Manufacture of Paint, Varnish & Allied Products (2nd Revised Edition)
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Paint is any liquid, liquefiable, or mastic composition that, after application to a substrate in a thin layer, converts to a solid film. It is most commonly used to protect, color, or provide texture to objects. Paint can be made or purchased in many colors—and in many different types, such as watercolor, artificial, etc. Paint is typically stored, sold, and applied as a liquid, but dries into a solid. Varnish is a transparent, hard, protective finish or film primarily used in wood finishing but also for other materials. Varnish is traditionally a combination of a drying oil, a resin, and a thinner or solvent. Varnish finishes are usually glossy but may be designed to produce satin or semi-gloss sheens by the addition of “flattening” agents. Varnish has little or no color, is transparent, and has no added pigment, as opposed to paints or wood stains, which contain pigment and generally range from opaque to translucent. The technology of paints, varnishes and allied products is changing rapidly and becoming more complex each day. The paint industry is an important segment of the chemical industry. Paint technology utilizes the science of chemistry, physics and engineering. The paint industry is broadly classified into decorative and industrial segment. Decorative paints consist 70% of market. Paints, varnishes, and allied product industry is gaining ground at a rapid pace in modern time accompanied with closed advance in surface coating technology. They are formulated for specific purposes like outside house paints and exterior varnishes are intended to give good service when exposed to weathering; interior wall paints are formulated to give excellent coverage.

The Rs 40,600-crore Indian paint industry is likely to see a 20 per cent compounded annual growth rate until 2016. The industry will reach the level of Rs 62,000 crore in the next two years. The rural market grew 20 per cent. Rural India’s incremental consumption expenditure is growing well. And, the rural sector has a major share of the decorative paints segment. In FY14, per capita consumption of paint increased to a little over four kg, of which the decorative segment contributed 73 per cent at Rs 29,638 crore. The remaining Rs 10,962 crore was contributed by the industrial segment. The unorganized sector has around 35 per cent of the paint market. In the unorganized segment, there are about 2,500 units. The future for industrial paints, varnishes and allied product is bright.

The content of the book includes information about Paint, Varnish & Allied Products. The major contents of this book are project profiles of projects like Paint industry in India, Acrylic emulsion paints, Aluminium Paint, Cement Paint, Industrial paint, N.C. Thinner, Oil Based Paint, Paint Additives, Red Oxide Paint, Stoving Paint, insulating Varnishes etc.

Project profile contains information like properties, B.I.S specification, market survey, manufacturing process, suppliers of raw material, process flow diagram, plant economics, land and building, plant and machinery, fixed capital, working capital requirement/month, total working capital/month, cost of project, total capital investment, turn over/annum, profit sales ratio, rate of return, breakeven point (B.E.P). This book is very useful for new entrepreneurs, technical institutions, existing units and technocrats.

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Sample Chapter:
Acrylic Emulsion Paints

Paints and coating materials normally consist of a physical mixture of binders, pigments, extenders, additives, and solvents. Depending on the method of application and area of use, the solids content may reach 80 wt%, the proportion of pigment may reach 60% of the solids content. The technologically most important component is the binder (or binder mixture). Binders may be classified as physically or chemically drying according to their film-forming mechanism.

Physically drying paints are solutions of thermoplastic polymers with molecular masses exceeding 20,000 on account of their low solubility they have a high solvent content (> 60%) and low solids content. Chemically drying paints have a fairly low solvent content (30 - 60%) and high solids content because the polymer network is formed by cross-linking of the binder (M_r Ca. 800-10,000) to form thermosetting coatings. Oxidative drying paints contain alkyl groups and reactive double bonds, and cross-link by absorbing oxygen and forming ether bridges.

