KNOWLEDGE SESSION ON UNDERSTANDING OF PAINT TECHNOLOGY

SPEAKER:-
MOHUA SINHABABU

TATA COLOURS
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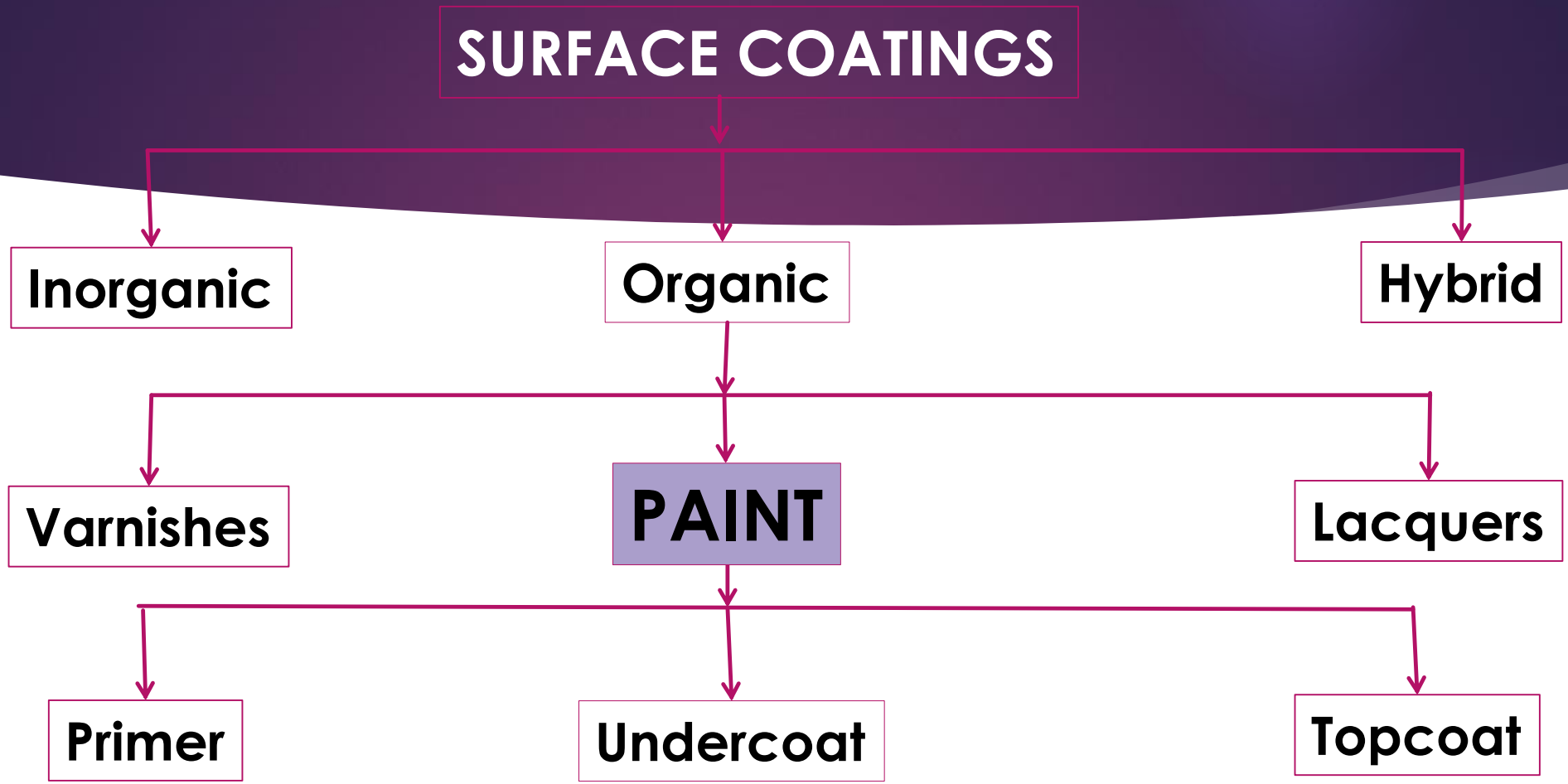
DISCUSS ABOUT??

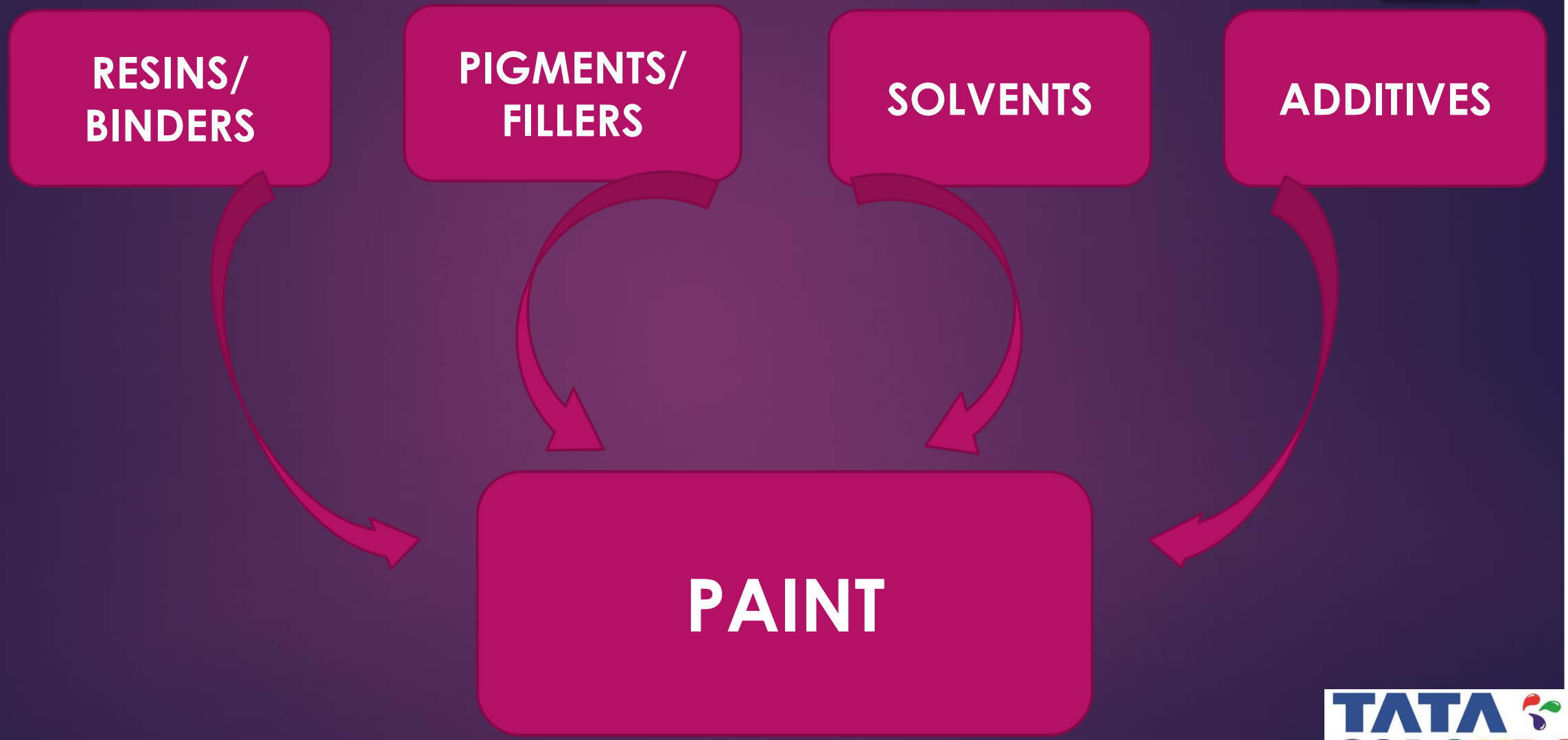
- SURFACE COATING.....WHAT IS PAINT....???
- WHAT IS RESIN..???? .... ITS CHARACTERISTICS... ITS TYPES??
- FUNCTION OF DIFF INGREDIENTS??
- PAINT COMPOSITION.. MANUFACTURING
- ATTRIBUTES OF THE FINAL PAINT....
- APPLICATION PROCESS...
- PAINT DEFECTS...
- SOME MARKET INSIGHTS..



