

Future scope

Environmental concerns

- The VOC content, often more than 20% by weight, during manufacture & use contributes to smog in urban areas.
- On 1st January 2010, India banned the sale of leaded petrol.
- More than 90% of paint manufacturers have shifted to low-VOC products.
- Paints have been禁售 in Europe since 1991.

Challenges faced by the paint industry

- High initial investment required for plant setup.
- Raw material costs are high.
- Fluctuation in oil prices affects the cost of production.
- Regulations and environmental concerns.
- Competition from foreign companies.
- Technological advancements.

Process Equipment



Spray booth
Spray booth is a closed chamber used for applying paint to objects. It contains filters to remove overspray and dust particles.

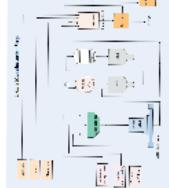
Introduction

What are paints?
Paints are coatings that consist of solvents or pigments suspended in a liquid or solid medium.

What are the uses?
- Protecting metals from corrosion.
- Insulation.
- Protection against water damage.
- Protection against fire and heat.

- More than 90% of paint manufacturers have shifted to low-VOC products.

- Paints have been禁售 in Europe since 1991.



Properties of a Good Paint



Industrial Paints
Industrial paints are used for protection and decoration of industrial structures.

Future scope

Paints

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Characteristics of a Good Paint

- Substitution
- Cost effective
- Easy to apply
- Good adhesion
- Water proof
- UV protection
- Smooth surface
- Easy to clean
- Easy to remove

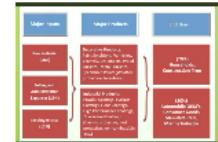
Raw materials

- 60% of total expenditure is spent on raw materials.
- Price fluctuation of cost of titanium dioxide and other raw material has a substantial impact on cost of production.

Company analysis

Category	Business Model	Total Sales (in Rs Cr)	Total Profit (in Rs Cr)	Net Profit Margin (%)
Paints Sector	Manufacturing	36000	3100	8.6%
Interior Paints	Manufacturing	20000	1800	9.0%
Exterior Paints	Manufacturing	16000	1300	8.1%
Other Paints	Manufacturing	4000	300	7.5%
Total Paints Sector	Manufacturing	66000	6500	9.8%

So how does the industry works??



Raw materials

Raw materials include pigments, binders, solvents, and additives. Pigments provide color and opacity, binders hold the pigment together, solvents thin the paint, and additives improve performance.

Manufacturing

Paints are manufactured through various processes like emulsion, dispersion, and solvent-based methods.

Distribution

Paints are distributed through intermediaries like paint dealers and distributors.

Marketing and sales

Marketing involves creating demand through advertising, sales promotion, and distribution channels.

Economic issues

- Globalization and competition from foreign companies.
- Fluctuation in oil prices and raw material costs.
- Regulations and environmental concerns.
- Technological advancements.

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Market Analysis

- The market for industrial paints is growing rapidly due to increasing industrialization and infrastructure development.
- The market for exterior paints is also growing rapidly.
- The market for interior paints is stable.
- The market for other types of paints is small but growing.

Paint Industry

- The paint industry is highly fragmented, with many small and medium-sized companies.
- There is a significant number of foreign players in the market.
- The industry is heavily regulated by environmental laws.
- Technological advancements are driving growth.

Nonionic Compounds As Pigments In Paints

- Nonionic compounds are widely used as pigments in paints due to their good lightfastness and stability.
- Common nonionic compounds include titanium dioxide, zinc oxide, and barium sulphate.
- These compounds are used in various applications such as exterior and interior wall coatings, floor coatings, and industrial coatings.

Paints

- Paints are coatings that consist of solvents or pigments suspended in a liquid or solid medium.
- Paints are used for protection and decoration of surfaces.
- Paints are manufactured through various processes like emulsion, dispersion, and solvent-based methods.
- Paints are distributed through intermediaries like paint dealers and distributors.
- Paints are marketed through advertising, sales promotion, and distribution channels.

Fin

Manufacturing Of Paints



Chemical Process Technology

By - Jitendra J 2013A1PS509G
- Ahmed 2013A1PS524G
- Abhijay Giri 2013A1PS454G
- Arnika Jain 2013A1PS672G



Introduction

What are Paints ?

- Paint is a term used to describe a number of substances that consist of a pigment suspended in a liquid or paste vehicle such as oil or water.

What are the uses ?

- It helps to protect the metal from corrosion
- Art work
- It is used as a "reflective coating" for traffic system
- It is also used as "water insulation for roofs and ceilings"
- As a "Fire resistant coatings"



History

Primitive paintings tended to depict humans and animals.

Early artists relied natural substances to make paint, such as natural earth pigments, charcoal, berry juice and blood.

The earliest known cave paintings/ drawings of animals are at least 35,000 years old, at Maros on the island of Sulawesi in Indonesia



At the top of the worn painting is a faint outline of a human hand. Below it is the earliest depiction of an animal

Cueva de las Manos ([Spanish](#) for **Cave of Hands**), Santa Cruz, Argentina. It is famous for (and gets its name from) the paintings of hands.

It has been dated to 7300 BC.

Mineral pigments include iron oxides, producing reds and purples; kaolin, producing white and manganese oxide, which makes black.





- Ancient Chinese, Egyptians, Hebrews, Greeks, and Romans used materials to produce paints for limited decoration, such as painting walls. Oils were used as varnishes, and pigments such as yellow and red ochres, chalk and malachite green were mixed with binders such as gum arabic, lime, egg albumen, and beeswax.
- In Boston around 1700, Thomas Child built the earliest American paint mill, a granite trough within which a 1.6 foot granite ball rolled, grinding the pigment.
- It wasn't until 1867 that manufacturers began mixing the vehicle and the pigment for consumers.
-
- The Earliest paint factory in India dates back to 1902 when Shalimar Paints Colour and Varnish Co. was established at Calcutta. (A Pinchin johnson Unit.)

Paint Content

Resin (Binder)

20% - 30%

- The resin is the fine-forming component that identifies the paint. A variety of resin and polymer materials that will undergo reaction to form a resin are used in paints.

