Paper Coatings

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Content of Presentation

- **What is Coating of Paper and Paper Board.**
- **Coated Paper and Board Grades.**
- **Coated Paper requirements.**
- **Components of Coating Colors.**
- **Coating Color Formulations.**
- **Coating Color Preparation.**
- **Types of Coating Machines.**
- **Coated Paper CTQ's.**

What is Coating ?

What Is Coating ?

is a process by which a mixture of water, white pigments, binder, and various additives are applied to one or both sides of paper sheet.

What Is the objective of Coating ?

The main objectives of coating process for paper and paperboard are to improve their appearance, and printability.

What does Coating do ?

Coating impart smoothness, gloss, brightness, and opacity to the base sheets for improved appearance, and provide them with is a process by which a mixture of water, white pigments, binder, and various additives are applied to one or both sides of paper sheet.enhanced printability.

Need for Coated Paper and Board ?

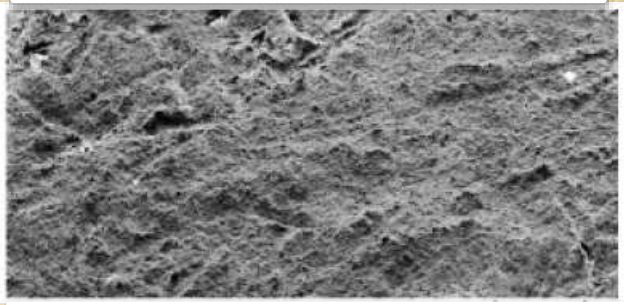
Why we need Coated Paper and Board ?

- To meet customer print expectation.
- To improve aesthetics of Packaging.
- Provide Glossy effect to the paper /board.
- To Create a image.

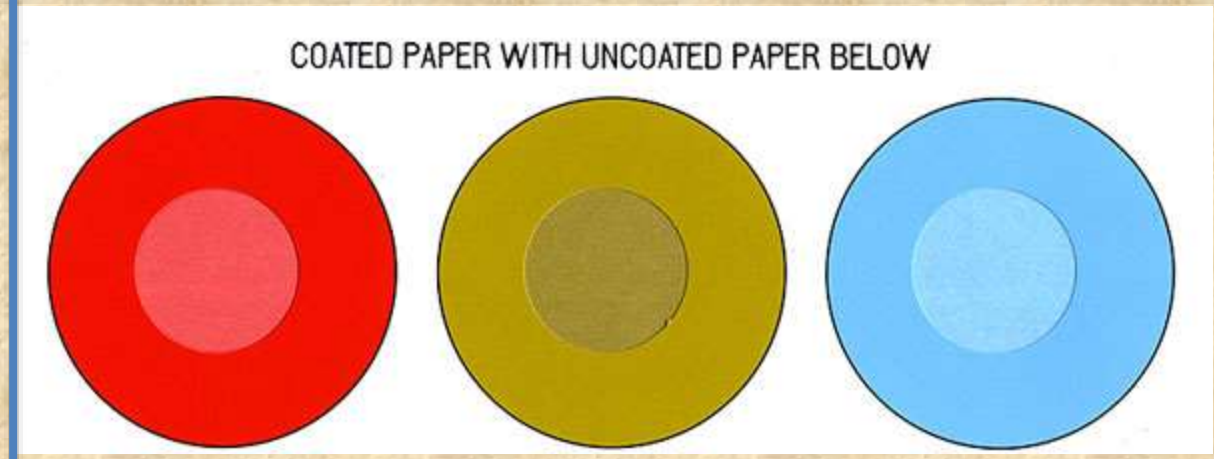
Difference between Un Coated and Coated Paper

Un Coated Paper Surface

Single Coated Paper Surface

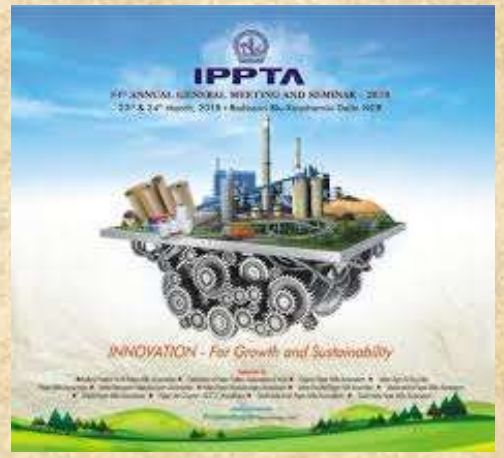


Double Coated Paper Surface



Coated Papers produce sharp print images

Print Images on Paper and Board



Magazine and Periodicals

LWC

Label Print

Paper Board

Print Collage

Coated Paper grades

Coated Paper and Paper Board can be classified as :

- **Art paper and Board – C2S Grades**
- **Chromo-papers – C1S Grades**
- **Light-weight coated (LWC) papers**
- **Folding boxboard and SBS Boards(Virgin Boards)**
- **White Line Chip Board (Duplex Board)**

The Selection of particular grade of Coated Paper depends on End Use Application

Coated Paper grades

S.No	Grade	Coating	Coat Weight	Application	GSM Range
1	C2S Art Paper /Board	2/Side Coating	25-30 GSM	Commercial Printings , Book Covers	100 - 300
2	C1s Art Paper	1/S Coating	25-30 GSM	Labels	90-130
3	LWC Paper	2/S Coating	10 – 15 GSM	Magazines	
4	FBB/SBS Board	1/S Coating	20 -25 GSM	FMCG Cartons	190 - 450
5	White Line Chip Board	1/S Coating	20-25 GSM	FMCG cartons	200- 450 GSM

Requirements of Coated papers

Coated Paper/Paper Board should posses :

- ✓ Good Brightness
- ✓ Good Smoothness
- ✓ Good ink receptivity
- ✓ Tendency to provide good print gloss
- ✓ Low Yellowing tendency
- ✓ Low/No Odor
- ✓ Good Glue ability attributes.
- ✓ Good Creasability.

Components of Coating Color

The main components of a coating color are :

- Pigments
- Binders
- Dispersing agents for the pigments
- Additives for reducing wet abrasion
- Products for control of viscosity and water retention
- Foam control agents
- Optical brighteners

Pigments for Coating

- **The pigment is a highly important component of coated paper.**
- **Pigments form the actual "body" of paper coatings.**
- **They account for at least 80% of the total dry coating weight.**
- **Pigments largely determine the quality and cost of the coating.**
- **The principle function of the pigment is to fill in the irregularities of the paper surface.**
- **Produce an even and uniformly absorbent surface for printing and to improve the appearance of the coated sheet.**

Requirements of Coating Pigments

- ✓ Appropriate particle size with good distribution.
- ✓ Free from Contaminants(Sand/Grit/Residue)
- ✓ Good dispersibility
- ✓ Good Chemical Stability
- ✓ Good compatibility with other coating components
- ✓ High Brightness
- ✓ Ability to improve opacity.
- ✓ Ability to render Gloss.
- ✓ Low binder demand
- ✓ Cost effective.

Types of Pigments

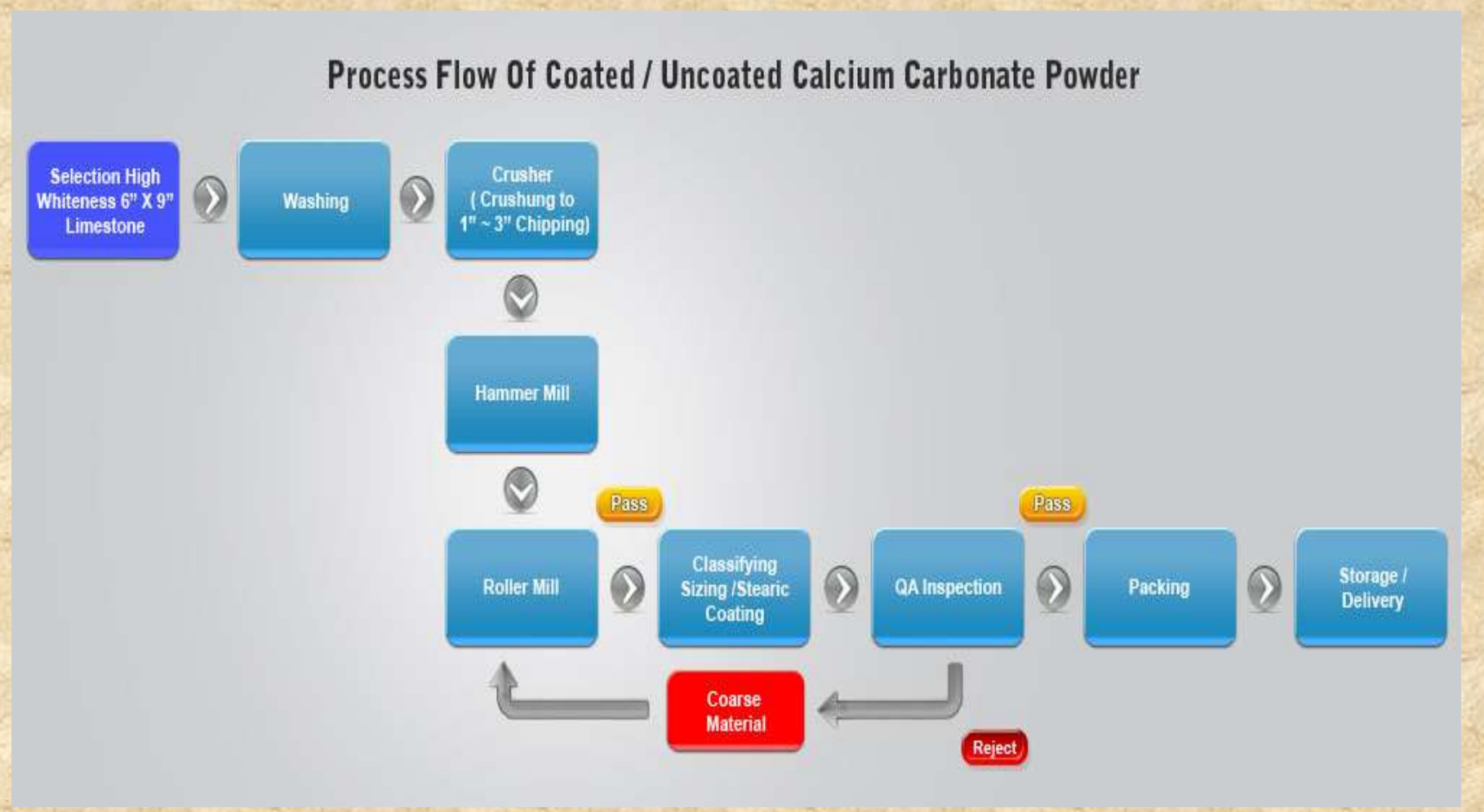
- Calcium Carbonate - GCC
- Clay
- Calcined Clay
- De Laminated Clay
- Titanium Di oxide
- Plastic Pigments

