur trioxide) (1 No.).
10. Miscellaneous tools and equipments like weighing scale, fire extinguishers, testing and measuring instruments.
11. Reactor mild steel having capacity 10 tonnes (1 No.).

Cost Analysis

For a plant in small scale sector producing 200 kgs. of dimethyl sulphate per day the cost of machinery and equipment is likely to be Rs. 90,000. The covered area required is 175 square metres. The expected rate of return on total capital investment is likely to be 20%.

DI-OCTYL PHTHALATE (D.O.P.)

Introduction

Di-Octyl Phthalate (DOP) are important plasticizers. It is used in manufacturing vinyl resins. Other applications include in other synthetic resins, elastomers, organic coatings, for compounding with PVC as a plasticizer.

At present about 10 units are manufacturing this product.

Since the growth rate of various plastic industries is increasing at a faster rate, so there is good scope for creation of further capacity in view of the present scarcity experienced in this field.

Raw Material Requirement (Basis 1 M.T. per day)

	Kgs.
Phthalic anhydride	750
Butyl alcohol	475
2-Ethyl hexanol	350
Catalyst	Small quantity

Process of Manufacture

The manufacture of dioctyl phthalate consists in esterification of phthalic anhydride with butyl alcohol or 2-ethyl hexanol in presence of a suitable catalyst to obtain di-octyl phthalate. The ester formed is subject to vacuum distillation and purification. Purified di-octyl phthalate, is then dehydrated under vacuum and treated with activated carbon for decolourization, filtered and then packed in drums.

Equipment & Machinery

1. Reactor with operating pressure 100 mm (1 No.).
2. Distillation kettle (1 No.).
3. Dehydration kettle (1 No.).
4. Sulphuric acid storage tank (1 No)
5. Soda ash solution tank (1 No.).
6. Condensate Tank (1 No.).
7. Mini boiler 100 kgs./hr. at a pressure of 150 psig (1 No).
8. Pumps and motor (4 Nos.).
9. Miscellaneous tools and equipments.

Cost Analysis

For a small scale unit manufacturing 300 tonnes/year of di-octyl phthalate (D.O.P.), the cost of equipment and machinery is likely to be about 5 lakhs. The covered area required is 800 square metres and the expected rate of return on investment is likely to be 20%.

FUMARIC ACID

Introduction

Fumaric Acid is used as an important food acidulant and drug intermediate in the manufacture of ferrous fumrate. It is colourless, odourless, crystalline substance with fruit acid taste. It is slightly soluble in water but insoluble in chloroform and benzene. Besides its major use it is coming up in the field of alkyd resins where it replaces maleic anhydride to give varnishes and lacquers having selective properties. At present ten small scale units and four/five big companies are manufacturing this chemical.

So far accelerated development of chemical industries, there is, therefore, need to augment the production of this product.

Raw Material Requirement (Basis 1 M. T. per day)

	Kgs.
Maleic Anhydride	2100
Water	2000
Catalyst	Small quantity