- Oil was commonly used in paint formulation but has declined as improved polymers were developed that could be used for a broader variety of coatings.

- Paint binders may be referred to as convertible and nonconverting types

Solvents

30% - 55%

- A solvent is a pure or mixed liquid that is used to make the paint flowable prior to its application.
- Solvents are chemical substances that can dissolve, suspend, or extract other materials, usually without chemically changing either the solvents or the other materials.
- For a solvent to work it needs to have similar chemical characteristics to the substance that it's trying to dissolve.
- Ideally the solvent should also be nontoxic, of low cost, and have an acceptable odour.

Driers

1% - 4%

- The drying process is a complex oxidation reaction. The unsaturated drying oils polymerize by a reaction mechanism which involves a peroxide intermediate.
- Natural rate of reaction is slow and it is usually accelerated by the addition of driers.
- Examples: Cobalt or Lead Naphthenate.

Pigments

12% - 15%

- Pigments are particulate solids that are dispersed in paints to provide certain characteristics to them, including colour, opacity and durability.
- Paints differ from varnishes mainly because they contain a pigment.
- Pigments have to be uniformly dispersed in the binder to provide a consistent appearance. They have to remain in suspension or be easy to disperse if settling occurs.
- Titanium dioxide is the most important white pigment and carbon black is the principal black pigment.

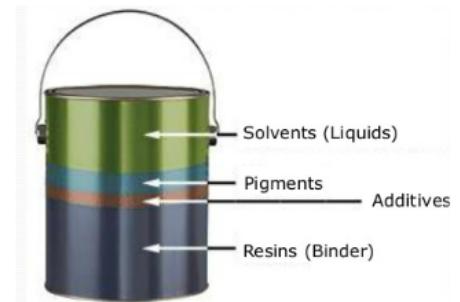
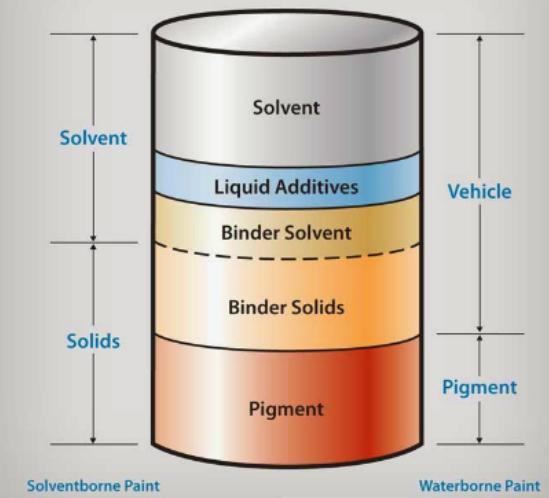
Additives

2% - 9%

- Additives are chemical additives in paint, usually in small quantities, to achieve special effects.
- Typical paint additives may be classified by their effect on the properties of liquid or dry paint.
- Additives can affect the paint material characteristics and the finished film properties.
- Examples of properties that can be affected with paint additives include: viscosity, bonding, pigment dispersion, stability, flexibility/hardness, gloss, UV resistance, fire resistance, barrier resistance, and many more.

Paint Contents

55 gallon Drum



Resin (Binder)

20% - 30%

- The resin is the film-forming component that identifies the paint. A variety of resins and polymers (materials that will undergo reaction to form a resin) are used in paints.
- Oils were commonly used in paint formulation but have declined as improved polymers were developed that could be used for a broader variety of coatings.
- Paint binders may be referred to as convertible and nonconvertible types

Convertible paints are materials that are used in an un-polymerized or partially polymerized state and undergo reaction (polymerization) to form a solid film after application to the substrate.

They include oils, alkyls, amino resins, epoxy resins, polyurethane resins and thermosetting acrylics.

Nonconvertible paints are based on polymerized binders dispersed or dissolved in a medium that evaporates after the coating has been applied to leave a coherent film on the substrate surface.

They include cellulose, nitrocellulose, chlorinated rubber and vinyl resins

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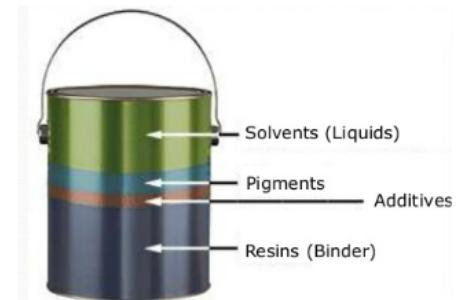
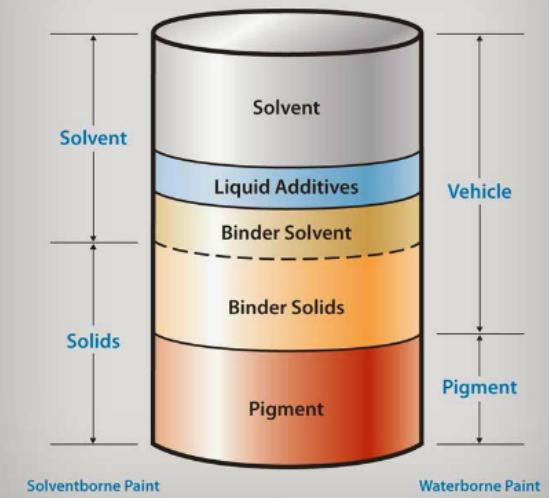
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Paint Contents

55 gallon Drum



Pigment	Content
White	Titanium Dioxide Zinc Oxide White Lead
Yellow Pigments	Lead Chromates <u>Benzidine Dyes</u> Azo Dyes
Blue	<u>Pthalocyanine Blues</u> Prussian Blue Ultramarine Blue
Green	<u>Pthalo Green</u> Chromium Oxide Lead Chrome Green
Red	Toluidine Red <u>Arylamide Red</u> Red Iron Oxide

INORGANIC COMPOUNDS AS PIGMENTS IN PAINTS

A NUMBER OF INORGANIC COMPOUNDS ARE USED AS PIGMENTS IN PAINTS. MANY OF THESE COMPOUNDS ARE COLOURED DUE TO THE ABSORPTION OF LIGHT ENERGY BY ELECTRONS IN d ORBITAL SUBSHLLS, MEANING WE SEE COLOURS DEPENDING ON WHICH WAVELENGTHS OF LIGHT ARE NOT ABSORBED BY THE COMPOUND.