Normally paints are also classified according to the nature of the principal binder and its associated film properties; e.g., alkyd, acrylic, polyester, nitrocellulose, epoxy, and oil-based paints. The method of application, surface properties, and intended use are also utilized for classification. Since the beginning of the 1980s environmental requirements have become increasingly important for two main reasons, especially in the case of paints with low material transfer (application) efficiencies

1. Avoidance of the use of toxic, carcinogenic, mutagenic, or teratogenic organic solvents.
2. Drastic and in some cases legally imposed reduction of solvent contents.

Legal regulations have resulted in a sharp rise in the solids content and a reduction in the solvent content of the most important paints systems. Among solvent borne paints, high-solids paints have enjoyed the largest growth rate; in the Federal Republic of Germany production of this type of paint rose by 32% between 1988 and 1989, whereas the production of all solvent borne paints increased by only 3%. A sharp drop in high-solvent paints is to be expected in the United States and Europe. The definitions of "low" and high-solids" paints differ. For example, the verb and der Deutschen Lackindustrie (Association of the German Paint Industry) defines "high-solids" paints as paints with a no aqueous (i.e., organic) solvent content of less than 30 wt%, whereas the Environmental Protection Agency (EPA) in the United States defines "high-solids" paints as having volatile organic contents of < 2.8 pounds/gallon (336 g/L).

Typical examples of low-solids paints (solvent content usually > 60 wt%) are:

1. Metallic (effect) base paints for mass production of automobiles and touch-up finishes
2. Thermoplastic coatings
3. Coatings for the electronics and opt-electronics industries

Of these three groups metallic basecoats are quantitatively the most important. Technical reasons for the high solvent content of these paint systems include the need for thin layer thickness (e.g., when applying paint with a spin coater). Secondly, binders such as polyamides for electrical insulation coatings and thermoplastic acrylic resins have low solubility. Finally, in some cases (e.g., in metallic basecoats) a high solvent content is needed to optimize rheological behaviour. Rheological factors limit the reduction of the solvent content, particularly when coatings vertical surfaces. Significant improvements can often only be achieved by replacing organic solvents with water. For example, the solvent borne metal effect paints used in the automobile industry are increasingly being replaced by waterborne paint systems with a reduction in the solvent content in the paint to ca. 10% based on 25% solids.

General Properties of Acrylic Paints

General Properties: Paints containing acrylic resins as binders have been known since the 1930s. They are now one of the largest product classes in the paint and coatings sector. Polyacrylates as binders consist of copolymers of acrylate and methacrylate esters. Other unsaturated Polyester resins, which are derived from the polymerization of maleic anhydride and unsaturated alcohols, also find widespread applications. Polyesters are formed from the esterification of a diacid or diacid chloride and a diol. Typical examples of polyesters are polyester resins containing 2-5% maleic anhydride, known as polyester acrylates.
monomers (e.g., styrene and vinyl toluene) may also be incorporated, but usually to a lesser extent.
Copolymers formed exclusively from acrylates and/or methacrylates are termed pure acrylics. The co-
monomers differ as regards the alcohol residues of the ester group, which also allow incorporation of
additional functional groups. Choice of suitable monomers allows wide variation of the physical and
chemical properties of the resulting polymer. Hydrophilicity, hydrophobicity, and acid-base properties can
be adjusted; resins containing hydroxyl, amine, epoxy, or isocyanate groups can also be produced.
The resin product may be solids, solutions in organic solvents or water, emulsions, or dispersions.
Acrylate resins have several advantages over other paint binders:

1. Polyacrylates are only slightly attacked by chemicals, and confer a high degree of resistance to
paints.
2. Polyacrylates are colourless, transparent, and do not yellow, even after prolonged thermal stress.
3. Polyacrylates do not absorb above 300 nm and are therefore not degraded by UV radiation (as long
   as they do not contain styrene or similar compounds).
4. Polyacrylates do not have unstable double bonds.
5. Polyacrylates have outstanding gloss and gloss retention.
6. Acrylates, and especially methacrylates, are stable to hydrolysis.