GCC and Clay forms the major component of the Coating Colour

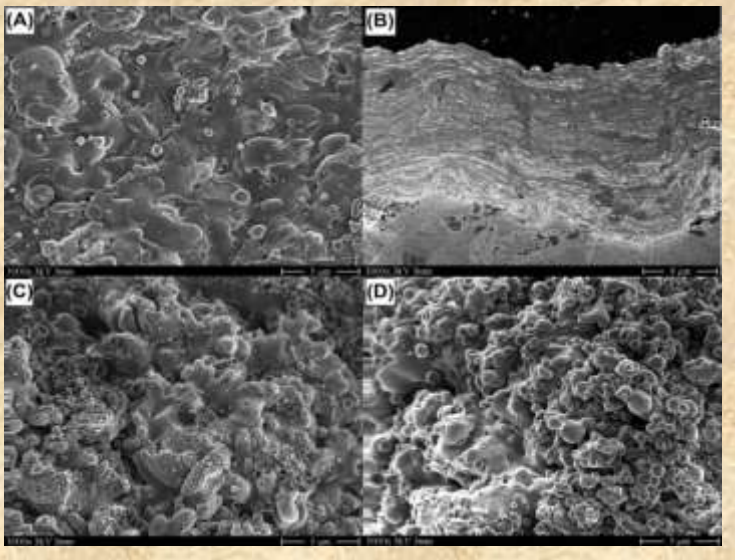
Calcium Carbonate

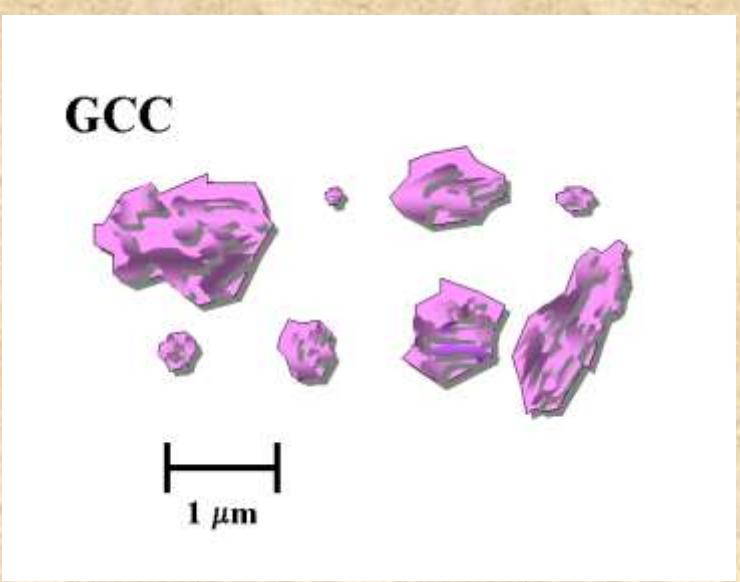
- **Calcium carbonates are distinguished from one another by their particle size distributions.**
- **Most of the calcium carbonates used in paper coatings are produced by grinding up a suitable mineral deposit and then filtering to produce the requisite particle size distribution.**
- **Carbonates are supplied in either powder or liquid form , liquid Calcium Carbonate are pre dispersed and are supplied in solids 75 – 80%. These are easy to use and have less handling issues, these plants either located inside the Paper Plant or located in the near by location.**
- **Critical parameters are Brightness , Whiteness , Residue Content and Particle Size distribution.**
- **The Quality Lime Stone plays a important role in deciding the optical properties of the pigment, apart the base raw material, cleaning and screening process also impacts the quality.**

Calcium Carbonate Processing



Calcium Carbonate Structure

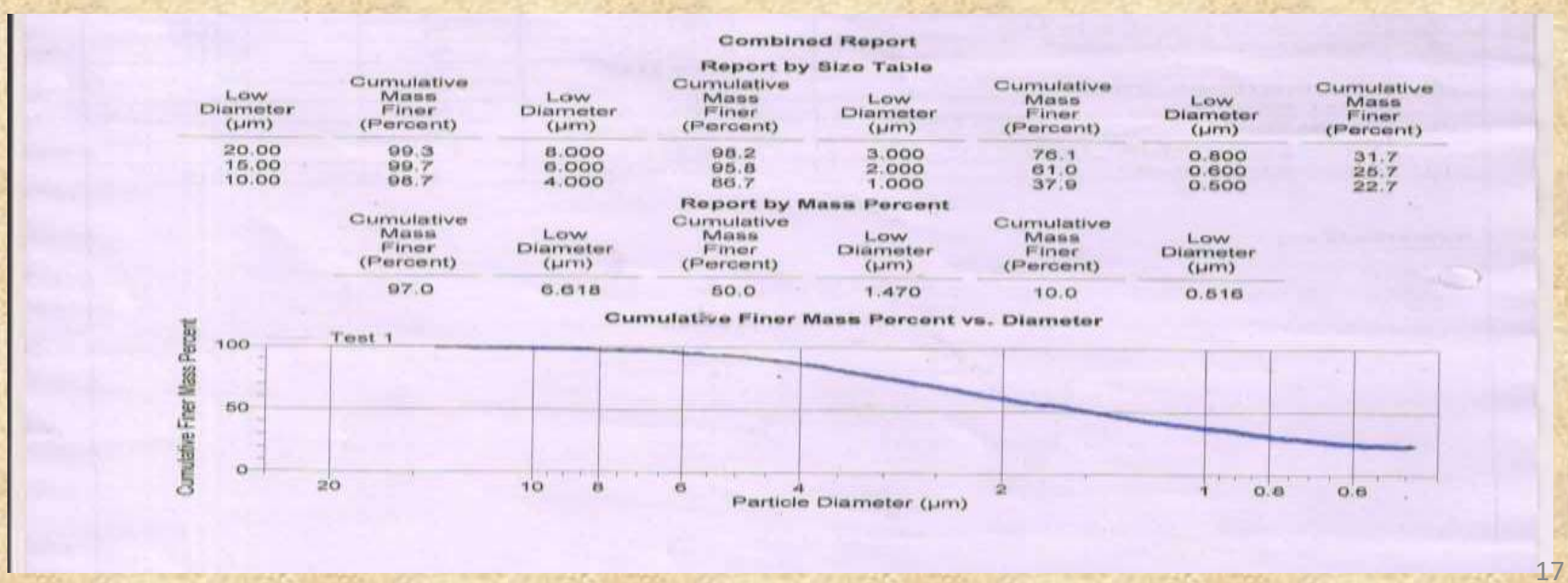




- **The Particle Size distribution of Coarse GCC will 60% < 2 microns and Fine GCC will be 90 – 95% < 2.0 microns.**
- **Coarse GCC is used in Pre Coat application to provide a base coat for applying finer pigment in the top.**

Calcium Carbonate – Data Sheet

S.No	CHARACTERISTICS	SPECIFICATION	UOM	RESULTS
1	"Calcium Carbonate(As CaCo3,% by Mass)"	97 - 99	%	98.5
2	"Magnesium Oxide(As MgO,% by Mass)"	0.800 MAX	%	0.410
3	"Iron Oxide(As Fe2O3,% by Mass)"	0.100 MAX	%	0.036
4	"Silica(As Sio2,% by Mass)"	0.100 MAX	%	0.042
5	Sulphates	0.200 MAX	%	0.011
6	Brightness(Elrepho-3300)	92.0-94.0	%	93.51
7	Solid Content	74.0 - 76.0	%	74.91
8	Particle Size (-2 Micron)	59.0-61.0	%	61
9	Viscosity(100RPM)(RV No.2) at 35°C	70-130	Cps	112
10	Retention (+325 Mesh)	0.010 MAX	%	0.0019



Combined Report

Report by Size Table

Low Diameter (µm)	Cumulative Mass Finer (Percent)	Low Diameter (µm)	Cumulative Mass Finer (Percent)	Low Diameter (µm)	Cumulative Mass Finer (Percent)	Low Diameter (µm)	Cumulative Mass Finer (Percent)
20.00	99.3	8.000	98.2	3.000	76.1	0.800	31.7
15.00	99.7	6.000	95.8	2.000	61.0	0.600	25.7
10.00	98.7	4.000	86.7	1.000	37.9	0.500	22.7

Report by Mass Percent

Cumulative Mass Finer (Percent)	Low Diameter (µm)	Cumulative Mass Finer (Percent)	Low Diameter (µm)	Cumulative Mass Finer (Percent)	Low Diameter (µm)
97.0	6.618	50.0	1.470	10.0	0.516

Cumulative Finer Mass Percent vs. Diameter

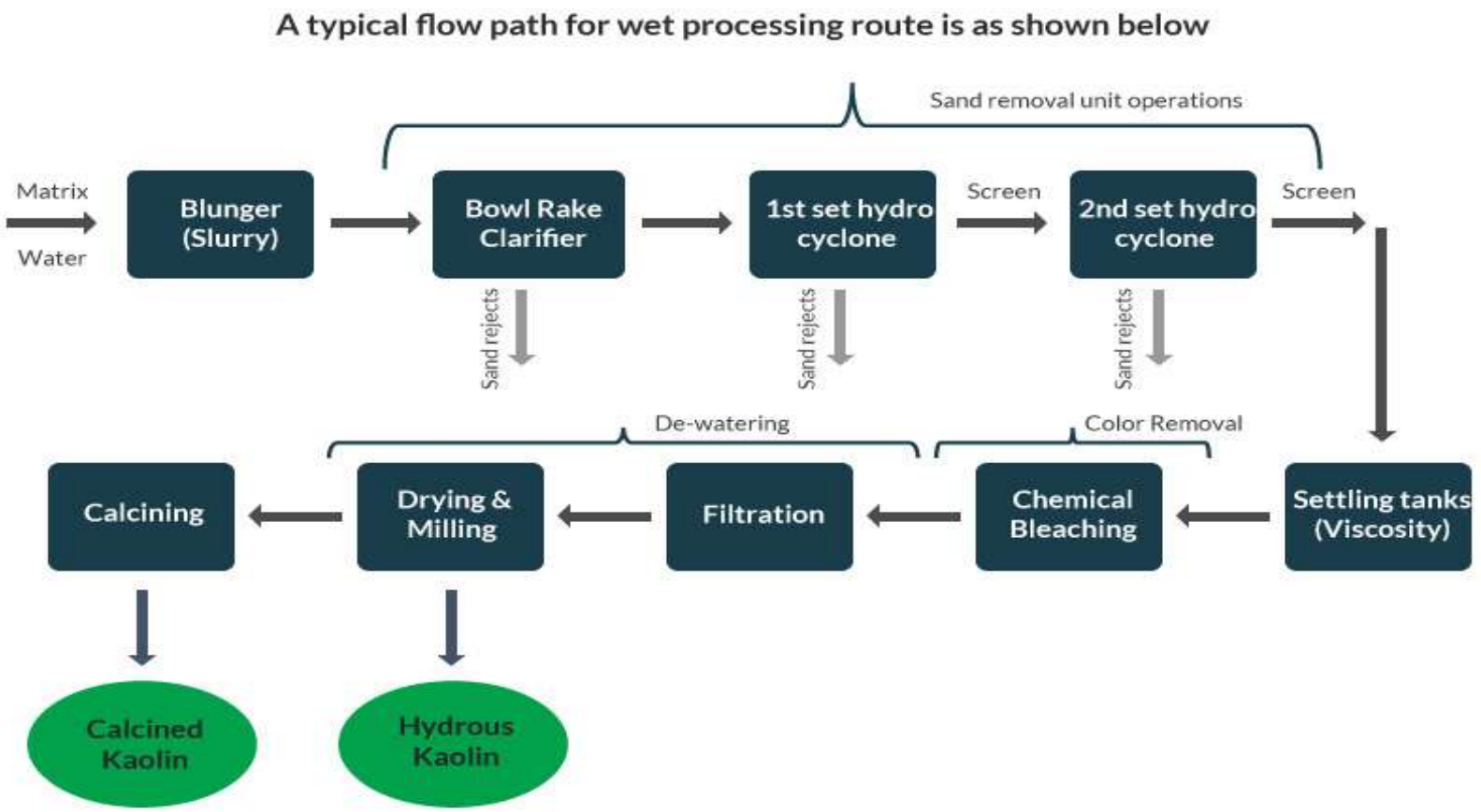
Calcium Carbonate in Coating

- **The amount of GCC in Pre Coat formulation varies from 50% to 100% based on the grade paper/paper board applications.**
- **The particle size plays a major role is achieving the smoothness and gloss properties, lower particle size distribution enhances surface smoothness and gloss.**
- **Carbonate enhance brightness and absorbency levels.**
- **Its availability is more and cost effective.**