CARBON BLACK
Carbon
C



TITANIUM WHITE
Titanium dioxide, TiO_2 ,
ANTIMONY WHITE
Antimony trioxide, Sb_2O_3 ,
ZINC WHITE
Zinc Oxide, ZnO



COBALT VIOLET
Cobalt (II) phosphate
 $\text{Co}_3(\text{PO}_4)_2$



ULTRAMARINE BLUE
 $\text{Na}_3\text{Al}_2\text{Si}_3\text{O}_{10}$,
PRUSSIAN BLUE
Ferric hexacyanoferrate, $\text{Fe}_3(\text{CN})_6$,
COBALT BLUE
Cobalt (II) aluminate, CoAl_2O_4



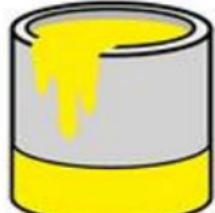
CERULEAN BLUE
Cobalt (II) stannate
 Co_2SnO_4



CHROME GREEN
Chromium (III) oxide
 Cr_2O_3



VIRIDIAN GREEN
Hydrated chromium (III) oxide
 $\text{Cr}_2\text{O}(\text{OH})_4$



CADMIUM YELLOW
Cadmium sulfide, CdS ,
CHROME YELLOW
Lead chromate, PbCrO_4 ,
ZINC YELLOW
Zinc chromate, ZnCrO_4



CADMUM ORANGE
Cadmium sulfoselenide
 Cd_2SSe



CADMUM RED
Cadmium selenide, CdSe ,
RED OCHRE
Iron (III) oxide, Fe_2O_3



Pigment Production Process

TiO₂ Manufacturers In India

Travancore Titanium Products Ltd.,
(Thiruvananthapuram)

KMML (The Kerala Minerals and Metals Ltd.)

Kilburn Chemicals Ltd. (Kolkata)

Aromax Colourants Pvt. Ltd., (Ahmedabad)

United Chemical Corporation, (Mumbai)



TiO₂ Manufactures In India

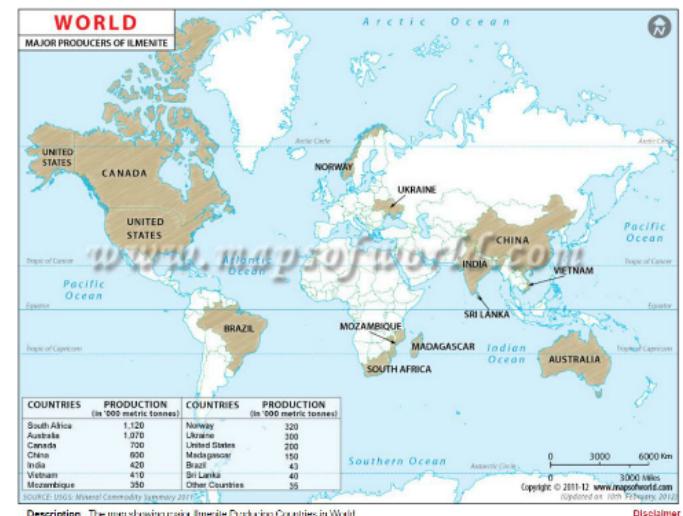
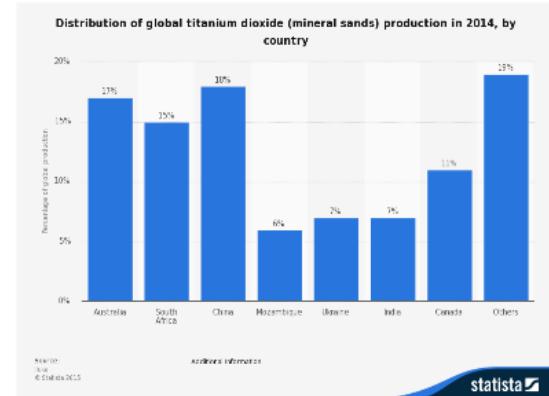
Travancore Titanium Products Ltd.,
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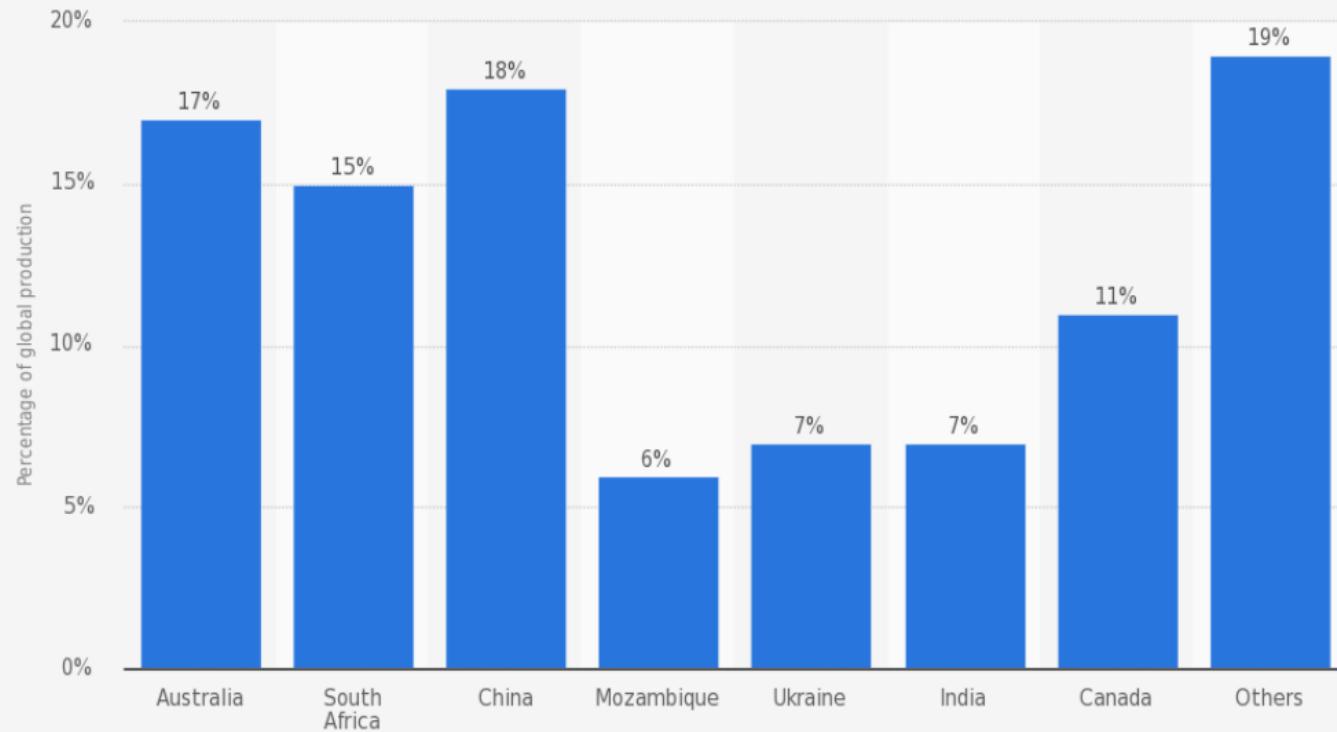