What is Paint?

Paint is a mechanical dispersion of pigments in vehicle(binder +solvent) which is applied as a thin layer on the substrate(surface of an article) , which after drying leaves a solid film which can bear mechanical and chemical abrasions and also enhances the aesthetic appeal of the surface , paint is formulated as per the end usages.

INGREDIENTS OF PAINTS



VARNISHES AND LACQUERS

Varnishes

- Paint without pigmentary material is called Varnishes like Wood Polish.

Lacquers

- Physical state of binder is in sold state.

WHAT IS RESIN AND ITS CHARACTERISTIC??

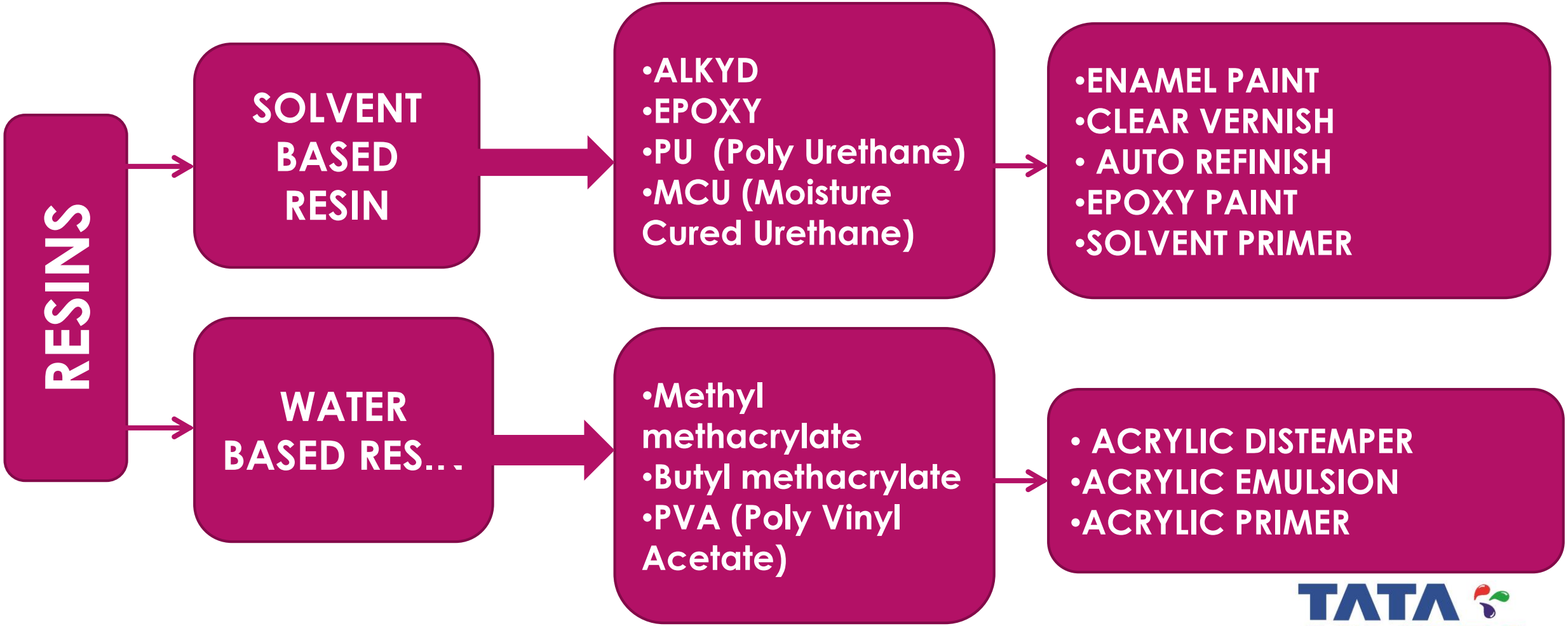
Resin

- Resin is basically a highly viscous colorless / yellowish non-volatile liquid or low melting solid which acts as film former in paint system

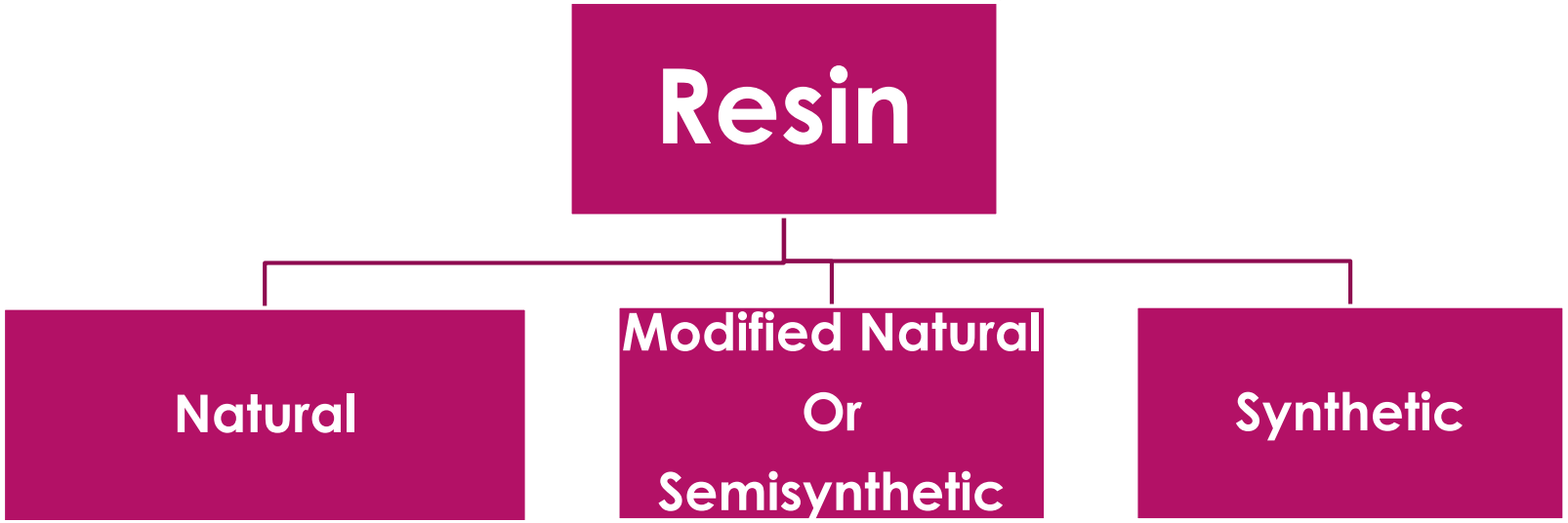
Characteristic of a Resin

- Physical State (non-volatile viscous liquid to low melting solid)
- Thermal Behavior (no sharp melting point, softening range)
- Chemical Composition (mostly organic)
- Solubility (mostly in organic solvent, now in water also)
- Film formability (it can form a film from solution or from molten condition)

RESINS – TYPES & USE



TYPES OF RESIN



Natural Resin: Rosin, Rubber, Cellulose
Semisynthetic Resin: Rosin esters, Chlorinated Rubber, Maleic Resin
Synthetic Resin: Alkyd, epoxy, acrylic, PU, silicones

WHAT IS ALKYD RESIN??
THE CHEMISTRY

- **Alkyd = Alcid = Alcohol + Acid**
  = Polyol + Polybasic Acid + oil / fatty acid

- **Polyol =** Multiple alcohol group in structure

Ex. Glycerin, Pentaerythriol, sorbitol etc.