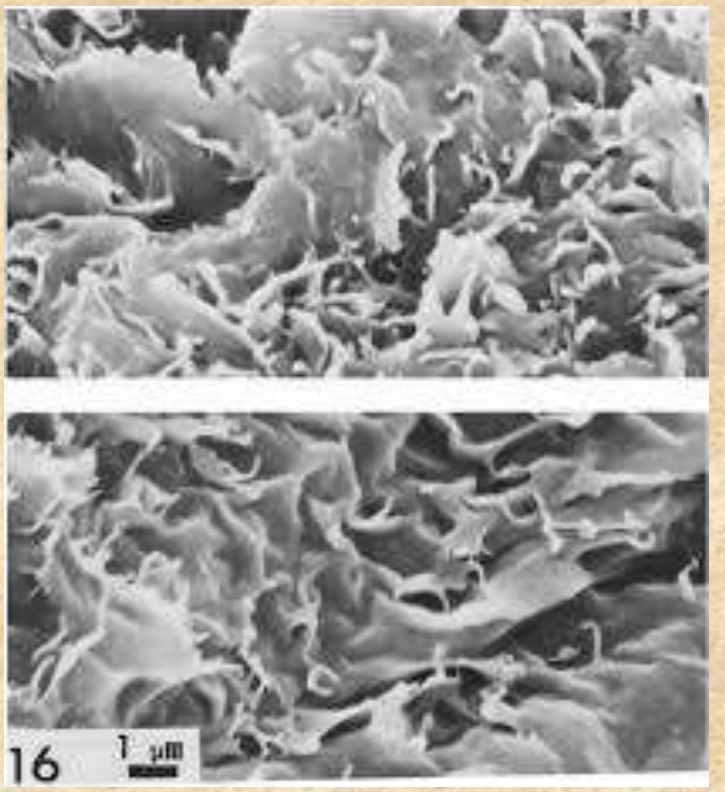
Clay in Coating

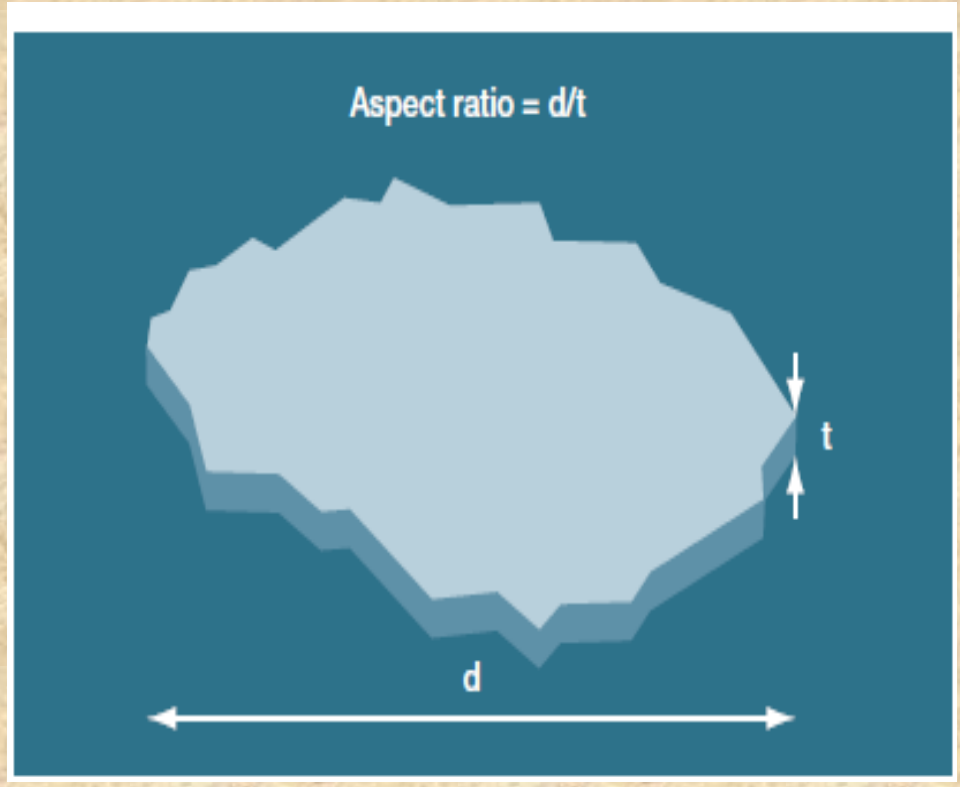
- **Kaolinite clays ($Al_2Si_2O_5(OH)_2$) have long been used in the ceramic industry because they can be easily moulded, have a fine texture, and are white when fired. These clays are also used as a filler in making paper and as a pigment in Paper Coating.**
- **Kaolinite is the purest of clays, meaning that it varies little in composition. It also does not absorb water and does not expand when it comes in contact with water.**
- **Clays are distinguished both by their particle size distribution and also by a property called the aspect ratio.**
- **A high aspect ratio indicates a very platy clay (a platy clay particle is one which is thin and wide like a plate as opposed to being thicker and narrower)**
- **The aspect ratio varies depending on the size of the clay particles.**

Processing of Clay



Clay Structure





Clay in Coating

- **The ratio of clay to calcium carbonate used in the coatings depends on a number of factors.**
- **Clay is a very yellow pigment compared to calcium carbonate and has a significantly higher opacity.**
- **The higher opacity of the clay makes this pigment less compatible with OBAs than calcium carbonate.**
- **Clay is a softer pigment than calcium carbonate. As clay is less abrasive than calcium carbonate.**
- **The clay content of a coating has a large impact on gloss.**

Carbonate and Clay Pigments

Property	Kaolin	GCC
Brightness	80% to 85%(some 90%)	>90% to 96%
Particle size	Naturally 2µm	Requires grinding
Opacity	Excellent	Moderate at high load
Loading levels	20% to 30%	50% to 100%
Sheet strength	Good	Excellent
Bulking	Moderate	Good
Absorption	Low	Low
chemical reactivity	Inert	Unstable in acid environments
Flexibility	Filler/coating	Alkaline-only filler/coating
Processing	Extensive	Grinding/sizing
Availability	Restricted	Geologically plentiful

Carbonate and Clay Pigments

Pigment	Composition	Refractive index	Specific gravity	Dry brightness %	Average particle size,µm
Kaolin	$Al_2O_3.2SiO_2.2H_2O$	1.55	2.65	70-91	at least 70% <2
Calcined Clay	$Al_2O_3.2SiO_2$	1.62	2.70	90	~ 2aggregate
Natural GCC	$CaCO_3$	1.49-1.66	2.72	90-96	0.8-1.5
Talc	$3MgO.4SiO_2.H_2O$	1.57	2.75	85-90	~ 50% <2
Gypsum	$CaSO_4.2H_2O$	1.52	2.34	85-90	at least 70% < 2
Titanium dioxide	TiO_2,rutile®	2.70	4.20	97-98	0.2-0.5
	TiO_2,anatase(A)	2.55	3.90	98-99	0.2-0.5

Binders in Coating

- The function of the binder or adhesive is to bind the pigment particles to each other and to fix the coat to the base paper.

- Binders have a large influence on the coating and processing properties of the coating color.

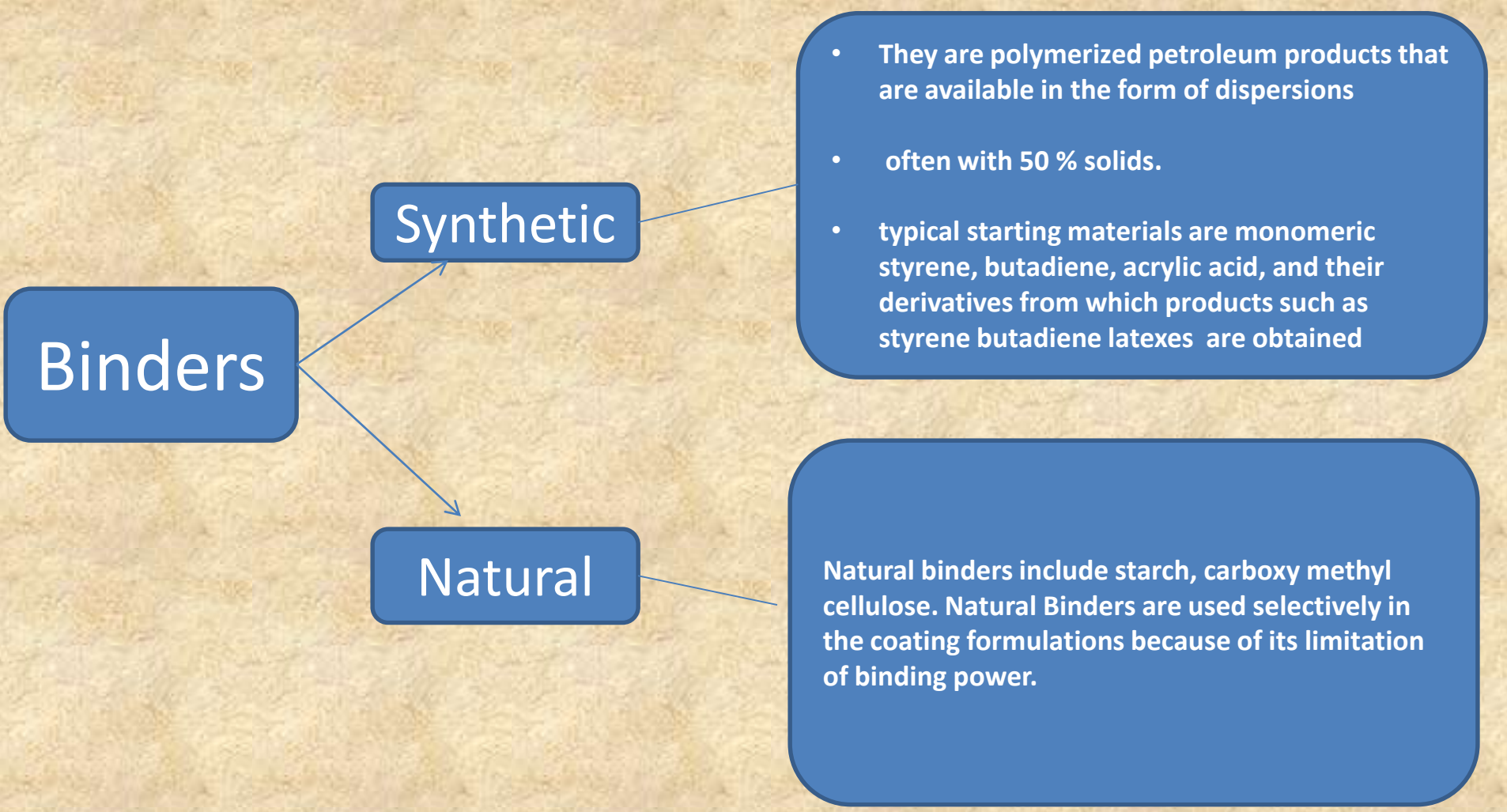
- Binders paly a very important role in developing surface strength of coating color.