Description : The map showing major Ilmenite Producing Countries in World.

Disclaimer

Distribution of global titanium dioxide (mineral sands) production in 2014, by country



Source:
Iluka
© Statista 2015

Additional Information:

statista

US, the corresponding figures for the uses of titanium dioxide in paint is 50%, whereas those for plastics and paper are similar, 25% and 13%

Titanium dioxide is a simple inorganic compound produced as a pure white powder. It is commonly available in two main crystal forms, **anatase** and **rutile** and typically supplied to the market in a range of package sizes or in bulk. Water based slurry production are also common in USA.

It is the properties and uses of titanium dioxide that make it interesting and valuable chemical and overshadow its rather mundane appearance.

It has a very high refractive index of ca. **2.7** which compares with values of only **2.0** and **1.6** for **zincOxide** and **china clay** respectively.

This high refractive index gives the potential for producing much greater opacity or hiding power, making TiO₂ a much better pigment than the other chemicals

The **crystal size** of the TiO₂ also needs to be optimised to maximise its effectiveness as a pigment, the optimum for light scattering being **around 0.2 μm** .



Uses of titanium dioxide

TiO₂ is resistant to UV radiation and thus does not discolour over a long period of time and ultra pure and fine crystal titanium dioxide grades are being increasingly used for sun screens.

It is also being used in novel nanotechnology applications.

World	5.1 million tonnes
Europe	1.4 million tonnes
US	1.4 million tonnes
China	1.7 million tonnes

Annual production of titanium dioxide

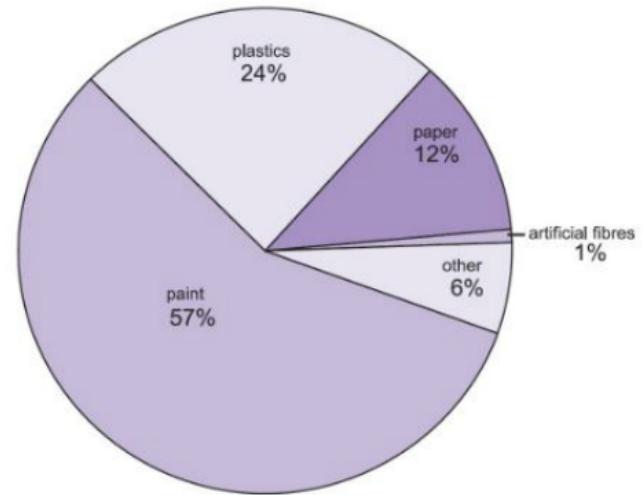


Figure 1 *Uses of titanium dioxide*

The proportions shown in Figure 1 are for the World. The figures vary country by country. For example in the US, the corresponding figures for the uses of titanium dioxide in paint is 50%, whereas those for plastics and paper are similar, 25% and 13%

Manufacture of Titanium Dioxide From Ilmenite

- The process for the manufacture of titanium dioxide is known as sulphate process using the ilmenite ore ($\text{FeO}-\text{TiO}_2$) as the raw material and converting it to a more Suitable form of rutile ore (TiO_2).
- The rutile grade produces better quality paint. Almost all paint manufacturers use the rutile quality pigment.
- Modern plants convert ilmenite ore into rutile grade (called **synthetic rutile**) and produce titanium dioxide



Ilmenite beneficiation

Sand containing ilmenite ($\text{FeO}-\text{TiO}_2$), obtained from ilmenite rich washed **beach sands from seashore**, is separated from other constituents using first milling and drying and then using electrostatic, magnetic and gravitational separation techniques.

HCl digestion and recovery

Sand is **roasted and leached**, by which most of the ferrous iron is removed. Then it is digested with HCl and leached to obtain beneficiated ilmenite. The HCl reacts with the ferric iron (Fe_2O_3) in the digestion process and forms FeCl_3

Feedstocks	TiO_2 (%)
Rutile	93 – 96.5
Synthetic Rutile	88 - 95.5
Chloride Slag	85 – 86
Sulphate Slag	79 – 86
Ilmenite	45 - 65



The HCl is reclaimed by a process of spray roasting and heating, converting highpurity ferric chloride to ferric oxide and HCl.