The following properties of the coatings can be ascribed to individual monomers. Methyl methacrylate
promotes weather resistance, light fastness, hardness, gloss, and gloss retention. Styrene increases
hardness and resistance to water, chemicals, and salt spray, but reduces light fastness and gloss retention.
Alkylacrylates and alkyl methacrylates impart flexibility and hydrophobicity, while acrylic acid and
methacrylic acid improve adhesion to metals.

The increasing importance of environmental considerations places new requirements on paint resins and
has broadened the range of paint systems. Paints are now required that have a low solvent content
(medium-solids, high-solids coatings) or are solvent-free (powder coatings), that can be adjusted by dilution
with water (waterborne paints), and that are thermoplastic or capable of undergoing cross-linking. All of
these properties must be obtained via the polymer structure of the binders. Important parameters are
described below.

The glass transition temperature ($T_g$) affects adhesion, flaking and peeling from the substrate, crack
formation, and resistance to impact shock. In acrylates adjustment of $T_g$ is achieved relatively easily via the
ratio of methyl methacrylate ($T_g$ of the homopolymer + 105º C) to n-butyl acrylate ($T_g$ of the homopolymer-
54ºC). The $T_g$ also influences properties of dispersions and the viscosity of solutions. A high $T_g$ value is
associated with a faster drying rate. In the low molecular mass range (< ca. 6000), which is of interest
particularly for high-solids paints, the $T_g$ depends on the cross-linking density.
The styrene content in the binder reduces resistance to yellowing and weathering, but improves resistance
to chemicals, hydrophobic properties, adhesion, and pigment wetting. Styrene is therefore largely avoided
in topcoat paints for exterior use and in clear coats.

The development of low-solvent (high-solids) paints requires resins with a very low viscosity. The principal
viscosity-determining parameters for such binders are the molecular mass and molecular mass distribution.
Oligomers with a molecular mass of ca. 1000-3000 are required for high-solids paints. An acrylate binder
with a molecular mass of 1,00,000 can be processed to form a paint with 12.5% solids content at the
application viscosity; a molecular mass of ca. 6000 results in a paint with 50% solids content. A narrow
molecular mass distribution is beneficial in achieving low viscosity. However, the mechanical properties of
paint are favoured by a high molecular mass. Low molecular mass binders that cross link after application
are therefore used exclusively for high-solids paints. When it is applied, the paint contains low-viscosity
oligomers; a highly polymeric system is formed after cross linking and curing. Further possibilities of
reducing the viscosity include specific interactions between the binder molecules and choice of a low-
viscosity solvent that does not interact significantly with the resin. The melt viscosity is an especially important criterion in powder coatings; acrylic resins have disadvantages in this respect when compared with polyesters.

Incorporation of functional groups in the polymer skeleton is necessary for the production of dispersions. Most free carboxyl groups. Water thin ability is achieved by neutralizing the acid groups with aqueous alkali or amines. Binders may also contain basic nitrogen-containing groups; dispersion can then occur after neutralization (e.g., with acetic or lactic acid). Since the viscosity of dispersions is very low irrespective of the molecular mass, polymers of very high molecular mass, polymers of very high molecular mass are generally used; dispersions are therefore ideal for physically drying coatings.

Solvent emission from paints can be reduced without lowering the molecular mass by using non aqueous dispersions (NAD). Acrylates have been described as binders for NADs, but apart from a low viscosity they offer few advantages over conventional coatings and moreover must compete with high-solids paints and powder coatings.

**Application and Uses of Acrylic Paints**

Acrylic paints are used in many different areas and applied by all commonly used methods. Recent developments (low-solvent paints and aqueous dispersions) require special formulation. The largest application sector of acrylate binders are emulsion paints for ceilings, walls, and building fronts. These emulsion paints are generally physically drying and only contain a small amount of binder; the main constituents are pigments and extenders. Acrylate dispersions for paints have a good water vapor permeability and good water resistance.