Binders in Coating

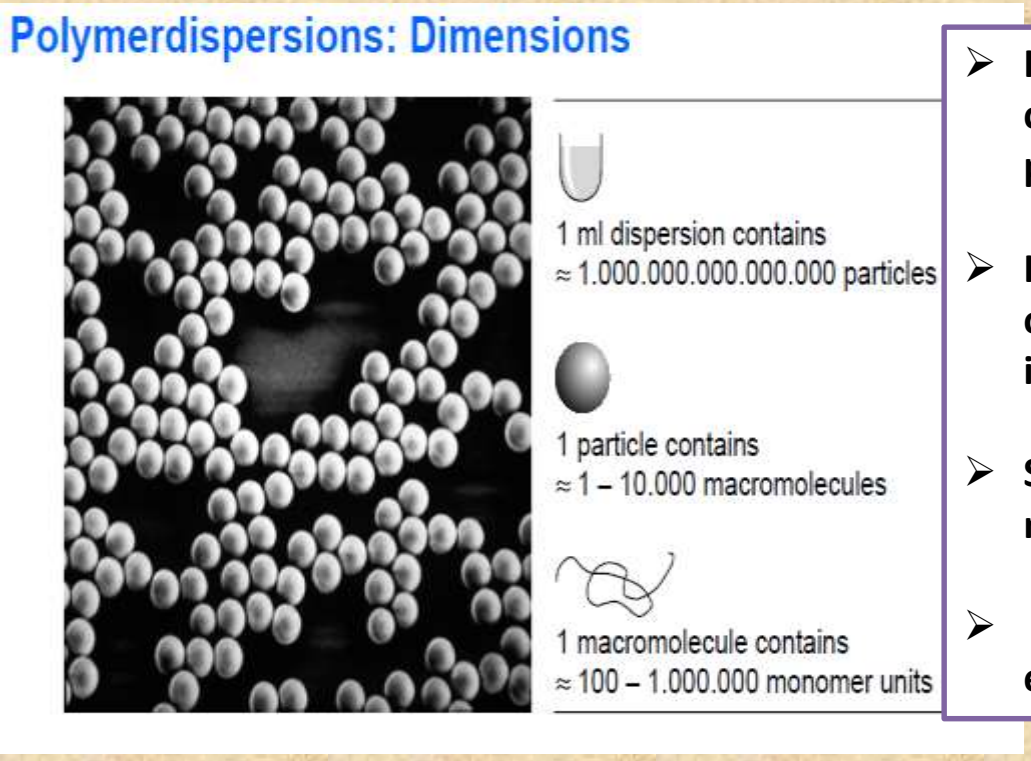
An Binder should have:

- **Good Binding Power.**
- **The correct viscosity for the solid content.**
- **Strong filming properties to prevent excessive penetration of coating.**
- **Compatibility with the pigment.**
- **Enough plasticity .**

Binders in Coating



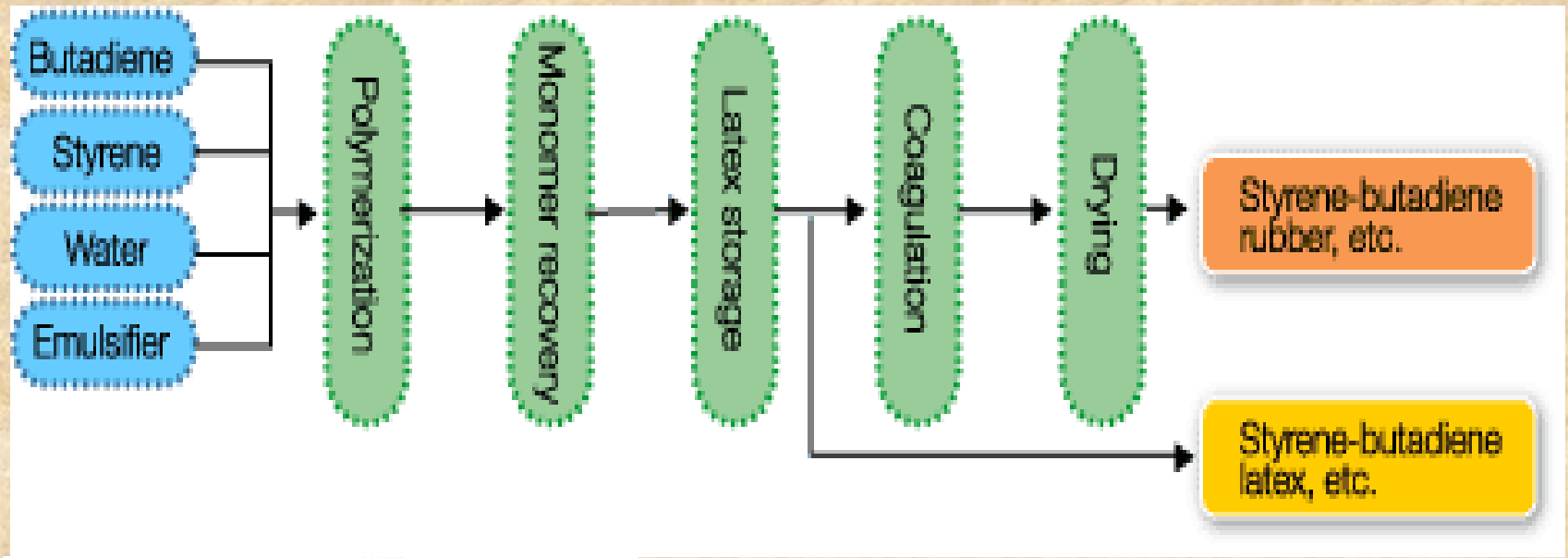
Latex

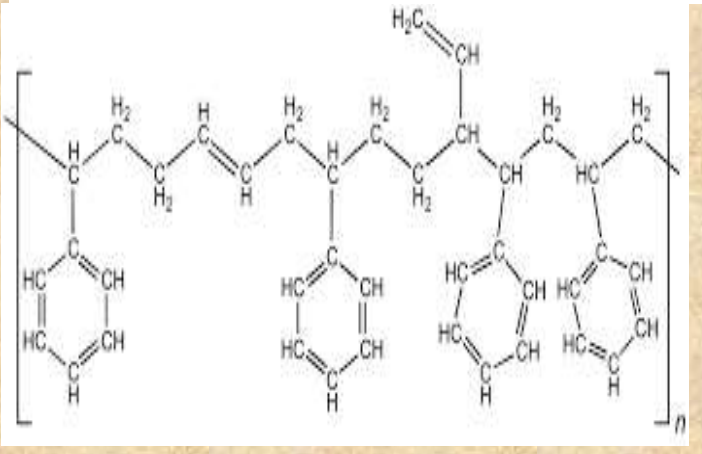


- **Is a synthetic polymers and they are usually created by a process called emulsion polymerization.**
- **Is a combination of two components - an organic compound named styrene and an industrial gas called butadiene.**
- **Styrene is produced when benzene and ethylene react with each other at room temperature.**
- **Butadiene is a by product of the hydrocarbon ethylene..**

styrene-butadiene latexes dominate, Styrene-acrylate dispersions are specialties and of high importance for impressive prints. Additionally acrylate dispersions have an excellent brightness and ageing resistance and are less odorous. Within the paper industry styrene-butadiene or styrene-acrylate latex most commonly used.

Latex

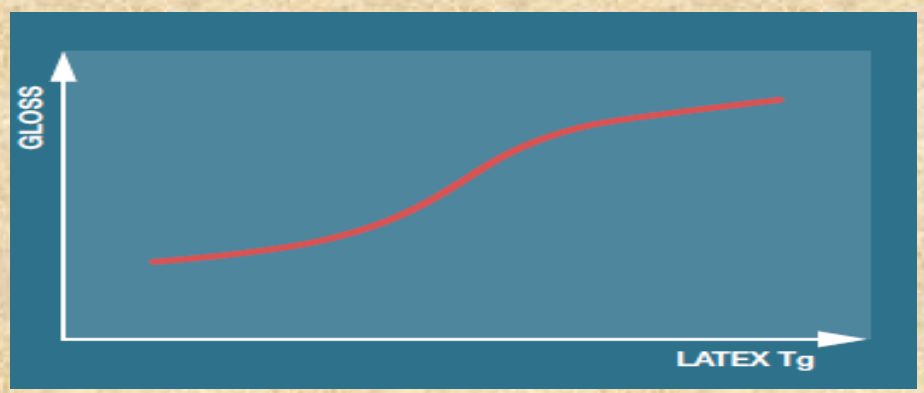




Material	Parts by weight
Styrene	64.0
Butadiene	35.0
A vinyl carboxylic acid	1.0
Nonionic surfactant	7.0
Anionic surfactant	0.1
Water	105.0

Latex

- Latex are often described by their glass transition temperature.(Tg).
- Tg refers to the temperature below which the polymer chains no longer have freedom of motion; above the Tg the polymer can be irreversibly deformed. In behavioural terms, below the Tg the latex is a hard, brittle substance, above the Tg the latex softens and its behaviour can be likened to that of chewing gum.
- A latex with a high Tg is often described as being hard while a latex with a low Tg is described as being soft.
- The properties of the latex used affect the properties of the coating layer formed.
- A coating layer formed with a soft latex (low Tg) is generally more easily deformed than a coating layer formed with a hard latex (high Tg)



Natural Binder - Starch

- Starch is both used in Surface Application and as well in Coating as Binders.

- Starch is polysaccharides it is composed of a number of glucose monomers.
- These molecules are bound to each other through glycosidic bonds .

- Amylose and Amylopectin are two types of polysaccharide. In Amylose molecules in a linear Manner. In Amylopectin glucose units are arrange in a branched manner.

- Source of Native starch are Corn, Maize, Tapioca, Potato, Wheat ….