The following chemical reaction takes place, forming titanium tetrachloride ($TiCl_4$)



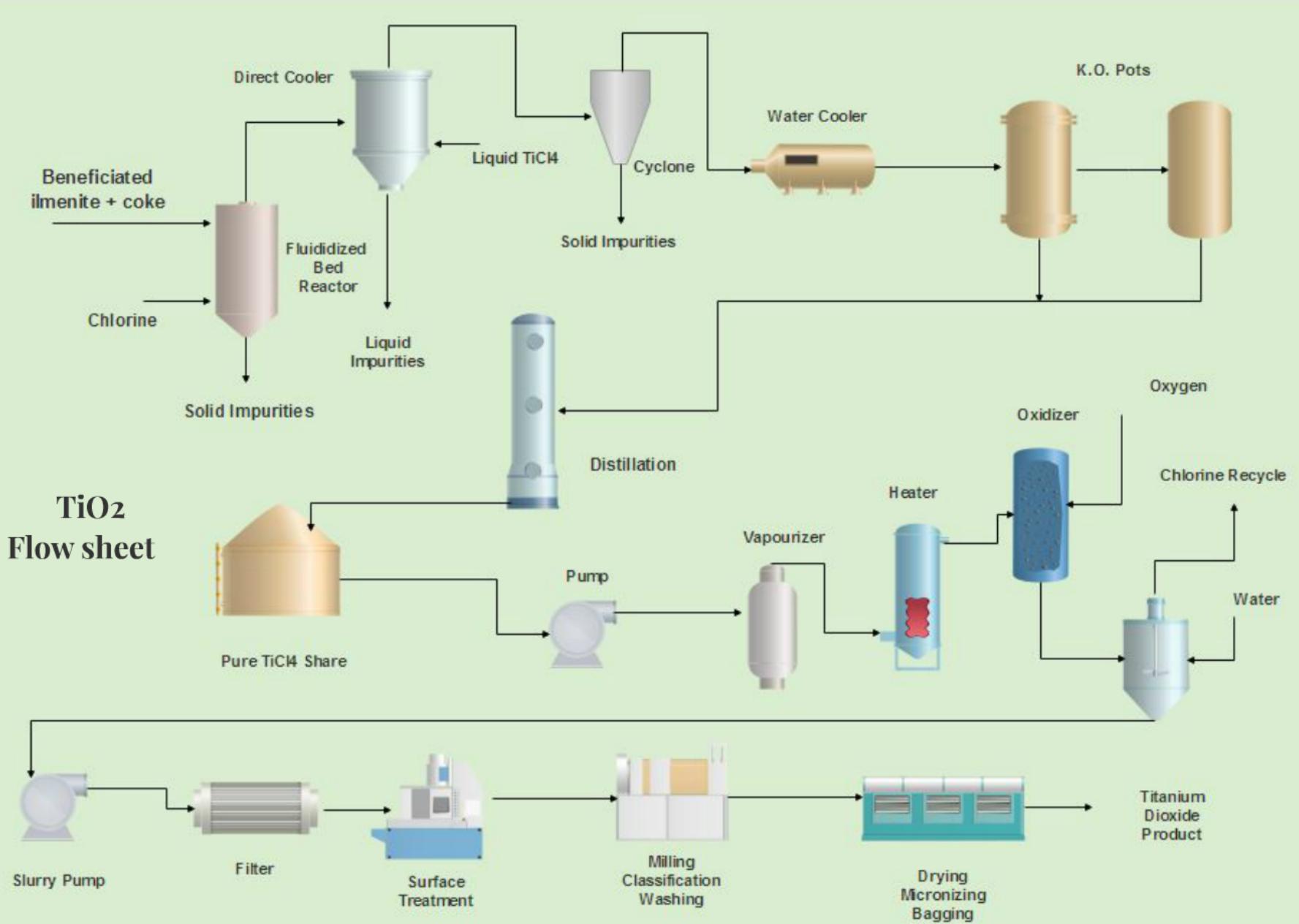
The other chlorides are removed from $TiCl_4$ by directly cooling using $TiCl_4$. Solid impurities are removed by cyclone separation. Again $TiCl_4$ is cooled with cooling water and then with chilled refrigerant concentrated by distillation to obtain pure $TiCl_4$ in liquid form which is sent to storage.

Oxidation, surface treatment and finishing

The pure $TiCl_4$ is vaporized and preheated and sent to an oxidiser where by an oxygen stream (99.98 % purity) produced by an air separator plant. The following chemical reaction takes place.



This reaction is exothermic. The chlorine gas evolved is recycled back to the fluidized bed reactor. The product is quenched in water which forms a slurry of titanium dioxide in water. The slurry is stored and then sent to filtration , milling, polishing and surface coating . Micronizing is done using superheated steam as the medium. Finally, the product is packaged in bags and sent to storage for sale or further processing in paints