Acrylic resins have been used in the automotive sector since 1957. They are now important binders in automotive finishes and topcoats, and have replaced alkyd resins in many cases. Advantages for automotive finishes and coatings are high transparency, weather resistance, gloss retention, and yellowing stability. Automotive finishes are always cross-linked; melamine resins are generally used as hardeners, polyisocyanates are being increasingly used for clear coats. Automotive fillers and metallic basecoats may be formulated with acrylate dispersions to reduce solvent emission. Solvent-containing system are, however, still indispensable in the topcoat sector.

**Properties and Testing**

Anyone wishing to test the quality of paint or coating quickly realizes that only a few properties can be accurately scientifically defined. In many cases there is a good correlation between defined physical properties and the behaviour of interest to the scientist or practitioner. In some cases, however, it is impossible to obtain such a correlation. A large number of laboratory testing methods have therefore been developed for paints and coatings that are intended to simulate in-use conditions. These testing methods are often similar but their results are not fully comparable. Standard manuals provide a good overview of available test methods.

**B.I.S. Specifications**

*for further detail, please contact....*

**M/S. Bureau of Indian Standards,**
9, MANAK BHAVAN,
B.S. ZAFAR MARG,
NEW DELHI - 110 002.
Tel: (091) (11) 23230131, 23233375, 23239402.
Fax: 011-23234062, 23239399
E-mail: bis@vsnl.com
Website: http://www.bis.org.in

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**Manufacturing Process**

**Basic Raw Materials Required:**
1. Pigments
2. Acrylic Acid or Ester or Acrylate
3. Aluminium Oleate
4. Hydrogenated Castor Oil
5. Ethylene Glycol
6. Propylene Glycol
7. Tributyl Phosphate
8. Potassium Tripolyphosphate
9. Zinc Phosphate
10. Water
11. Printed Metallic/Plastic Containers

**Basic Plant and Machineries Required:**
1. Dispenser
2. Scales
3. Pre mixer, Dissolver
4. Movable Container
5. Pump
6. Ball Mill
7. Paste Mixer
8. End Product Mixer
9. Filter
10. Sieve
11. Container/Storage Tank
13. Mixing Machine

**Most Probable General Formula of Acrylic base Emulsion paints**

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<tr>
<th>Component</th>
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<tr>
<td>Pigment</td>
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<tr>
<td>Acrylic Acid</td>
<td>10%</td>
</tr>
<tr>
<td>Aluminium Oleate</td>
<td>5%</td>
</tr>
<tr>
<td>Hydrogenated Castor Oil</td>
<td>5%</td>
</tr>
<tr>
<td>Ethylene Glycol</td>
<td>25%</td>
</tr>
<tr>
<td>Propylene Glycol</td>
<td>25%</td>
</tr>
<tr>
<td>Tributyl Phosphate</td>
<td>2%</td>
</tr>
<tr>
<td>Potassium Tripolyphosphate</td>
<td>2%</td>
</tr>
<tr>
<td>Zinc Oxide</td>
<td>1%</td>
</tr>
<tr>
<td>Water</td>
<td>15%</td>
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**Process**
Take above all the materials from store by weight. Keep all the materials separately with their serial use.

Take pigments by weight and put it in the ball mill to ground it and pass it through the shifting sieve and make powder below 300 meshes. Store it in the storage tank. Now put Acrylic Acid in the premixer. Add ethylene glycol and propylene glycol in the premixer and agitate the premixer at 200 rpm, such that acrylic acid mixes homogeneously in the solvent. Now add aluminium oleate in the premixer and mix it at 200 rpm, such that a homogeneous mixed solution formed. Now add Zinc oxide to the premixer and agitate continuously such that a homogeneous mixed product formed. Now keep on mixing another hour after last product addition.

Take water in the premixer where add potassium tripolyphosphate and agitate the mixer till it form uniform homogeneous mixed product. After that add tributylphosphate to the water and mix it till it forms a homogeneous mixed product. Heat the mixed product to 90°C and add hydrogenated castor oil to it with agitation 200 rpm, till a homogeneous mixed product formed.