Natural Binder - Starch

	Potato	Barley	Wheat	Corn	Waxy maize	Tapioca
Source	Tuber	Grain	Grain	Grain	Grain	Tuber
Particle size (m)	10–100	10–35	3–35	5–25	4–30	3–30
Gelatinization temperature (°C)	60–65	80–85	80–85	75–80	65–70	65–70
Moisture at 65% RH (%)	19	13	13	13	13	13
Protein (%)	0.05–0.1	0.3–0.5	0.3–0.5	0.3–0.5	0.2–0.4	0.05–0.1
Fat (%)	0.05	0.4	0.8	0.7	0.2	0.1
Ash (%)	0.3–0.4	0.1–0.2	0.2–0.4	0.1–0.2	0.1–0.2	0.2–0.3
Phosphorus (%)	0.08	0.02	0.06	0.02	0.01	0.01

Size press & Coating Starch

Size press starch	Coating Starch
• **Source** – Tapioca, Maize, Corn and Potato	• **Source** – Tapioca, Maize, Corn and Potato
• **Starch Conversion** – Oxidized, Enzyme, Other Modified and Specialty starches cooked in particular Solid and temperature	• **Starch Conversion** – Thermal/Chemical /Other Modified Starches cooked and mixed with latex and other pigments
• **Impacts on Process**- Improve printing, Improve surface strength, Fill voids, Improve surface for coating application	• **Impacts on Process** – Improve Optical, Printing, Binding of pigments and Functional properties

Other Coating additives

Chemical	Composition	Purpose
Cross Linker	**Water based Ammonium Zirconium Carbonate solution /Poly-Hydro oxylated resin**	**Reinforces the Structure of the binder in the board**
Thickener	**Emulsion of Acrylic copolymer**	**To Increase the viscosity of the slurry without substantially changing its other properties**
Defoamer	**Oil based /Silicone based**	**To destabilize the foam lamellas. The foams in the coating slurry will prevent the efficient filling of coating chemical on the surface of the board**
Dispersants	**Sodium Poly Acrylate Solution**	**To improve the efficiency of the dispersion process by uniformly dispersing the solid particles with in slurry to assist in lowering in Viscosity and enhancing the stability - Preventing from settling /Agglomeration**

Other Coating additives

Chemical	Composition	Purpose
Co binder	Carboxyl Methyl Cellulose	It acts as binder and better water retention aid in coating slurry
OBA	stilbene disulphonic acid derivative	To enhance the Brightness and reduce yellowing of coated board
Lubricant	Aqueous dispersion of calcium stearate	To improve the smooth coating application under the tool of applicator (Bar/Blade) and to avoid friction

Coating Colour Formulations

The main driving forces to develop improved coating colour formulations are:

- **Requirement of improved coated paper quality such as higher brightness, print gloss and better coating coverage.**
- **Requirement of high uniformity of paper quality which calls for accurate process control during coating colour formation, application and drying.**
- **Trends in printing technology such as higher printing speeds**
- **Environmental requirements including recirculation and reuse of coating colours.**

Coating Colour Formulations

- **Coating colour have a very simple composition and consists primarily of pigments dispersed in water, plus binders, co-binders and additives.**

- **Calculations are, as a rule, based on the dry product, even if the actual ingredients deployed are mainly liquid products with differing dry contents.**

- **The basis of calculation is 100 parts of pigment, to which all additions are calculated. As an example 24 kg of commercial product binder must be added to 100 kg of dry pigment to obtain 12 parts of dry binder in the formulation if the synthetic binder has 50 % dry content, similarly calculation is done for all other inputs ex. Co Binder and additives.**

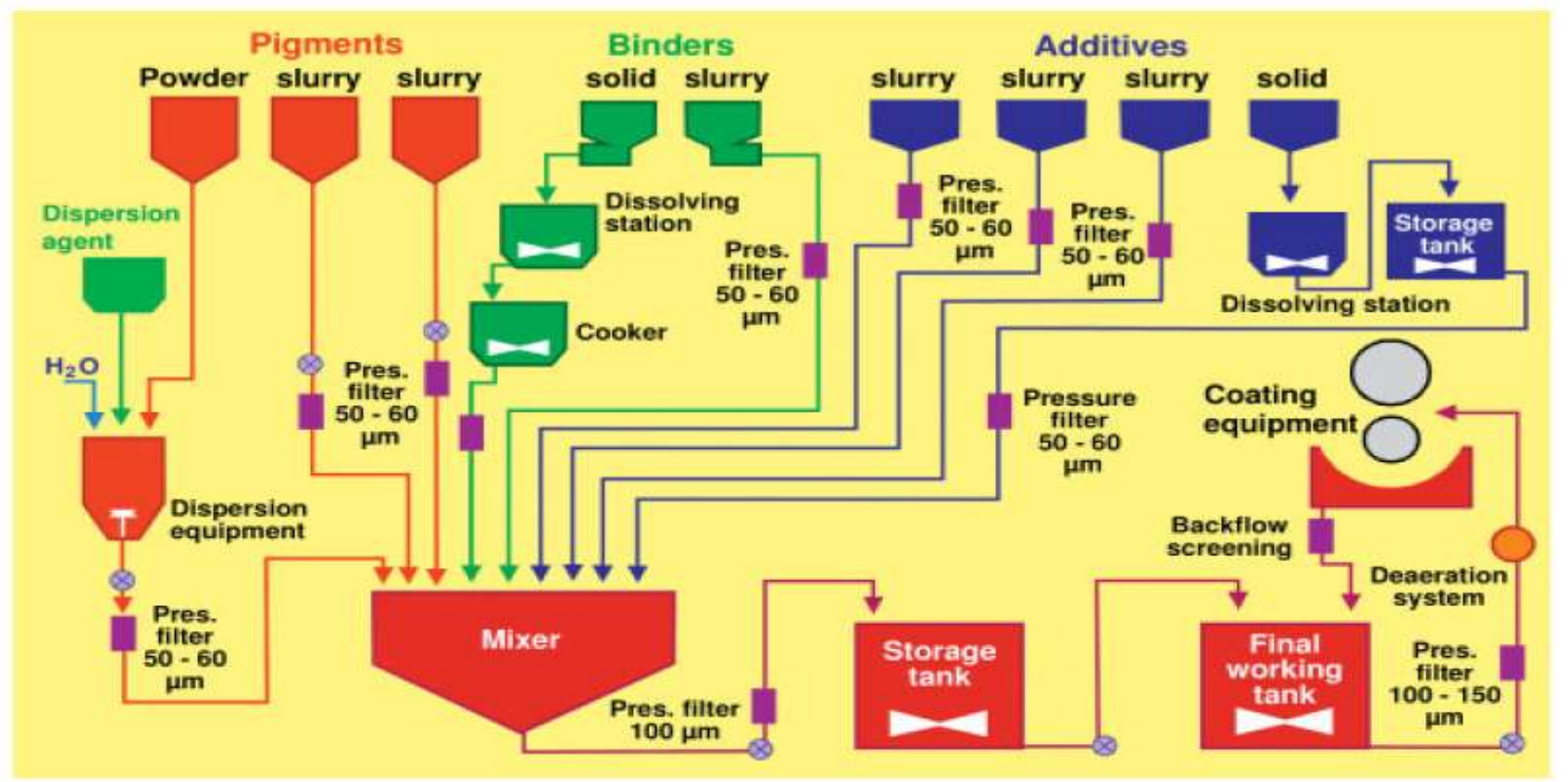
Parts[1]	Substance
100.0	Coating pigment
12.0	Binder
0.5	Cobinder
0.5	Additives (e.g. calcium stearate, wax, optical brightener) pH is set to 8.5 by adding sodium hydroxide solution (NaOH), and the solid content to 65 %–70 % by adding water.

[1] The term parts refers to the parts by weight addition of a component based on 100 parts by weight of pigment

Coating Colour Preparation

- **All components of the coating colour formula are pumped from their storage tanks into a mixer.**
- **The mixer is placed on load cells to measure accurately the batch sizes and weights of the major components.**
- **Other precise ways to dose the additives are mass flow meters and metering pumps.**
- **In batch processes, these metering devices can be optimally calibrated and dimensioned**
- **Batch processes are also very flexible for a wide dosing range of each component.**
- **The flexibility of a batch process is obvious in cases where the rheological or other properties of coating colours have to be changed by altering the order of addition of the same chemicals. The mixing time and mixing energy can also be easily changed**

Coating Colour Preparation



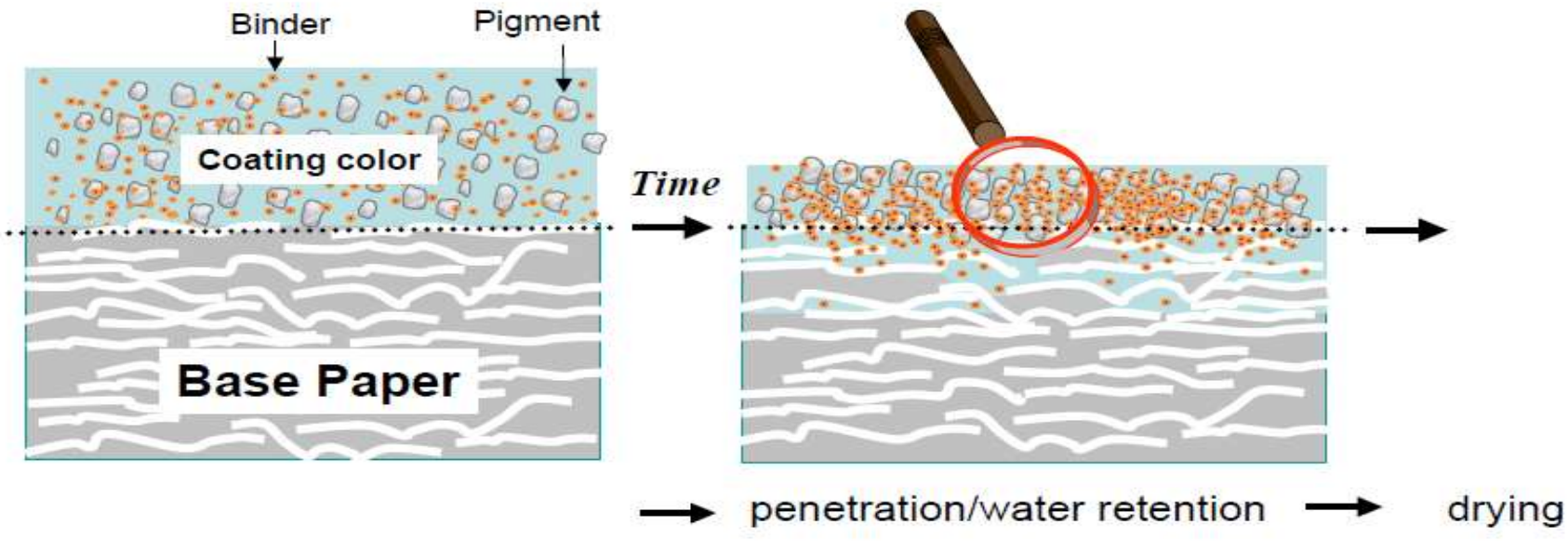
A Sematic Flow Diagram of a Coating Kitchen

Coating Application

- Almost all coaters consist of two functions:
  - application
  - metering
- ***Application*** consists of applying more material than is needed in the final product
- ***Metering*** methods remove the excess in a way which leaves the desired coating quality at the desired production rate