Equipments For Production



Sand washing plant

*SME equipments Manufacturing Co.
Shanghai, China*



ball mill

*SME equipments Manufacturing Co.
Shanghai, China*

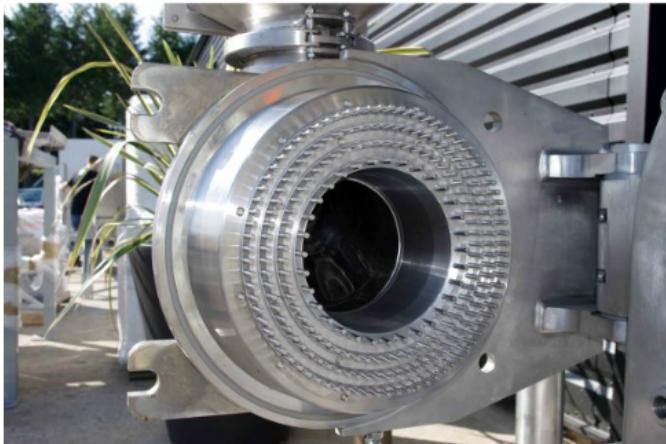




Cyclone Separators
*REES Memphis Co.
Memphis, Tennessee*



Fluidized Bed Reactor
*DEGREMONT TECHNOLOGIES
USA, Australia*



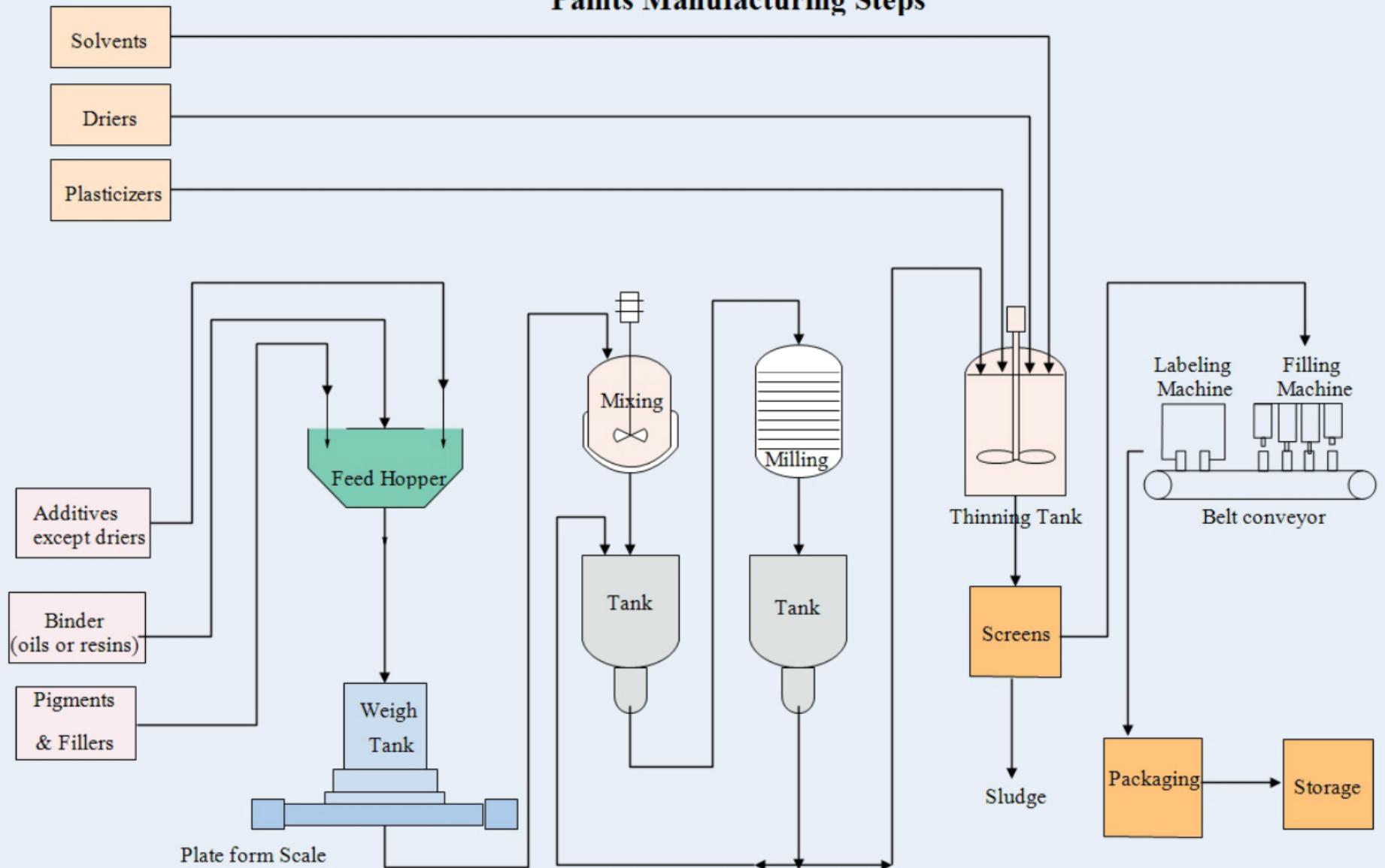
Micronizing equipment
*PALAMATIC PROCESS
Brécé, France*

Paints

Characteristics of a Good Paint

- Good Spreading power
- Consistency
- Drying up capacity
- Satisfactory adherence
- Impervious and weather resisting
- Neither crack nor shrink
- Should not reveal brush mark
- Attractive appearance
- Should not affect the health of the workers

Paints Manufacturing Steps



Process Equipment

Sand Mills



- >Mainly used by coating, ink and paint industries for the size reduction and dispersing of pigments in the liquids.
- >The pigment particles are dispersed upto 2 microns in a single pass.
- >The milling chamber is fitted with grinding media, where the feed is pumped from the bottom chamber.
- >Material moves upwards and subjected to high shearing force resulting in finely grinded material.
- >A jacket arrangement is also provided for the cooling of grinding material in the chamber.



Ribbon Blender / Pug Mixer



- >Consists of a center shaft of appropriate diameter. The center shaft of this equipment is fitted with specially designed agitator blades to provide contraflow action.
- >Contraflow action ensures constant circulation and proper mixing or blending of ingredients. Ends of the equipment are installed with stuffing boxes on the shaft that prevent leaking of blended ingredients and stop them from entering into bearings.
- >The shaft is supported by heavy duty pedestals, thereby, ensuring efficient functioning of our ribbon blender/pug mixer.
- >Fabricated using high quality mild steel and stainless steel.

Sigma Kneader



- >Sigma Kneaders are used for making stiff paints .
- >The equipment made available in this range is twin basin kneading machine, which is equipped with two horizontally arranged kneading blades. Further, kneading blades are deeply geared into one another and strip themselves reciprocally.
- >These machines are utilized for manufacturing specialty pigments and flushed colors.
- >The mixing action incorporated by Sigma Kneaders is a combination of shearing, stretching, folding, dividing and recombining.
- >Material fed into the equipment is processed between the sigma blades and the container walls.
- >Jacket arrangement of this machine is for heating or cooling application.

Twin Shaft Disperser

- > Considered as most versatile equipment for paint production.
- > Specifically designed to disperse, mix and homogenize products.
- > The process of dispersion is carried out by the centrally located shaft, and the low speed shaft is responsible for the mixing mechanism.
- > Extensively used for manufacturing plastic emulsions and eco-friendly water based paints.
- > These machines comprise two agitator shafts, and are available in different sizes and capacities.
- > One of the shafts operates at high speed and the other at slow speed.



High Speed Dispersers



- >These equipment are primarily used for premixing enamels before passing through sand mills, dispersion of water based emulsions and finish paint blending.
- >Effects of the mixing and equalizing is optimum due to little absorption and reservation of air during stirring and dispersing of the material.
- >>If stirred and dispersed at medium or fast speed, the materials fed into the machine will be dissolved quickly and their granules will become smaller.
- >>Owing to their optimum performance, these processing equipment find widespread application in industries engaged in manufacturing products such as paints, emulsion, printing inks, chemicals and many more.