- **Polybasic Acid =** acid containing two or more replaceable hydrogen atoms

Ex. Pthalic anhydride, Isopthalic acid, Terepthalic acid etc.

- **Oil / fatty acid =** carboxylic acid consisting of a hydrocarbon chain and a terminal carboxyl group

Ex. Linseed oil, soya oil, caster oil etc.

CLASSIFICATION OF ALKYD RESIN

- **Based on Quantity of Oil (oil length)**
  - Short oil (oil < 45%) – difficult to synthesize because of GELATION
  - Medium oil (oil 45-60 %)
  - Long oil (oil 60-75 %)
- **As the oil length of the resin increases**
  - generally the viscosity decreases
  - the hardness of the film decreases
  - film flexibility increases
  - water resistance is reduced
- **Oil length can be calculated as**

$$\frac{\text{Weight of oil}}{\text{Weight of all ingredients – water evolved}} \times 100$$

CONTD……

- **Based on Types of Oil**
  - Drying alkyd
  - Semi-drying alkyd
  - Non-drying alkyd

- oils are considered drying, semi-drying or non-drying depending upon their drying index

Drying Index = % linoleic acid + 2 (% linolenic Acid)

OIL USED IN ALKYD RESIN

Oil	Saturated	Linoleic	Linolenic	Source	Type
Linseed	10	16	52	Flaxseed	Drying
Safflower	11	75	1	Safflower	Drying
Soybean	15	51	9	Soybean	Semi-drying
Sunflower (TX)	11	38	nil	Sunflower	Semi-Non
Tall Oil (N. Amer.)	8	41	3	Pine Trees (by-product of paper mfg.)	Semi-Non
Coconut	91	2	0	Coconut	Non-drying

Important Note:
Although drying speed is improved as the % linolenic increases, the rate of yellowing for exterior white coatings is also greater

EPOXY RESIN

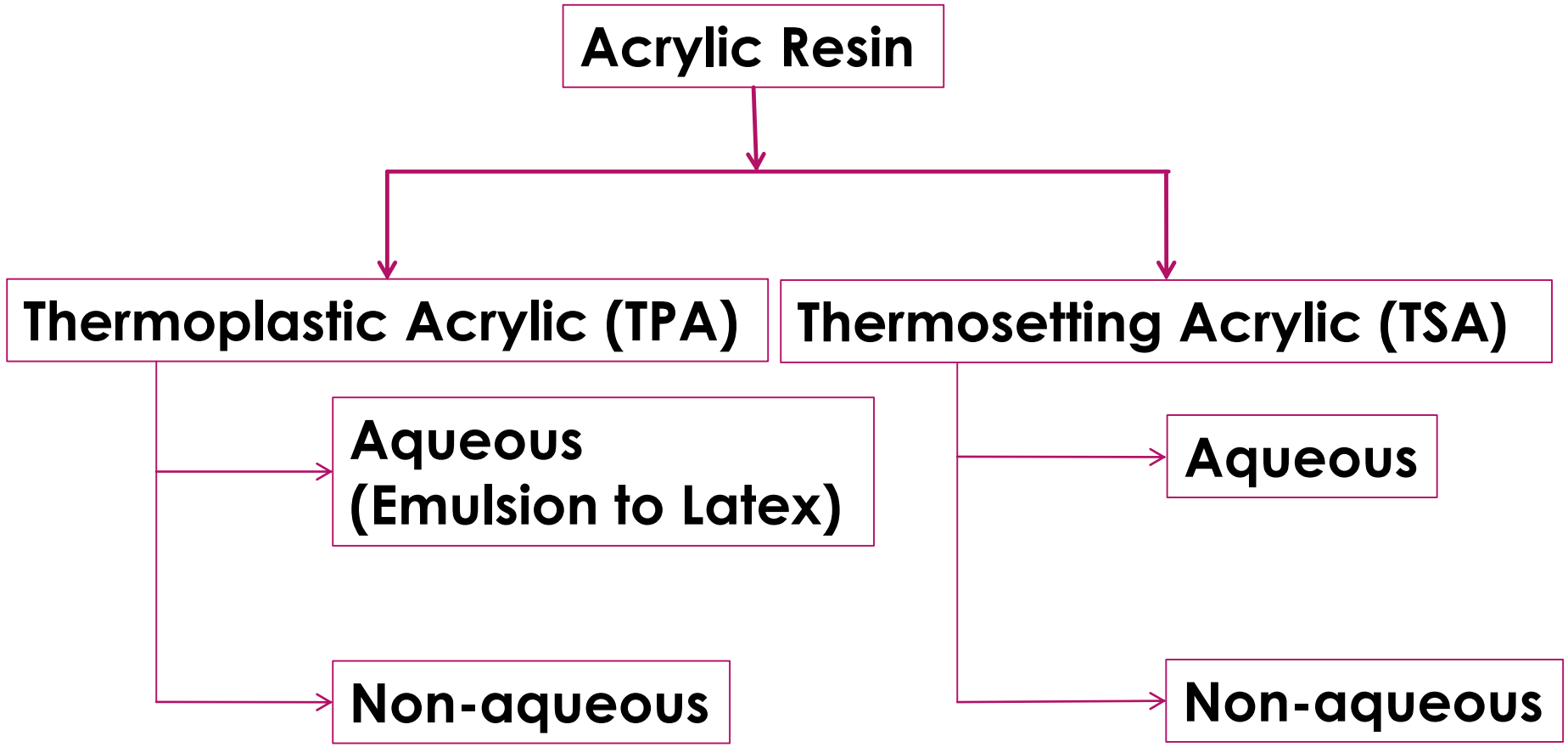
- Epoxy Resin is Prepared by Reacting Epichlorohydrin and Bisphanol-A
- Molecular structure has 'n' (Degree of Polymerisation), which determines the molecular weight
  If n ≤ 2 (0.2 - 2) Low MW / Liquid epoxies
  If n > 2 (2 - 13) High MW / Solid epoxies
- Characteristics
  – Viscosity / Solution Viscosity (MW)
  – Epoxy Value in WPE (Weight per epoxy ring) in g/mol

CURING AGENTS OF EPOXY RESINS

Active / Labile hydrogen containing materials are suitable:

- Linear Aliphatic Polyamines
- Cyclo aliphatic Amines
- Aromatic Polyamines (for low temp. cure)
- Polyamides
- Phenolic Resins
- Ketimines (Latent curing agents)