Now put both the mixed product (solvent base and water base mixed product) in the dispenser and agitate the dispenser at 400 rpm, such that both the product mixed together and formed homogeneous mixed product. Now add slowly pigments in the mixer with the agitation of 400 rpm, till the complete addition of the pigments. After complete addition of pigment agitate the mixed product another 12 hours such that it will form optimum viscosity. Check the product quality then fill in the printed packing material according to required weight. It may be vary from 1 Kg to 20 Kgs by automatic filling and sealing machine. Store the product for marketing.

Raw Materials Suppliers

M/s. Alka Minerals & Chemicals
25, DSIDC Sheds,
Jhilmil Industrial Area,
G. T. Road, Shahadara,
Delhi-110 095.
Ph.: 011-22271104, 22285830.
Fax: 011-25719220, 25756148.
E-mail: alkamine90@hotmail.com

M/s. Indian Aluminium Co. Ltd.
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Jeevan Deep Building,
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Kolkata-700 071.
West Bengal.
Ph.: 033-22402210, 22809710.
Fax: 033-22473808, 22884808.
E-mail: abhgr@indal.co.in
Web: www.indal.com

M/s. Taurus Chemicals (P) Ltd.
318, Swapnalok Complex,
92/93, S. D. Road,
Secunderabad-500 003.
Andhra Pradesh.
Ph.: 040-27814501, 27814502, 27811022.
Fax: 040-27849170.
E-mail: info@tauruschemicals.com
M/s. H. K. Finechem Ltd.
201, Aniket, C. G. Road,
Navrangpura,
Ahmedabad-380 009.
Gujarat.
Ph.: 079-26468752, 26402429.
Fax: 079-26460910.

M/s. VVF Ltd.
Opp. Sion Fort Garden,
109, Sion (E),
Mumbai-400 022.
Ph.: 022-24073221, 24073222, 24030802.
Fax: 022-24091554, 24073771.
E-mail: doy@vvfltd.com
Web: www.vvfltd.com

M/s. Acme Synthetic Chemicals
Next to Ram Mandir,
Ram Mandir Road,
Goregaon (W),
Mumbai-400 104.
Ph.: 022-28724258, 28722581, 28785753.
Fax: 022-287299178.
E-mail: acmechem@vsnl.com
Web: www.acmechem.com

M/s. Naren Chemicals
Plot No. 562, Phase II,
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Vatva, Ahmedabad-382 445.
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Fax: 079-25893896.
E-mail: narenchemicals@rediffmail.com

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Ph.: 022-22056895, 28894226.
Ph.: (R) 022-28899598.
Fax: 022-28894226.
E-mail: ritacorp@vsnl.net
Web: www.ritacorporation.com

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Hydrochem House, Gautam Nagar,
**M/s. Aamaan Industries**  
D-4, 549, Marmik Society,  
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Kandivali (W),  
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Ph.: 022-56004715.  
Fax: 022-56004715.  
E-mail: mehta_manor@yahoo.com

**PLANT ECONOMICS**

<table>
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<th>Description</th>
<th>Value</th>
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<td>Rated Plant capacity (MT/day)</td>
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<td>= Rated Plant capacity (MT/annum)</td>
<td>3000.00</td>
</tr>
<tr>
<td><strong>ACRYLIC EMULSION PAINTS</strong></td>
<td></td>
</tr>
<tr>
<td>Basis</td>
<td></td>
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<tr>
<td>No. of working days (days/month)</td>
<td>25</td>
</tr>
<tr>
<td>= No. of working days (days/annum)</td>
<td>300</td>
</tr>
<tr>
<td>No. of shifts</td>
<td>3 per day</td>
</tr>
<tr>
<td>One shift</td>
<td>8 hours</td>
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</tbody>
</table>