Filters

Used to remove foreign particles or remove particles which were not ground to the required size or some polymers that did not dissolve.

- > Fine Screens
- > Filter press
- > Centrifugal separator for varnishes purification
- > Settling for varnishes purification

PAINT INDUSTRY

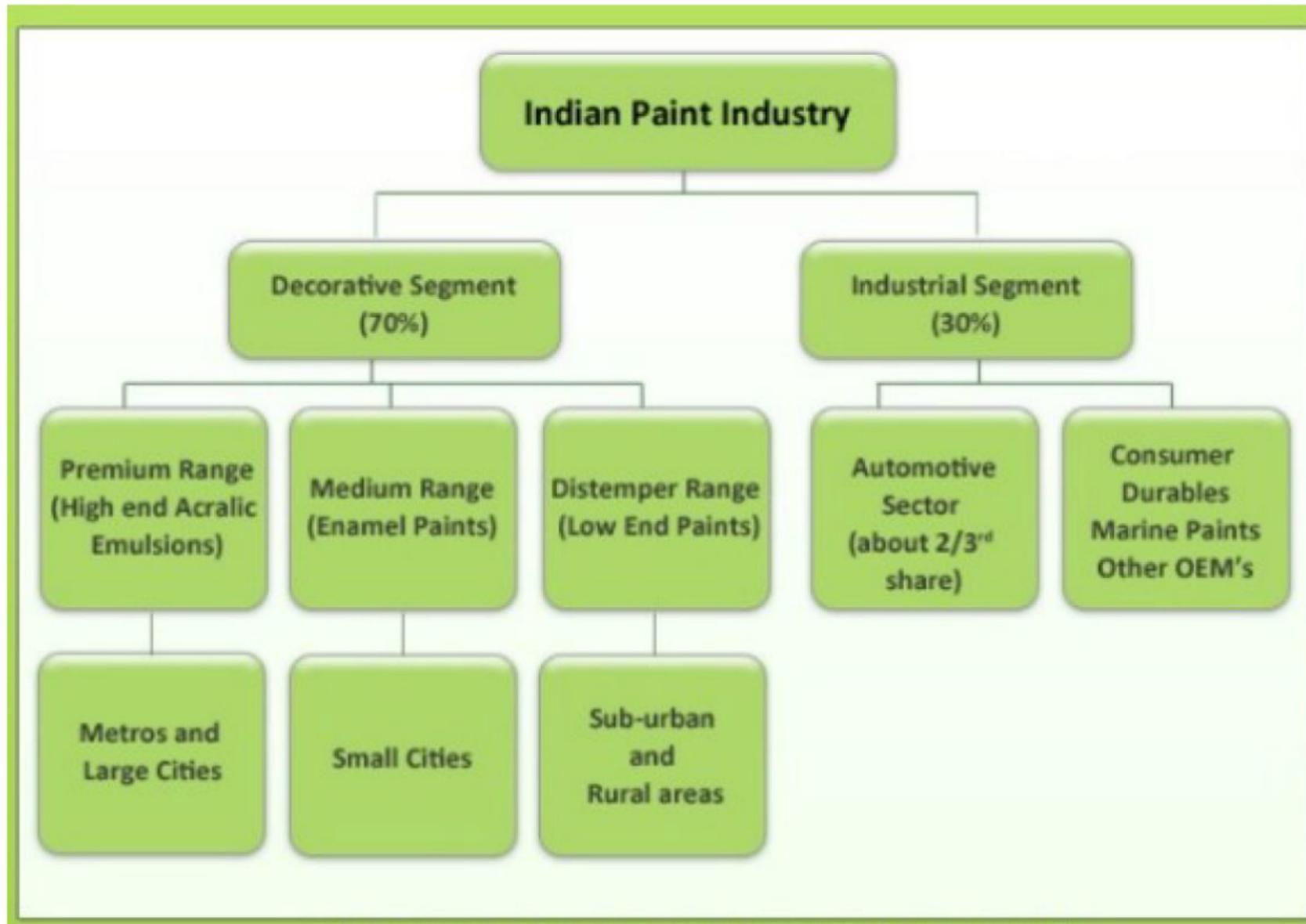
Trends found in the industry

- Indian Paint industry is estimated to be a Rs.21000 Cr industry
- Growing at a rate of 15%
- Focus on research and development
- View change to protective coating to aesthetic coating
- An increased boost on market creation and distribution