ACRYLIC RESIN



MONOMERS OF ACRYLIC RESIN

Monomers for TPAs & TSAs

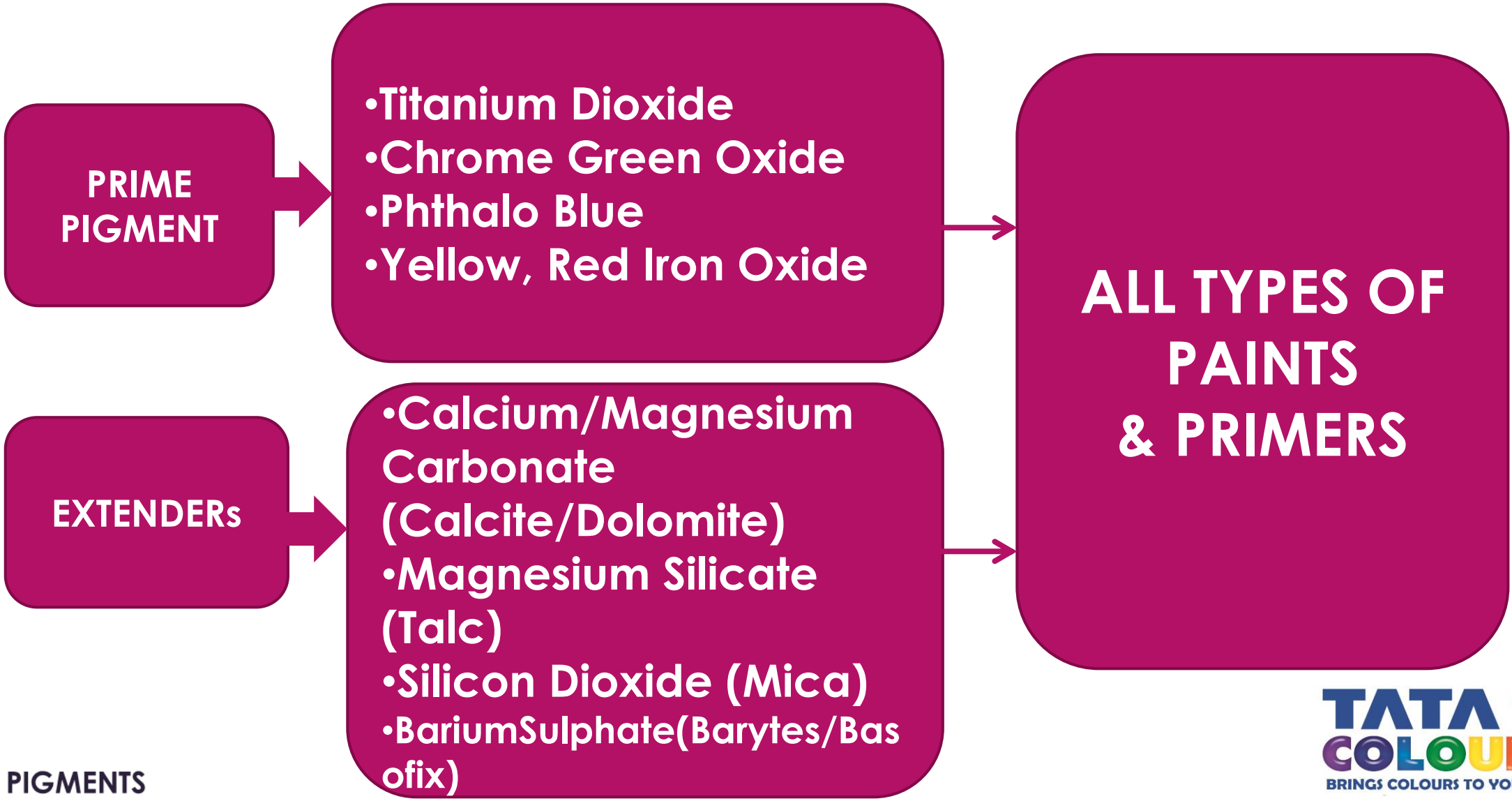
- TPAs
  - *Esters (Methyl, Ethyl, Propyl; but Butyl is too soft) of Acrylic acid & Methacrylic acid*
  - *May be copolymerized with Styrene & Acrylonitrile*

- TSAs
  - *Monomers have functional groups (-OH, -COOH, -amide, -epoxy)*
  - *To be crosslinked with co-reacting groups of cross-linkers*

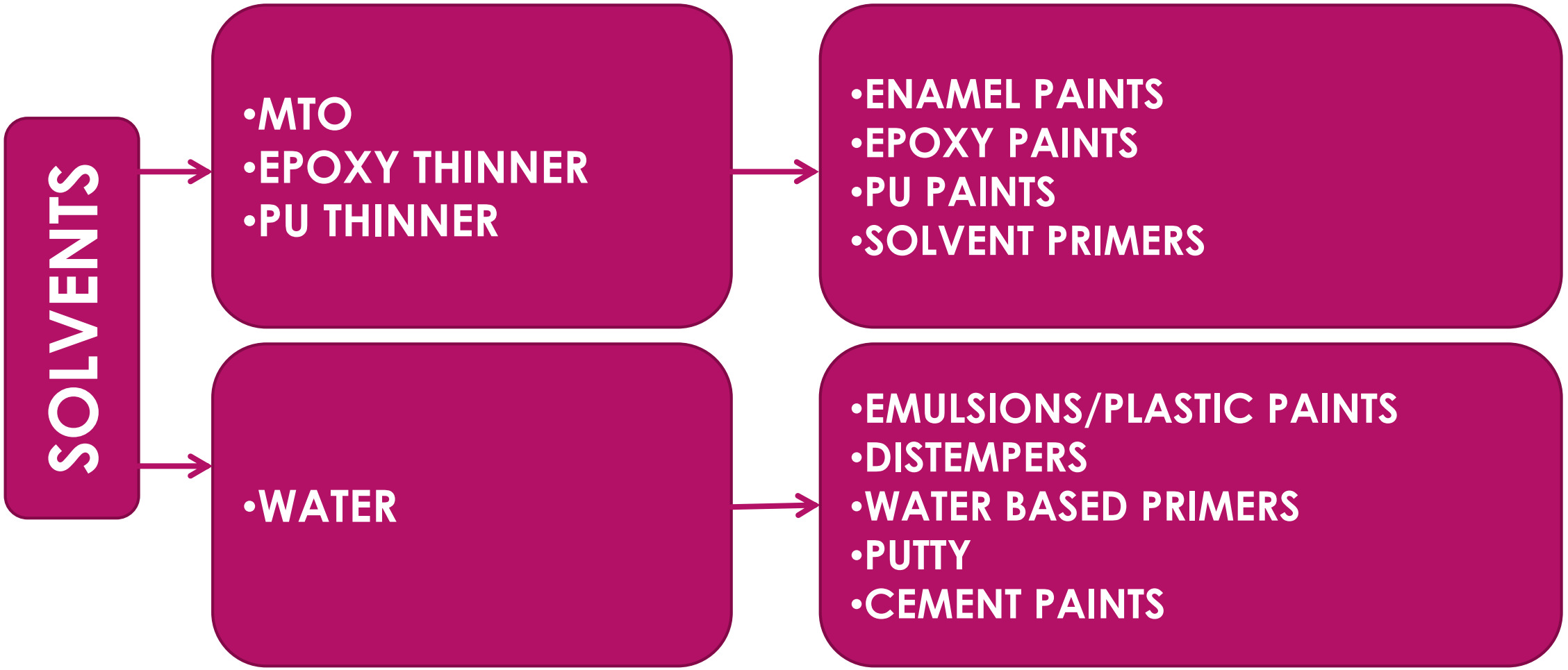
SELECTION OF ACRYLIC RESIN

S.No.	Film Property	MMA (Methyl Methacrylate)	MA (Methyl Acrylate)	EA (Ethyl Acrylate)	BA (Butyl Acrylate)
1	Softness (Flexibility) / Hardness	Hard	Less hard	Soft	Very soft
2	Film strength (Tensile strength)	High	Moderately high	Low	Very low
3	Elongation (stretchability)	Low	High	Very high	Extremely high

PIGMENTS & FILLERS/EXTENDERS:



SOLVENTS – TYPES & USE



ADDITIVES – TYPES & USE

ADDITIVES

- **Anti-skinning** - Prevents in-can skinning of paint.
- **Stabilizer** - Maintain pigment stability.
- **Anti-freezer** - Prevents in-can freezing of paints at low temp.
- **Anti-bacterial-** Prevents growth of algae and bacteria.
- **Anti-foaming-** Reduces foaming during agitation.
- **Catalysts-** Helps in fast drying of paint.
- **Emulsifiers-** Maintain homogeneous property in paint.
- **Thickeners-** Maintain desired viscosity.
- **Flatteners-** Provides low gloss property.
- **pH Modifiers –** Controls ph of water based paints.
- **Deodorant –** Provides pleasant smell to the paints.