Coating Process

Principle of Coating Process



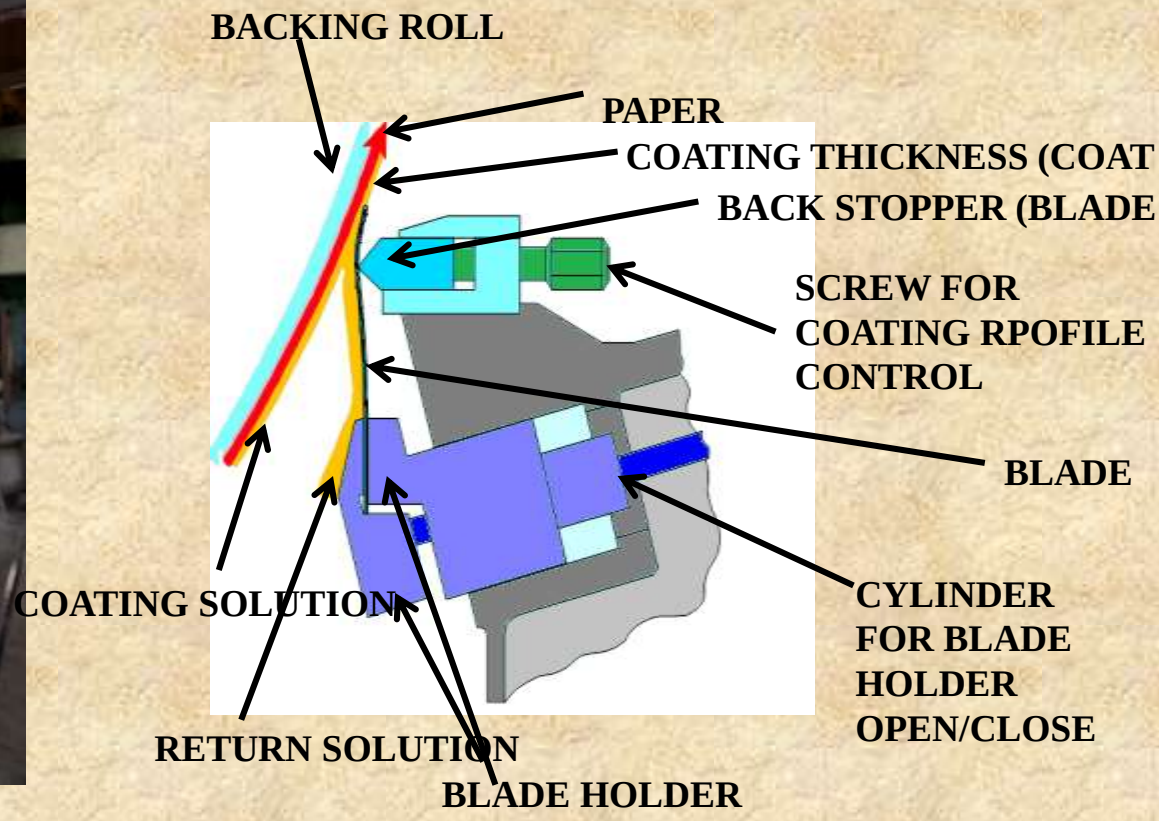
Coating Application – Blade Coater

- Blade coaters are the most commonly used metering device in the paper & board industry
  - ridged blade
  - bent blade
- Used with various application devices including:
  - roll applicator
  - short dwell
  - jet applicator

Coating Application – Blade Coater

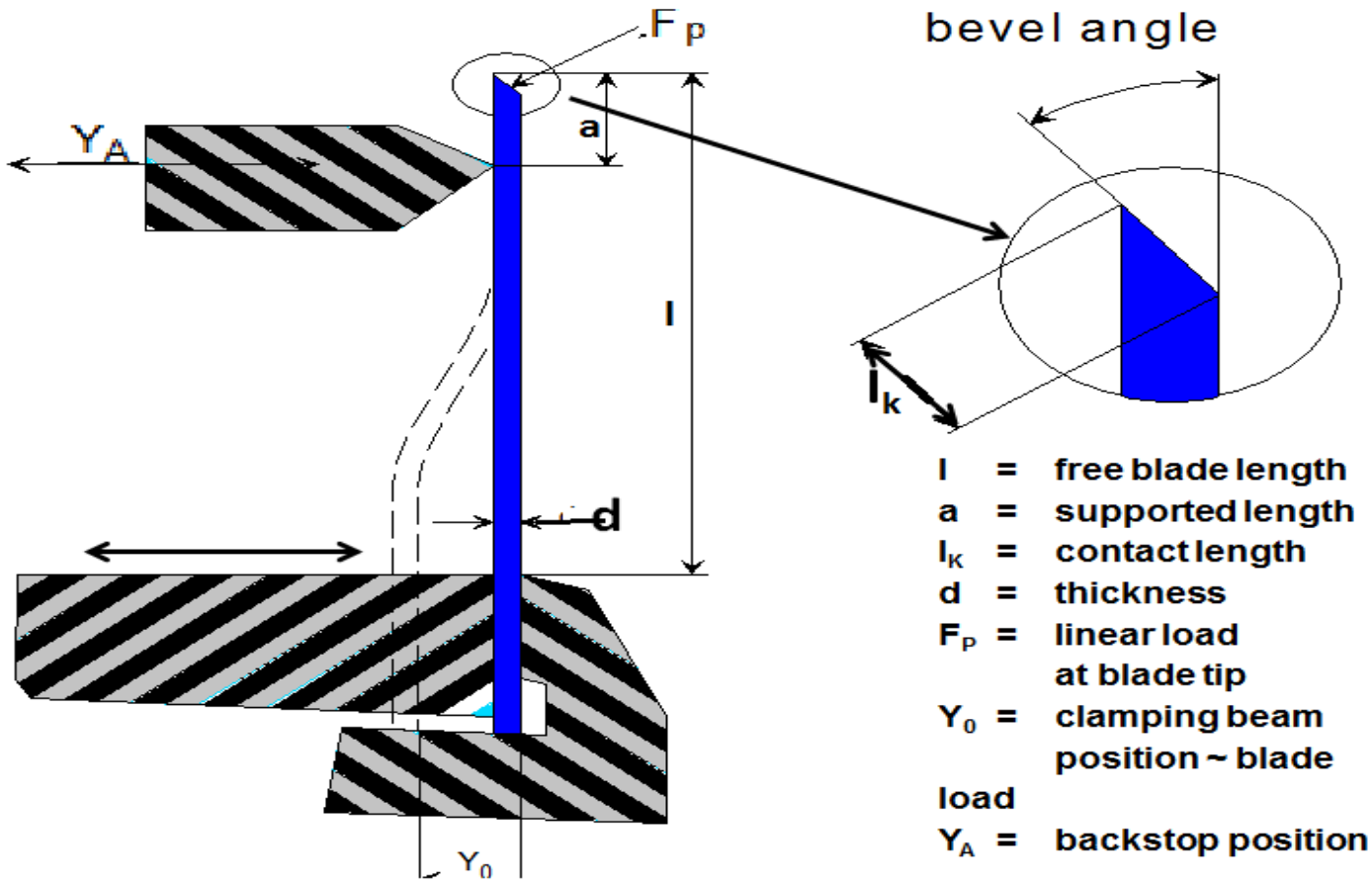
- Coat weight is controlled by:
  - Blade pressure (higher pressure = lower coat weight)
  - Blade angle (higher angle = lower coat weight)
  - Blade thickness
  - Coating solids (change with time due to recycle)
  - Coater speed (faster instantly gives higher coat weight)
  - Coating viscosity
- Coating rheology has large effects on runnability

Coating Application – Blade Coater



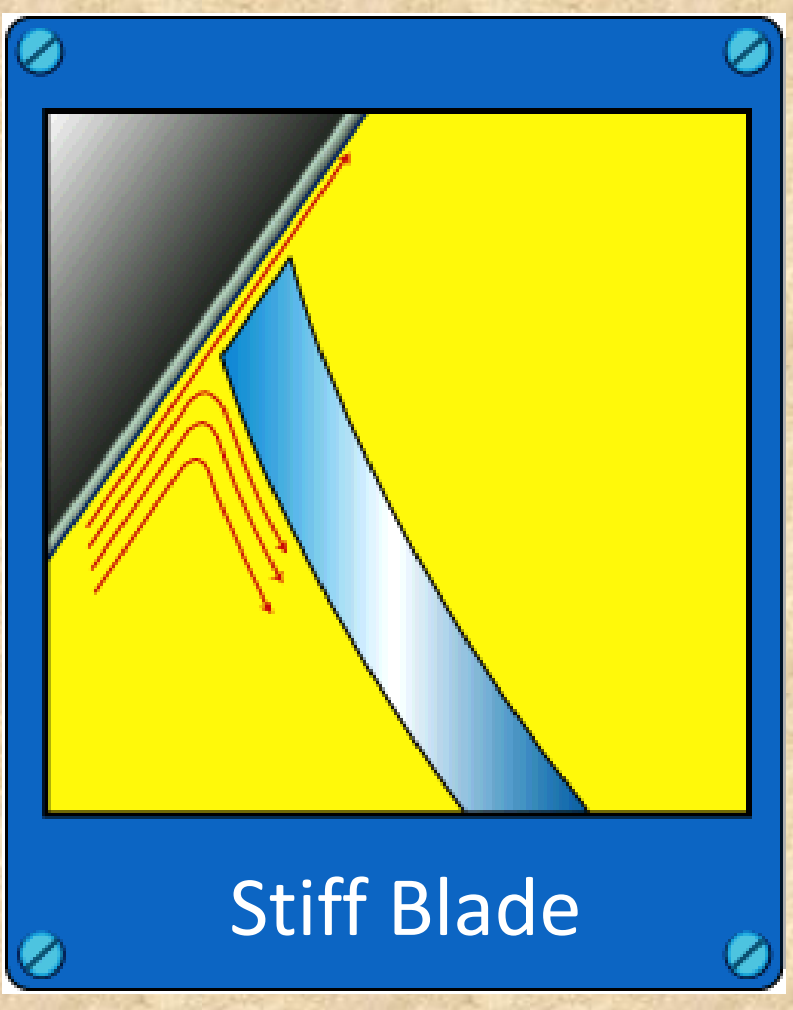
Coating Application – Blade Coater

Blade parameters



l	=	free blade length
a	=	supported length
l_K	=	contact length
d	=	thickness
F_P	=	linear load at blade tip
Y_0	=	clamping beam position ~ blade load
Y_A	=	backstop position