MARKET ANALYSIS

Two sectors

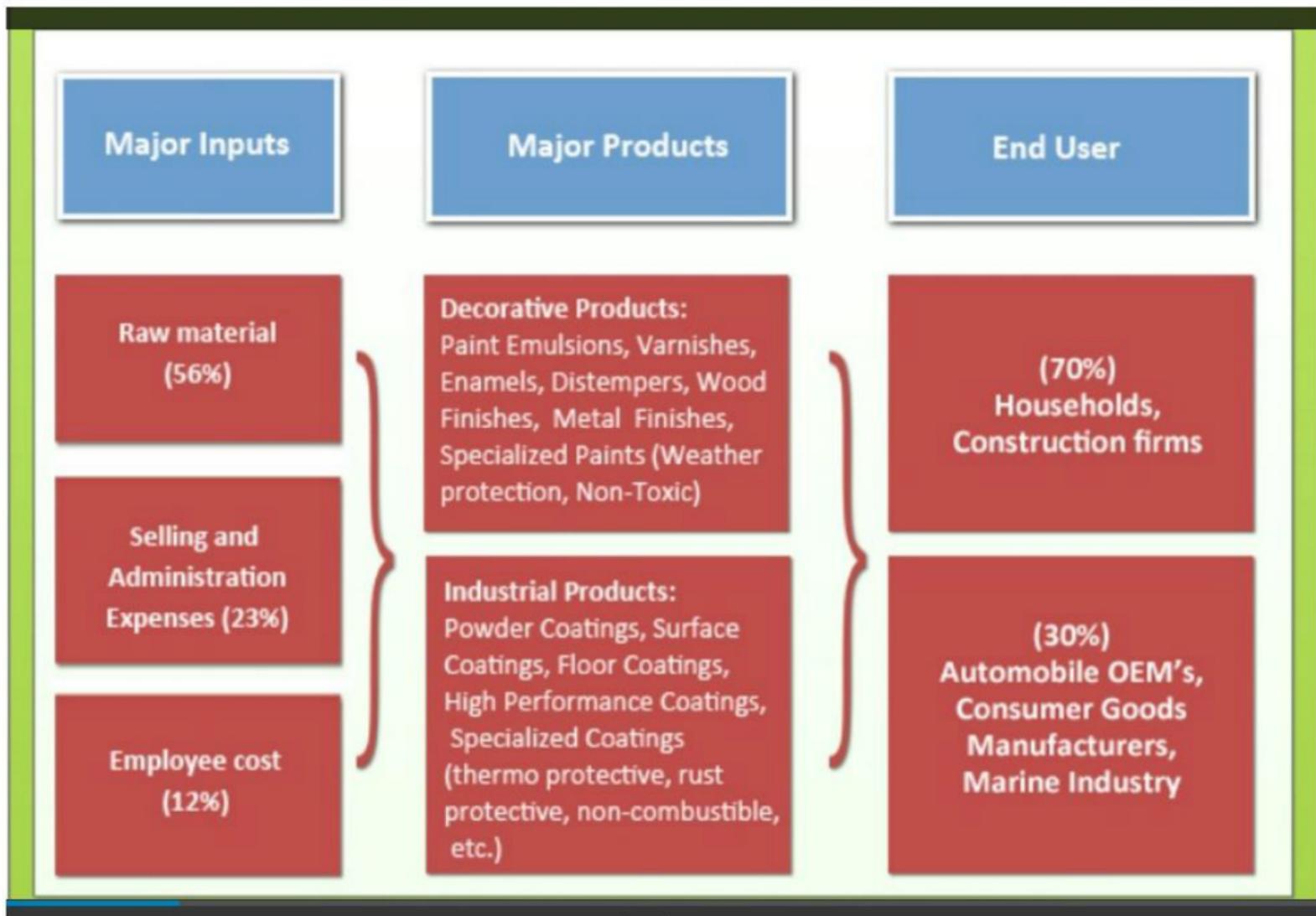
- Housing sector – decorative purposes-70%
- Industrial sector which consists of powder coatings, floor coatings and other protective coatings catering to the automobile, marine and other industries – 30%



Economic issues

- Supply : Supply exceeds demand in both decorative as well as the industrial paint segments.
- Demand : Demand for decorative paints depends in the housing sector and good monsoons. Industrial paint demand is linked to user industries like auto, engineering and consumer durables.
- Bargaining power of suppliers : Price increase constrained with the presence of the unorganized sector for the decorative segment. Sophisticated buyers of the industrial paints also limit the bargaining power of suppliers. Thus the margins are better in the decorative segment.
- Bargaining power of the customers : High due to availability of wide choice.
- Competition : In both categories companies in the organized sector focus on brand building. Higher pricing through product differentiation is also followed as a competitive strategy.

So how does the industry works??



Company analysis

Company	Business Model	Net Sales (FY 2011) in Rs. Cr.	Net Sales Growth Rate (5 Year CAGR)	Net Profit (FY 2011) in Rs. Cr.
Asian Paints	Overall Market Leader due to leadership in Decorative segment	6607.2	22%	773.55
Kansai Nerolac	Market Leader in Automotive Industrial Paint Segment, also into Decorative Paints.	2266.2	15%	186.52
Berger Paints	Major revenue from Decorative Segment, also into Industrial Paints.	2096.2	16%	148.31
Akzo Nobel	Major revenue from decorative segment, also into Automotive segment	1087.6	5%	121.60
Shalimar Paints	Mainly into decorative and non-automobile Industrial coatings.	404.4	13%	11.67

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Raw materials

- 56% of total expenditure is spent on raw materials
- Price fluctuation of cost of titanium dioxide and other raw material have a substantial impact on cost of production

Challenges faced by the paint industry

- Seasonal demand: Paint industry is a seasonal industry. The demand shoots up during diwali or other festive seasons and it will be low in rainy season.
- Inventory management at dealer level : The product differentiation is minimal in paint industry. The very close substitutes are easily available. Hence inventory management at dealer level is important for brand visibility
- Distribution costs : Important for lower price product like distemper. Its stiff and sold on weight basis. Consumption is highest. Hence cost associated with distribution of it is of prime importance.
- Shade offerings : As the shades offered by the paint companies are very high in number, the problem of distribution becomes very significant. The demand for a particular shade may peak up suddenly in a particular region. The inventory management at the distributor and dealer level is of great importance
- Low per capita paint consumption : It stands 815 gms per person per annum as compare to 25 kg per person per annum in US.
- Competition from unorganized players who were not liable for excise as well as other taxes

Future scope

- Wide potential for growth
- Markets for paint in India is expected to grow at 1.5 times to 2 times GDP in the next 5 years.
- Decorative paints segment is expected to witness higher growth going forward. The fiscal incentives given by the government to the housing sector have immensely benefited the housing sector. This will benefit key players in the long term.
- Although the demand for industrial paints is lukewarm it is expected to increase going forward. This is on account of increasing investments in infrastructure. Domestic and global auto majors have long term plans for the Indian market, which augur well for automotive paint manufacturers like Kansai Nerolac and Asian-PPG. Increased industrial paint demand, especially powder coatings and high performance coatings will also propel topline growth of paint majors in the medium term.

Environmental concerns

- The VOC content of paint and the CO₂ emitted during manufacture are key contributors to environmental impact - primarily in the form of air pollution (petrochemical smog) and to a lesser degree greenhouse gases.
- ozone from paint emissions irritates eyes, nose, throat and lungs; reduces breathing capacity
- Many metal pigments used in paints (e.g. cadmium) are highly toxic and relatively rare resources

Fin