PAINT COMPOSITION

Pigments/extenders by Volume:	**25-40%**
Resin/Polymer/Oils (Binder):	**30-40%**
Solvent/Thinner:	**30-40%**
Additives:	**1-5%**

MANUFACTURING STEPS OF PAINTS

Mixing : All pigment & some medium [resin+solvent+additives]

Grinding : Fine Dispersion of pigment in the medium

Reducing : Let Down [With Medium + Solvent +additive]

Tinting : Matching Color [Desired Shade]

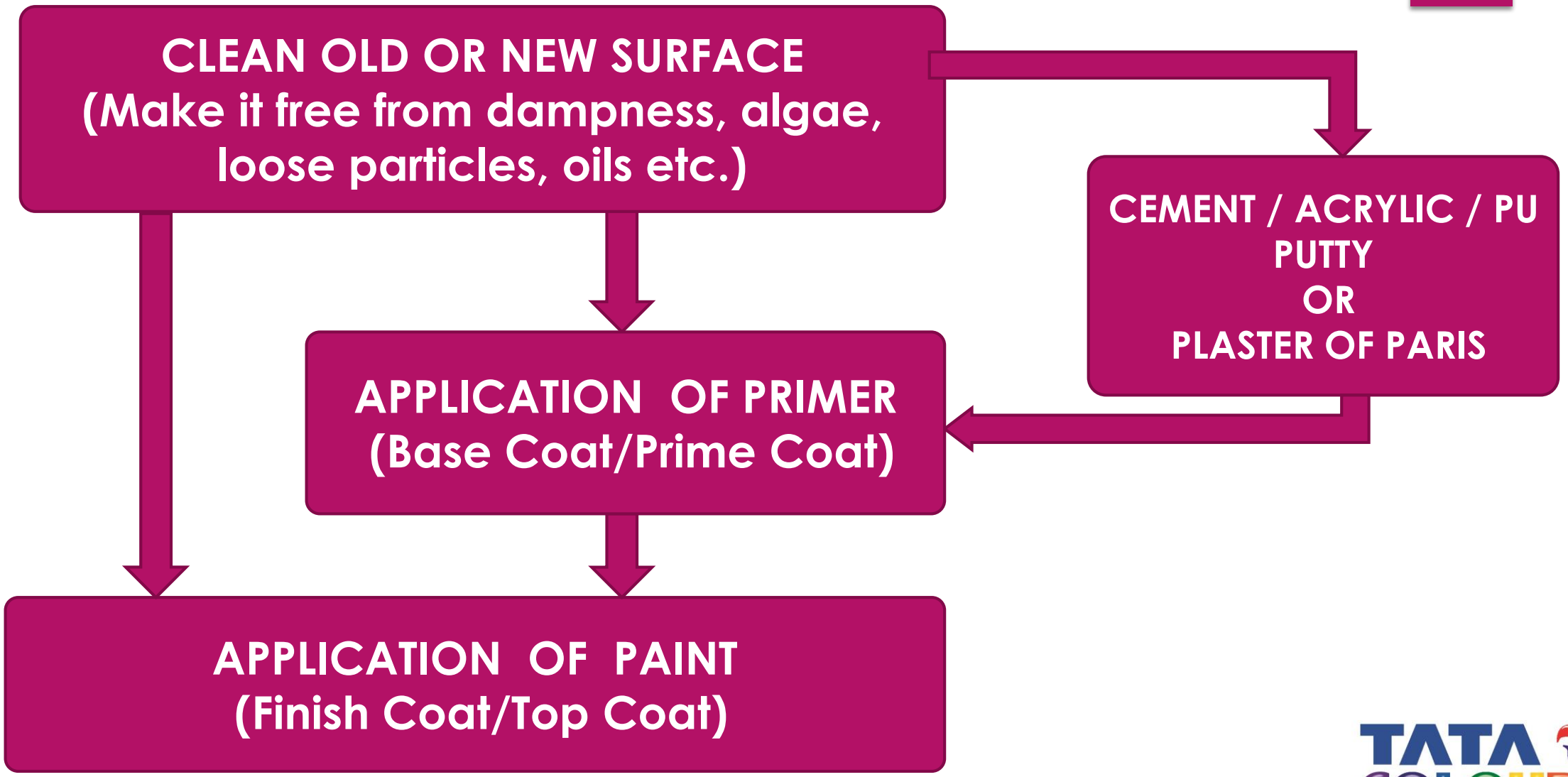
Straining : Filtering or Screening

Packing : Dispatch

ATTIBUTES OF WATER BASED PAINTS AND THE TESTING METHOD

SL.NO	ATTRIBUTES	METHOD OF TESTING
1	**COLOUR**	RGB Color Value in Spectrophotometer
2	**WASHABILITY**	No. of Cycle passed by Wet-Scrub measuring instrument(Scrub Tester)
3	**POT LIFE/OPEN TIME**	Repeatedly check for brush-ability or applicability
4	**FINISHING**	Visual identification.
5	**HIDING**	Amount of paint required to hide Checker Board panel completely.
6	**COVERAGE**	Sq. m. covered per Lt.(Kg) per coat in a masonry wall/ Cryptometer.
7	**DRYING TIME**	Standard interval minimum 6-8 Hrs for surface dry. Recoating interval-Over Night.
8	**LIGHT FASTNESS**	Accelerated Weather Meter(Weathorometer). Calculating the fading time with the effect of sunlight, rain water & salt.
9	**SHELF LIFE**	Accelerated testing in Hot air Oven at 60 degrees
10	**VOC**	Calculated in percentage as per the formulation. This determines the odor in paints.

APPLICATION PROCESS



APPLICATION PROCESS - STEP 1

- Scrubbing & Cleaning of the new plastered , wooden or metal surface/old painted surface using Steel Wire Brush or 80 no. Emery Paper.
- Removal of any loose dust by scratching, wiping or washing.

APPLICATION PROCESS - STEP 2

- If required application of one coat of Cement Putty/Acrylic Putty/PU Putty using still knife to be done.
- Surface to be left for 4-6 Hrs. for drying.
- Application of second coat to be done. Thickness of two coats should not be more than 2mm.
- Smooth the surface using 150 no. abrasive paper after 4-6 Hrs. of application.

APPLICATION PROCESS - STEP 3

- Application of ONE coat of primer with recommended dilution of solvent.
- To leave the surface 6-8 hrs. to dry.
- Application of second coat if required.

APPLICATION PROCESS – STEP 4

- Apply min. TWO coats of finish paint as per recommended dilution of solvent keeping 6-8 hrs. of interval between two successive coats.
- Another 1-2 coats may be applied depending on the shade or on the exterior horizontal surfaces.

WHY COATINGS FAIL

1. Mechanical Stress

- Includes parameters such as tensile strength, elongation, and toughness.

2. Internal Stress

- Develop within coatings during film formation, through temperature changes, and through relative humidity (RH) changes.
- These internal stresses have an effect on coating degradation.
- They affect adhesion and/or cohesion and have an effect on delamination and cracking

3. Chemical Attack

- In addition to protecting the product, it is preferable that the coating does not stain, does not lose adhesion, does not lose gloss, and is not permanently altered in any way by its contact with the hostile conditions

4. Weathering Stress

- Originate from the chemical composition change brought on by photo-oxidation.

PAINT FAILURES:

Research(Source: Journal on Coating Technology) has revealed that

- Over 80% of paint failures are purely due to poor surface preparation

- Only about 20% due to product failure and other factors.

REASONS FOR PAINT DEFECTS:

1. Improper surface preparation – the substrate surface is not adequately prepared for the coating that is to be applied. This may include cleaning, chemical pre-treatment or surface roughening.

2. Inappropriate coating selection – either the paint or coating selected is not suitable for the intended service environment, or it is not compatible with the substrate surface.