Coating Application – Type of Blades

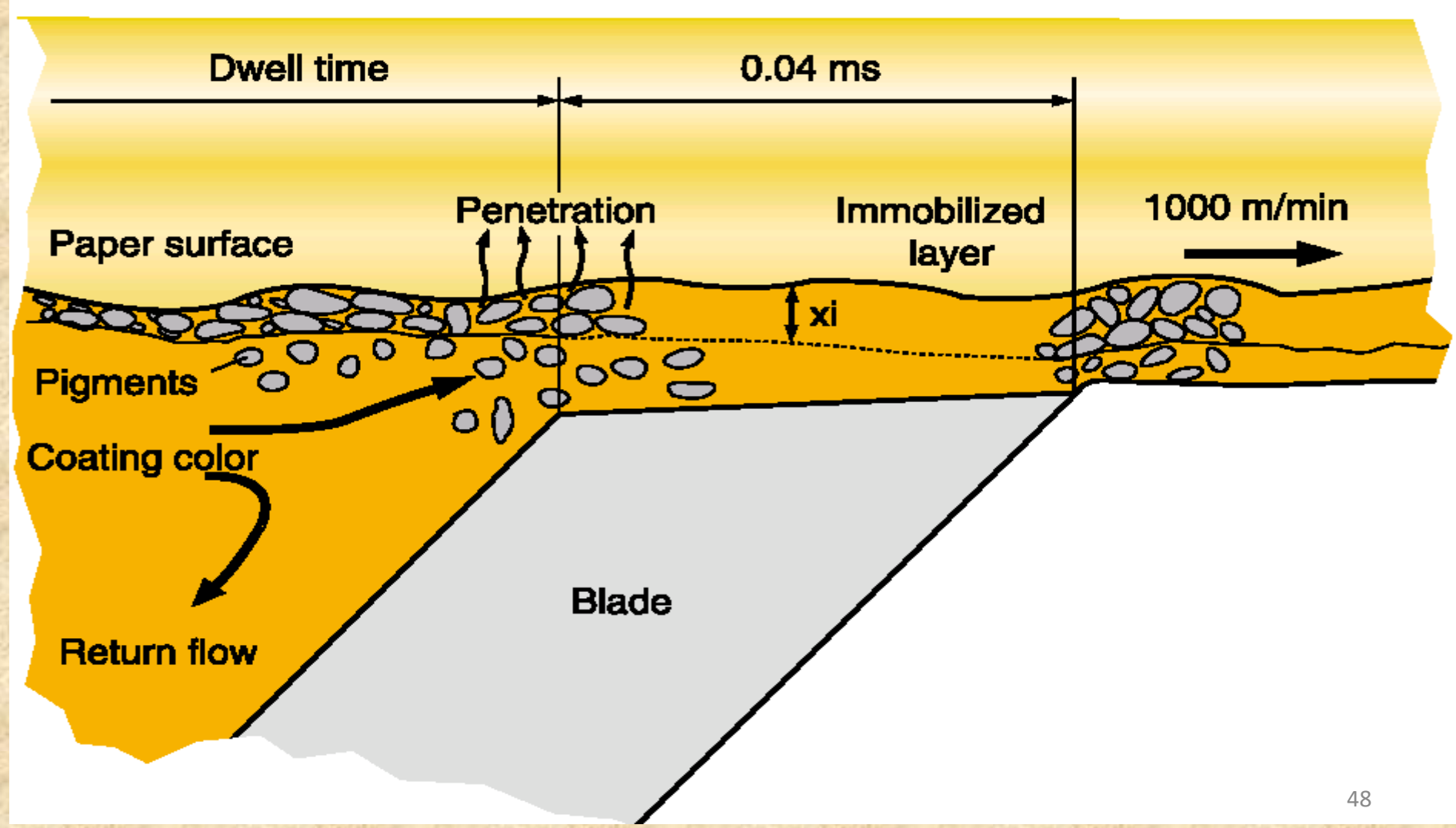


Coating Application – Type of Blades

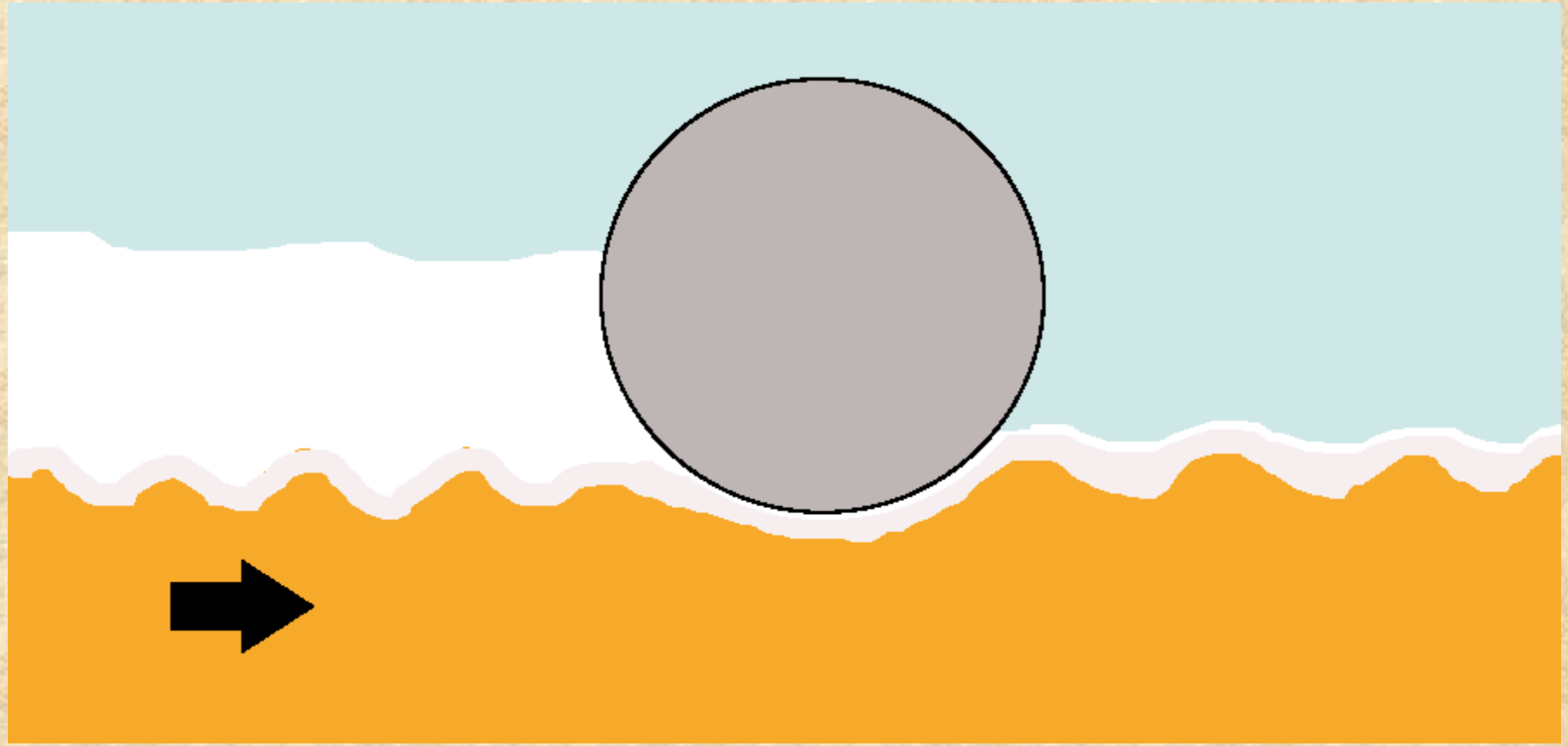
- Ridged blade coater advantages
  - smooth level surface .. Excellent roto & offset print
  - good coat weight control at high speed or solids
  - best LWC when used with short dwell applicator
- Ridged blade disadvantages
  - poor ability to achieve high coat weight at low speeds
  - high coating de-watering at high blade pressure
- Operational issues
  - blade lines/streaks
  - blade wear can be high

- Bent blade coater advantages
  - same smooth coating as stiff blade
  - ability to obtain high coat weight at low speed or solids
  - can apply high coat weight on smooth substrates with few blade lines
  - less problems with streaks than stiff blade
- Bent blade disadvantages
  - poor ability to achieve low coat weight at high speeds
  - Profile (variation in coat weight can be an issue)
- Operational issues
  - blade lines/streaks
  - blade wear can be high

Coating Application – Coating Behavior



Coating Application – Rod Coater



Coating Application – Rod Coater

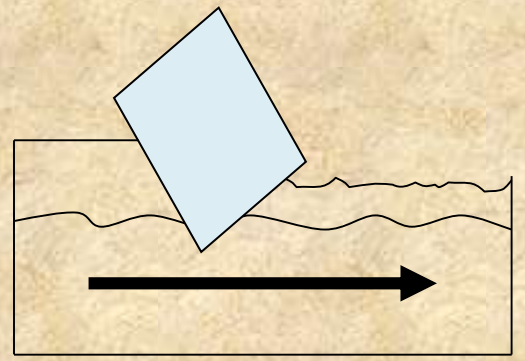
- Rod coater advantages
  - free of blade lines
  - excellent for base coats
- Rod coater disadvantages
  - coatings can have patterns
  - solids or viscosity change coat weight
  - Viscosity is critical
- Operational issues
  - Rod life is long compared to blade
  - Coat weight control is difficult.. especially at high speed

Coating Application – Rod Coater

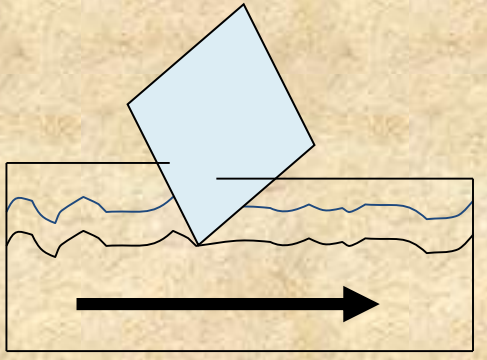
- Coat weight for a rod coater is controlled by two methods
  - grooved type rods = volumetric metering
    - larger grooves have more volume
    - higher solids more coating in volume
  - smooth rods = hydrodynamic metering
    - higher speed give more volume
    - higher viscosity gives more volume

Coating Application – Rod Coater and Blade

Property	Rod Coater	Blade Coater
Coat Weight	12 - 16 GSM	10 - 12 GSM
Dimension	12- 15 mm diameter	0.4 - 0.6 mm thickness
Metering	Wiping out Excess Coating	Scrapping out excess Coating
Coating Application	Follow the contour of the base board	Provides level coating application
Consumable	Long Life , low wear and tear	Short Life , high wear and tear
Coating Solids	62 – 64%	64 – 68%