**LAND & BUILDING TOTAL**  
Rs. 259 Lakh

**PLANT & MACHINERY**

1. Ball Mill
2. Moveable Balance (Electronic
3. Automatic Filling Weighing and Packing Machine
4. Conveyor Belt with driving motor, pulley,
5. Close Dispensers
6. Jacketed Close Premixer
7. Moveable Containers
8. Storage Vessels
9. Mixing Machine Containing Alfa blade as agitator inside volume of the mixer
10. Driving motors and reducing Gear.
11. Filtration Unit. Notch type filter Surface area
12. Sifter Sieves (Containing 300 mesh Sieve)  
   - Boiler 2 MT Capacity Steam  
   - Pumps  
   - Effluent Treatment Equipments  
   - Laboratory Equipment  
   - Maintenance Equipment  
   - Miscellaneous Machinery  
   **TOTAL**  
   Rs. 150 Lakh

**FIXED CAPITAL**

1. LAND & BUILDING  
   Rs. 259 Lakh
2. PLANT & MACHINERY  
   Rs. 150 Lakh
3. OTHER FIXED ASSETS  
   Rs. 112 Lakh
### RAW MATERIALS

1. Pigment
2. Acrylic Acid
3. Aluminium Oleate
4. Hydrogenated Castor Oil
5. Ethylene Glycol
6. Propylene Glycol
7. Tributyl Phosphate
8. Potassium Tripolyphosphate
9. Zinc Oxide
10. Printed Packing Material
11. Lab Chemicals
12. Miscellaneous Chemicals

**TOTAL** Rs. 315.6 Lakh

### TOTAL WORKING CAPITAL/MONTH

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
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</thead>
<tbody>
<tr>
<td>RAW MATERIAL</td>
<td>Rs. 315.6 Lakh</td>
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<tr>
<td>SALARY &amp; WAGES</td>
<td>Rs. 9.69 Lakh</td>
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<td>UTILITIES &amp; OVERHEADS</td>
<td>Rs. 1.1 Lakh</td>
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<td><strong>TOTAL</strong></td>
<td>Rs. 326.39 Lakh</td>
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### COST OF PROJECT

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<th>Amount</th>
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<tr>
<td>TOTAL FIXED CAPITAL</td>
<td>Rs. 326.39 Lakh</td>
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<tr>
<td>MARGIN MONEY</td>
<td>Rs. 2.41 Lakh</td>
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<td><strong>TOTAL</strong></td>
<td>Rs. 328.8 Lakh</td>
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### TOTAL CAPITAL INVESTMENT

<table>
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<tbody>
<tr>
<td>TOTAL FIXED CAPITAL</td>
<td>Rs. 326.39 Lakh</td>
</tr>
<tr>
<td>TOTAL WORKING CAPITAL FOR 3 MONTHS</td>
<td>Rs. 9.67 Lakh</td>
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<td><strong>TOTAL</strong></td>
<td>Rs. 336.06 Lakh</td>
</tr>
</tbody>
</table>

### TURN OVER/ANNUM

- **=** 908 Lakh

### PROFIT SALES RATIO

- **=** 25.06%

### RATE OF RETURN

- **=** 34.92%

### BREAK EVEN POINT (B.E.P)

- **=** 33.36%

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NIIR Project Consultancy Services (NPCS) is a reliable name in the industrial world for offering integrated technical consultancy services. Its various services are: Pre-feasibility study, New Project Identification, Project Feasibility and Market Study, Identification of Profitable Industrial Project Opportunities, Preparation of Project Profiles and Pre-Investment and Pre-Feasibility Studies, Market Surveys and Studies, Preparation of Techno-Economic Feasibility Reports, Identification and Selection of Plant and Machinery, Manufacturing Process and or Equipment required, General Guidance, Technical and Commercial Counseling for setting up new industrial projects and industry. NPCS also publishes various technology books, directory, databases, detailed project reports, market survey reports on various industries and profit making business. Besides being used by manufacturers, industrialists and entrepreneurs, our publications are also used by Indian and overseas professionals including project engineers, information services bureau, consultants and consultancy firms as one of the input in their research.