3. Improper application – this can be a problem with either shop-applied or field applied coatings, and occurs when the required specifications or parameters for the application are not met.

4. Inadequate drying, curing and over coating times – again, this problem relates to a lack of conformance to the required specifications or parameters.

5. Lack of protection against water and aqueous systems – this is a particularly serious problem with aqueous systems containing corrosive compounds such as chlorides.

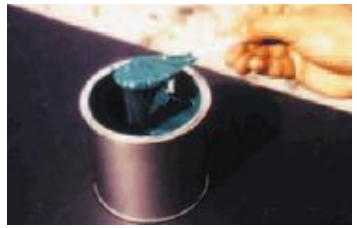
6. Mechanical damage – which results from improper handling of the painted or coated substrate, resulting in a breach in the paint or coating.

POSSIBLE FAILURE MODES:

There are innumerable possible failure modes which can result from these primary causes…

1. **Formulation related failures.**
2. **Substrate related failures.**
3. **Physical defect related failures.**

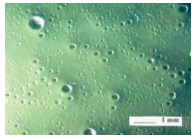
FORMULATION RELATED DEFECTS:

Defect	Cause	Prevention	Corrective Action
Skinning : 	• Container lid not air-tight, poor formulation , very hot conditions	• Use airtight container, proper formulation	•Carefully remove skin and stir the paint till homogeneous
Settling: 	•Insufficient stirring during storage /warm conditions, Excessive dilution or Inappropriate thinner	• Use recommended thinner, Avoid long storage, Ensure good storage conditions	•Stir in soft settlement till homogeneous •For mixing, use appropriate machinery
Gelling : 	•Contaminated tools or thinner, •Mixing of different brands or different paint types	• Use clean tools/ solvents and avoid mixing different brands or paints	•Discard Paints

SUBSTRATE RELATED DEFECTS:

Defect	Failure Appearance	Cause of Failure	Preventive Measure
Previously Used Steel	Blistering, rust, loss of adhesion	Retention of minute amounts of corrosion product; even after abrasive blast	Wash blasted surface with water or dilute phosphoric acid. Use anticorrosive primer with strong adhesion.
Galvanized or Metallic Zinc Surface	White zinc corrosion product forming under coating or breaking through.	Formation of zinc salts underneath coating.	Brush blast zinc surface or use commercial zinc treatment. Use anticorrosive primer with strong adhesion.
Aluminium	White corrosion Product, loss of adhesion, possible blistering.	Smooth aluminium oxide surface. No physical adhesion.	Light blast aluminium surface. Use anticorrosive primer with strong adhesion
Concrete	Blistering, peeling, or loss of adhesion. Formation of calcium salts under coating.	Chemical reactivity, moisture content and porosity of Concrete	Concrete surface should be clean and dry. Acid etch or light blast. Use elastic, highly penetrating paint with alkali resistance (epoxy).
Wood	Checking, cracking, and flaking of coating. Blistering from trapped Moisture in wood.	Expansion and contraction of wood due to varying temperatures and humidity.	Start with clean newly sanded surface. Use elastic, highly penetrating paint with high moisture permeability

PHYSICAL RELATED DEFECTS:

Defects	Failure Appearance	Cause of Failure	Preventive Measure
1. Bubbles & craters 	Bubble: dome-like raised area containing vapor. Crater: concave area once covered by bubble.	Solvent or moisture entrapment during drying or baking.	Application of coating in thin layers. Sufficient flash time before baking.
2.Blisters 	Dome-like raised area containing moisture or other liquids.	Contamination on surface prior to painting or coating. Moisture in wood substrate.	Clean surface prior to painting. Other means of moisture escape for wood substrates
3.Dirt	Any contaminants found in paint or on painted surfaces.	Inadequate facilities, poor housekeeping, poor painting practices.	Improved housekeeping and attention to painting practices and procedures
4.Color mismatch	Color deviations from one area/part to another.	Variations of film wetness and build, substrate, thickness, application and agitation.	Consistency required in film wetness, build, thickness, application and agitation.
5. Gloss variations	Gloss deficient patches of paint film.	Basecoat wet spots, improper oven conditions, insufficient film build.	Control bake oven conditions, proper application, consistent film thickness.
6. Orange peel 	Repetitive bumps and valleys similar to an orange surface.	Freshly applied paint film does not flow out smoothly.	Proper paint spray atomizing pressure, paint viscosity, and film thickness.
7. Runs, sags 	Downward flow of paints prior to film hardening.	Application of coating too thick or too wet.	Proper spray gun cleanliness and operation. Correct solvent amounts.

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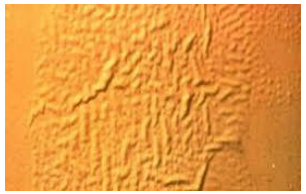
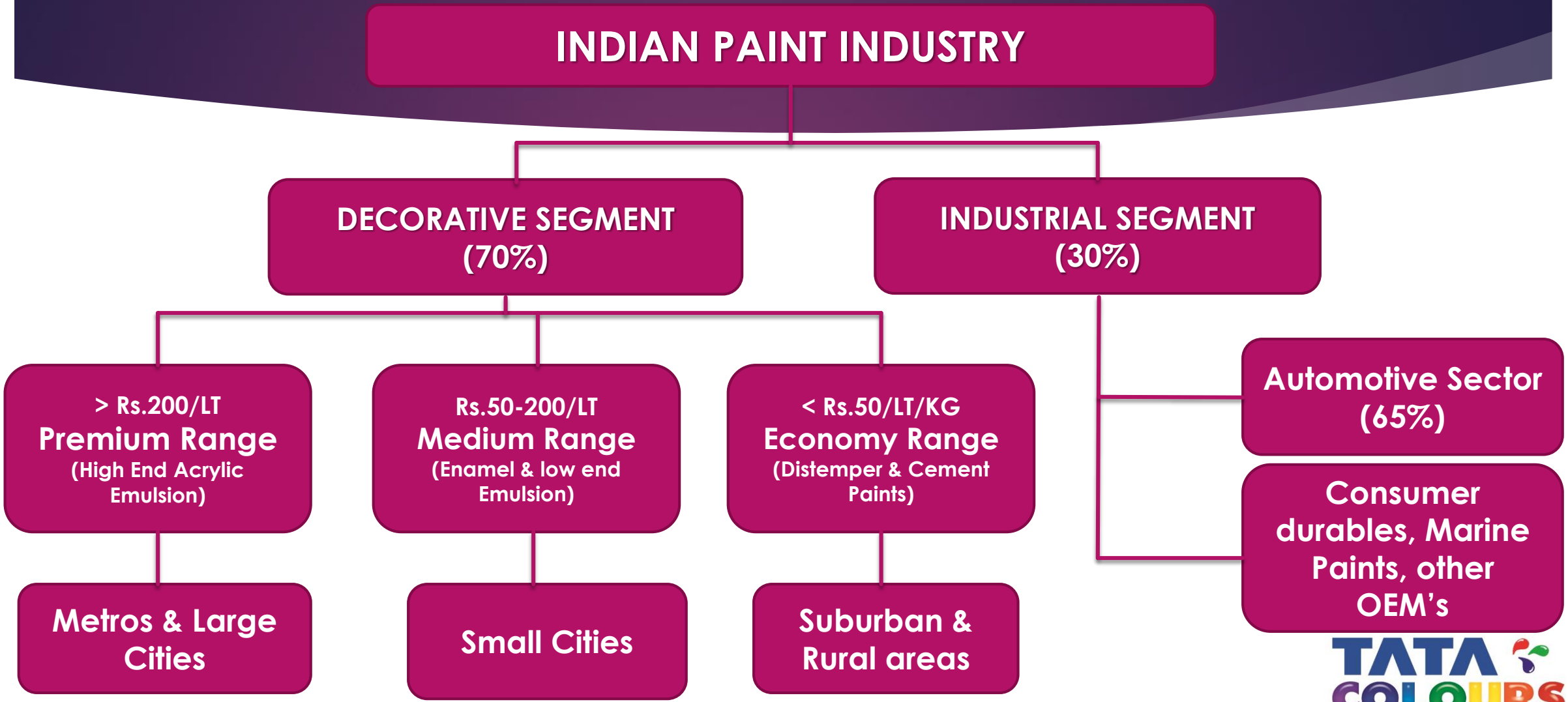
PHYSICAL RELATED DEFECTS:

Defects	Failure Appearance	Cause of Failure	Preventive Measure
8.Chalking 	Surface soft & powdery. Easily wiped away.	UV degradation of resin. Improper pigmentation.	Use UV-resistant resins and non-chalking pigments.
9.Alligatoring 	Large macro-cracking and cross-hatching.	Internal stresses with greater surface shrinkage.	Apply thin coats and thoroughly dry before reapplication.
10.Cracking 	Small breaks in coating to substrate of various geometries.	Stresses due to continued polymerization/ oxidation.	Use non-reactive resins and pigments.
11.Biological Failure 	Softening or slime reaction. Blotchy brown or black spots	Bacterial or fungal degradation	Use permanent fungicides or bactericides in coating.
12.Wrinkling 	Furrows and ridges in coating surface.	Surface dries more quickly than underlying coating.	Use coatings with even, thorough drying characteristics
13.Discoloration 	Yellowing, graying, or darkening	Weathering or chemical reaction	Use color stable resins and pigments.

INDIAN PAINT MARKET SCENARIO 2018-2023

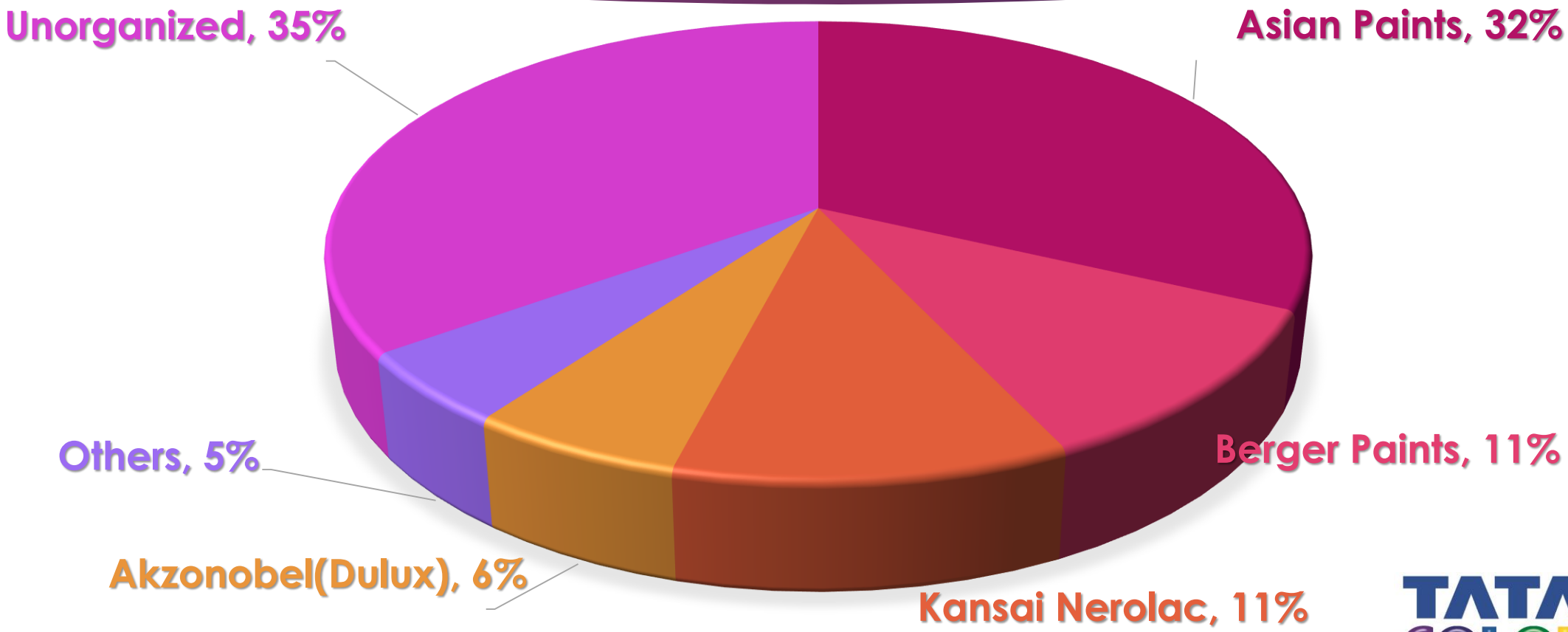
- India's per capita paint consumption is only 1.5-2Kg/year compared to 3-4Kg/Year in developed countries.
- Nearly 35% of the paint market is unorganized.
- The 'top-5'players captures around 60% of the market while the unorganized market is fragmented with over 2000 players.
- The paint industry is expected to grow at 10-12% annually to become around Rs.70875 Crores market in FY2020.

SEGMENTATION OF INDIAN PAINT INDUSTRY

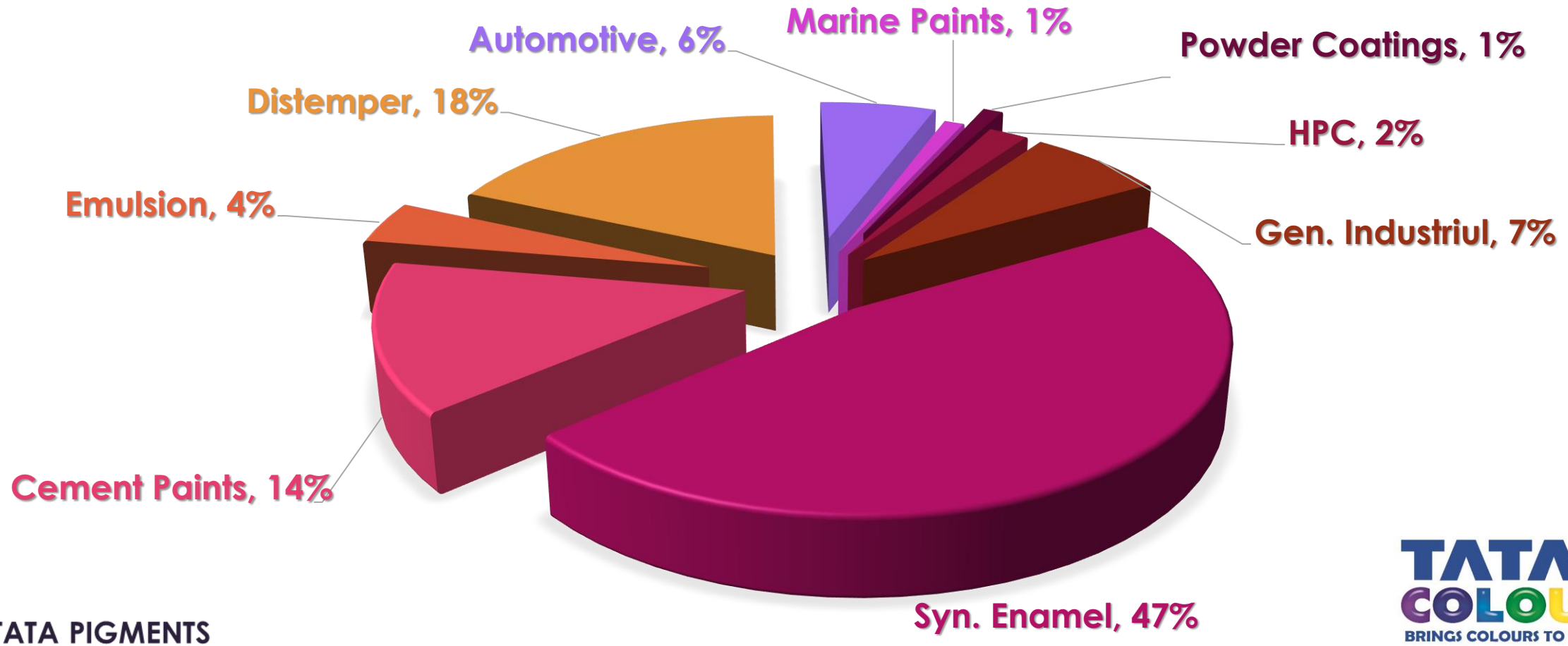


DECORATIVE PAINT

COMPETITOR'S MARKET SHARE IN INDIA IN %



PRODUCT WISE MARKET SHARE



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INDIAN PAINT MARKET

PRODUCT RANGE OF DECORATIVE PAINTS

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BRAND WISE COMPARISON

PRODUCT TYPE	CATEGORY	PREMIUM	GENERAL
CEMENT PAINT	TPL	CEMPLUS	ECOCEM
	SNOWCEM INDIA	SNOWCEM PLUS	SUPER SNOWCEM
	BERGER PAINTS	DUROCEM EXTRA	
	INDIGO PAINTS		CEMCOLOR

BRAND WISE COMPARISON

PRODUCT TYPE	CATEGORY	PREMIUM	GENERAL	INDUSTRIAL	SATIN FINISH	MATTE FINISH
ENAMEL	TPL	WONDER WATER FREE*/ ULTRA PREMIUM IS IN DEVELOPMENT STAGE		WONDER	DEVELOPED FOR ADLS SUNSHINE ON DEMAND	TO BE EVELOPED IF REQUIRED
	ASIAN PAINTS	APCOLITE	TRACTOR (UTSAV)		APCOLITE	
	BERGER PAINTS	LUXOL	BUTTERFLY	TUFF	LUXOL	BP FLAT WHITE
	NEROLAC PAINTS	NSE	GOODY	NEROMIN	PEARL LUSTURE	NEROLAC FLAT

WONDER WATER FREE: 100% water Free Enamel Paints- OUR USP AND A DIFFERENTIATOR**

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BRAND WISE COMPARISON

PRODUCT TYPE	CATEGORY	SYNTHETIC DISTEMPER	PREMIUM ACRYLIC DISTEMPER	GENERAL ACRYLIC DISTEMPER	POUCH DISTEMPER
DISTEMPER	TPL			ECOPLUS	UMANG
	ASIAN PAINTS	TRACTOR	TRACTOR	TRACTOR UNO (UTSAV)	UPD
	BERGER PAINTS		BISON	JADOO	JADOO
	NEROLAC PAINTS			BEAUTY	
	PIDILITE				DDL

BRAND WISE COMPARISON

PRODUCT TYPE	CATEGORY	LOW VOC	LUXURY	LOW SHEEN	PREMIUM	SEMI MATTE	REGULAR	ECONOMY
INTERIOR EMULSION	TPL	LUXORE	PREMIUM INT EMULSION-LUXORE	TO BE DEVELOPED IF REQUIRED	PREMIUM INT EMULSION	TO BE DEVELOPED IF REQUIRED	ECOPLUS	UMANG
	ASIAN PAINTS	ROYAL SHINE	ROYAL		APCOLITE	LUSTURE FINISH	TRACTOR	
	BERGER PAINTS	BREATH EASY	SILK	EASY CLEAN	RANGOLI		BISON	
	NEROLAC PAINTS	ECO CLEAN	IMPRESSION 24 CARAT	LOTUS TOUCH	BEAUTY GOLD	BEAUTY SILVER	BEAUTY REGULAR	LITTLE MASTER

BRAND WISE COMPARISON

PRODUCT TYPE	CATEGORY	EXTRA PREMIUM	ULTRA PREMIUM	PREMIUM	SPECIAL	REGULAR
EXTERIOR EMULSION	TPL	TO BE DEVELOPED IF REQUIRED	TO BE DEVELOPED IF REQUIRED	REGALIA	TO BE DEVELOPED IF REQUIRED	ECOPLUS
	ASIAN PAINTS	PROTEK	APEX ULTIMA	APEX		ACE
	BERGER PAINTS		WEATHER COAT ALL GUARD	WEATHER COAT SMOOTH		WALLMASTA ANTI FUNGAL
	NEROLAC PAINTS		EXCEL TOTAL	EXCEL	SIURAKSHA ADVANCED	SURAKSHA PLUS

BRAND WISE COMPARISON

PRODUCT TYPE	CATEGORY	PREMIUM EXTRIOR	PREMIUM INTERIOR	UNIVERSAL	ECONOMY INTERIOR
WATER BASED PRIMER	TPL	TO BE DEVELOPED IF REQUIRED	TO BE DEVELOPED IF REQUIRED	WALLPLUS EXT/INT	WALLPLUS INT.
	ASIAN PAINTS	EXTERIOR PRIMER	DECOPRIME WATER THINNABLE	AP UTSAV PRIMER WT	
	BERGER PAINTS	WC EXTERIOR PRIMER	BP CEMENT PRIMER WT	BP WHITE PRIMER WT	
	NEROLAC PAINTS	EXTERIOR PRIMER	NEROLAC CEMENT PRIMER WT	GOODY UNIVERSAL WT	

BRAND WISE COMPARISON

PRODUCT TYPE	CATEGORY	PREMIUM WHITE CEMENT PRIMER	WOOD PRIMER	ECONOMY WHITE CEMENT PRIMER	RED OXIDE PRIMER PREMIUM	RED OXIDE PRIMER ECONOMY
OIL BASED PRIMER	TPL	TO BE DEVELOPED IF REQUIRED	WHITE AND PINK PRIMER FOR WOOD	WONDER	TO BE DEVELOPED IF REQUIRED	WONDER
	ASIAN PAINTS	DECOPRIME SOLVENT THINNABLE	AP WOOD PRIMER	UTSAV WHITE PRIMER ST	DECOPRIME METAL PRIMER	UTSAV METAL PRIMER
	BERGER PAINTS	BP CEMENT PRIMER ST	PARROT WOOD PRIMER	BP WHITE PRIMER ST	BUTTERFLY RO PRIMER	BERGER RO PRIMER
	NEROLAC PAINTS	NEROLAC CEMENT PRIMER WHITE ST	NEROLAC WOOD PRIMER	GOODY UNIVERSAL ST	NEROLAC RED OXIDE	GOODY RED OXIDE PRIMER

BRAND WISE COMPARISON

PRODUCT TYPE	CATEGORY	COARSER CEMENT	PRE-COAT CEMENT	FINE CEMENT PREMIUM	FINE CEMENT PROJECT	ACRYLIC
PUTTY	TPL	WALLPLUS COARSER PUTTY	TO BE DEVELOPED IF REQUIRED	WALLPLUS	WALLPLUS	TO BE DEVELOPED IF REQUIRED
	BIRLA	COARSER PUTTY	WALL CARE	WALL CARE	WALL CARE	
	JK	COARSER PUTTY	WALL PUTTY	WALL PUTTY	WALL PUTTY	
	ASIAN PAINTS			ASIAN CEMENT PUTTY		ACRYLIC WALL PUTTY
	BERGER PAINTS			BISON SPECIAL	BISON EXTERIOR	HAPPY WALL ACRYLIC PUTTY
	NEROLAC PAINTS			CRACK FILL	NEROLAC	ACRYLIC WALL PUTTY

ANY QUESTIONS???

THANK YOU!