Rod Coating

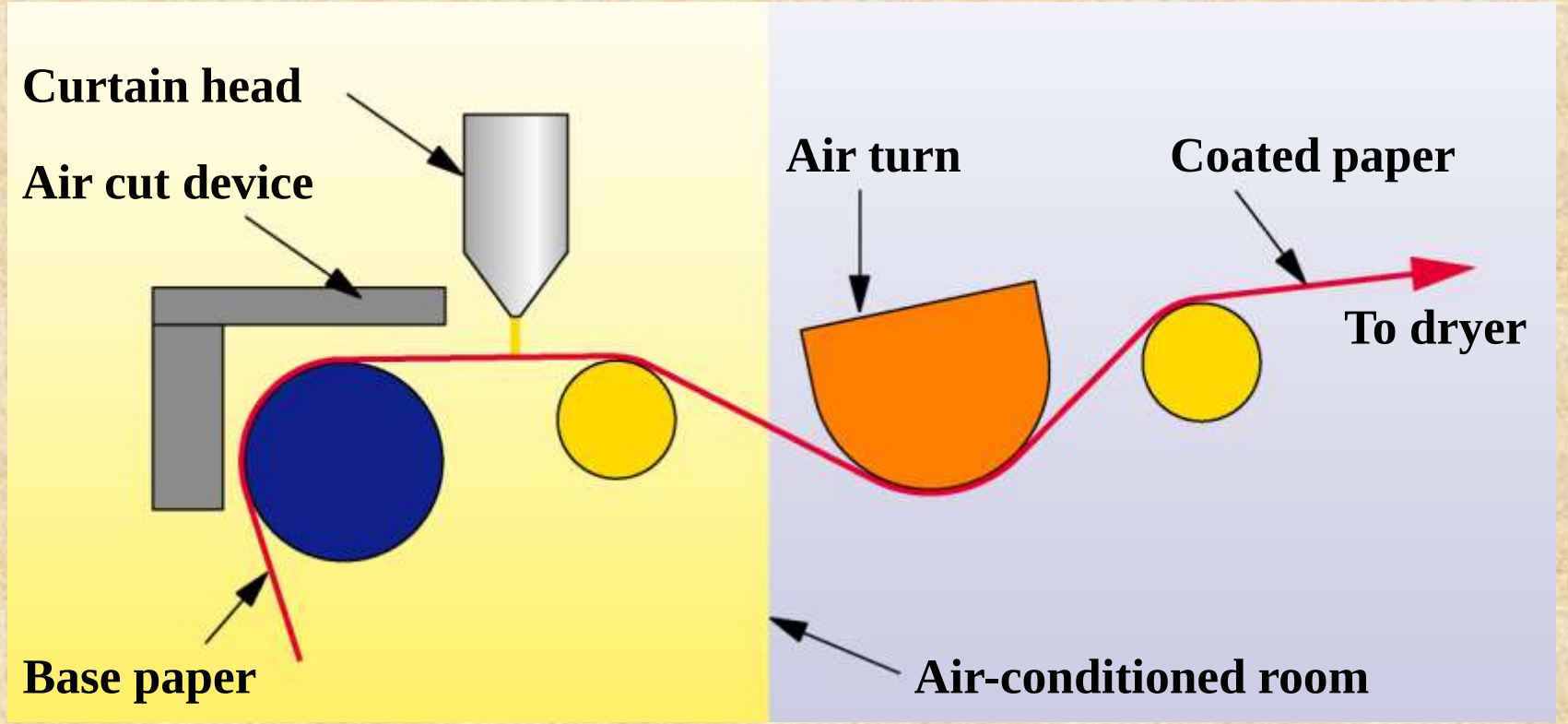


Blade Coating

Coating Application – Curtain Coat

- **Curtain coating is a process that creates an uninterrupted curtain of fluid that falls onto a substrate.**
- **The substrate moves at a regulated speed through the curtain to ensure an even coat on the surface.**
- **.The curtain is created by using a slit or die at the base of the holding tank, allowing the liquid to fall upon the substrate.**
- **Curtain coating is a pre-metered coating method, which means that the exact amount of coating needed to coat the substrate can be calculated before the process is actually accomplished.**
- **This is can be done by using the ratio of the flow rate (with respect to volume) and width of the substrate to the speed at which the substrate passes under the "curtain" of coating fluid.**

Coating Application – Curtain Coat



Coating Application – Curtain Coat

- Faster coating velocity
- Ability to produce a thinner coat
- Easily coat abstract surfaces
- Lower cost of dies
- Lower waste of coating
- Coats a more uniform layer

Coated Paper Drying

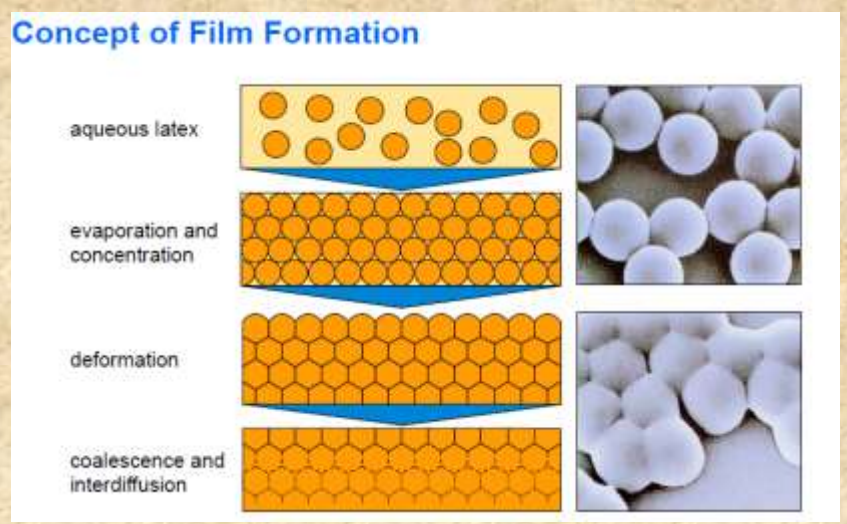
IR Drying System

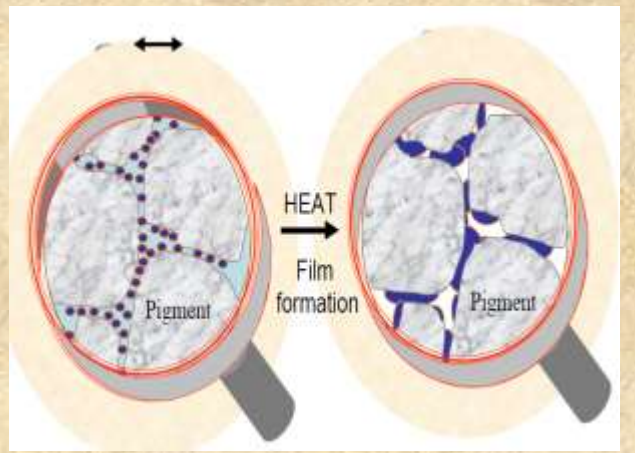
- IR Drying System are often installed immediately after the coating application,
- The IR radiation helps in preventing binder /pigment migration into the board.
- IR Dryer operates at surface temperature of 800 - 850 Deg C.

AIR Drying System

- Air Drying System forms the major drying source for Coated Papers.
- The Air Passes through heat exchanger and the temperature is increased to 145-155 Deg C.
- The Hot Air is Blown on the Coated Sheet.

Coated Paper Drying





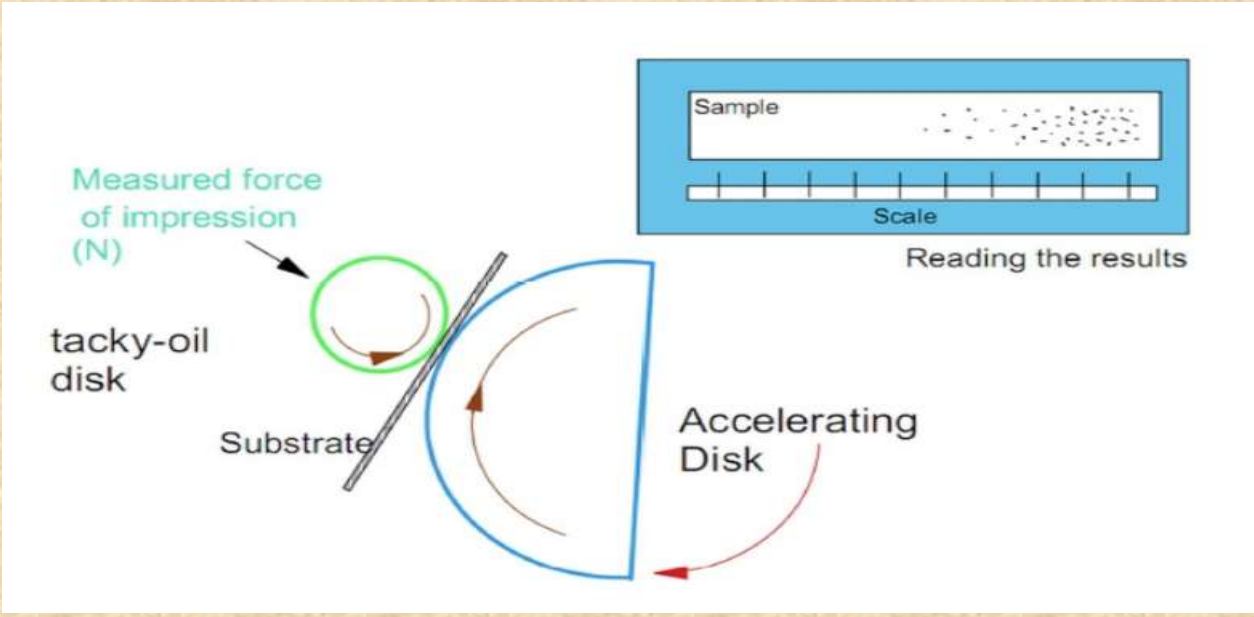
- Drying plays very important role in developing strength of coated papers.
- IR dryers prevents binder migration into the board , IR dryers are installed immediately after the coating application.
- Air Dryers actually removes the water from the coated surface.
- Binders and Pigments get settled onto the surface and develop a bond.
- Dryer temperature is very critical for bond development as the latex gets hardened as the water evaporates.

Critical Coating Color Parameters

Parameter	Significance
pH	pH of the coating solution to be maintained >8.0, Lower pH will destabilize the coating colour and agglomerate the particles and restrict free flow of Slurry (Affect viscosity)
Solids	Coating Solids determines amount of the coat weight applied to the paper higher solids render opaque coating
Viscosity	Viscosity determines the flow properties of the coating colour, for maintaining effective coat weight application , the viscosity needs to be maintained at optimum level.
Water retention	the ability of the coating colour to retain water in spite of the sucking action of the coating base paper. If the water retention capacity is too low, the coating colour may be too strongly dewatered between application and levelling. This leads to an increased solid content of the coating colour before it comes into contact with the levelling blade which causes streaking and an uneven coat surface, binder migration.
Residues	Residues are the unwanted material present the coating colour , these if present will cause blade streaks or cause picking while printing.

Critical Coated Paper Properties

Critical property	Significance	Reasons for deviation
IGT Dry Pick	This test measures the ability of coated paperboard to resist picking or blistering. This is one of the parameter to decide the printing speed. Higher the value better the printing speed. The test results are expressed in m/s	**1.Insufficient binder in pre-coat or top coat 2.Too much binder migration 3.Low size press solid 4.Coating pigment particle size and distribution 5. Poor bonding between the fibre. 6. In sufficient drying at coaters**
Wet Rub test	**Wet rub test is used to find the ability of coated paper to resist or withstand destruction by applying moisture and abrasion. This indicates the wet strength of coating surface while subjected to moisture and abrasion. During printing, the coated surface of the paper board contact with fountain solution several times. So, if the paper board having wet rub issue, the coating surface become weak and leads to picking, dusting issue as well as flaking issue in UV printing/varnishing.**	**1.In sufficient addition of Co-binder (CMC) 2.Too much binder migration 3.Insufficient binder in pre coat or top coat**
Surface Roughness (PPS)	**The Surface roughness is being measured by using PPS tester (Parker Print- Surf). The test results are expressed in micron. Lower the value better the smoothness. The Significance are 1. Good visual appearance 2. Good print and varnish gloss appearance 3.Visual impact of laminated coated board**	**1.Poor Calendaring 2. Uneven Coating application 3. Coating Pigments Particle Size variation.4. Poor Machine Glaze.5.Poor Formation of paper**



IGT Pick & Blister

This test measures the ability of coated or uncoated paper or paperboard to resist picking or blistering during offset printing. The test device operates by applying a known film thickness of polybutyne oil, which has a known viscosity, to the sample surface while under acceleration, ie, the application speed increases from 0 m/s to 4 m/s during the application. The oil creates a pulling action on the paper surface, like offset ink, resulting in picking, blistering, or both. The point at which the picking and blistering starts is the end point of the test. The reported units for both pick and blister are viscosity-velocity product (vvp). At a known oil viscosity, this indicates the velocity or press speed that can be achieved before the sheet is damaged.

Smoothness

Surface Roughness:

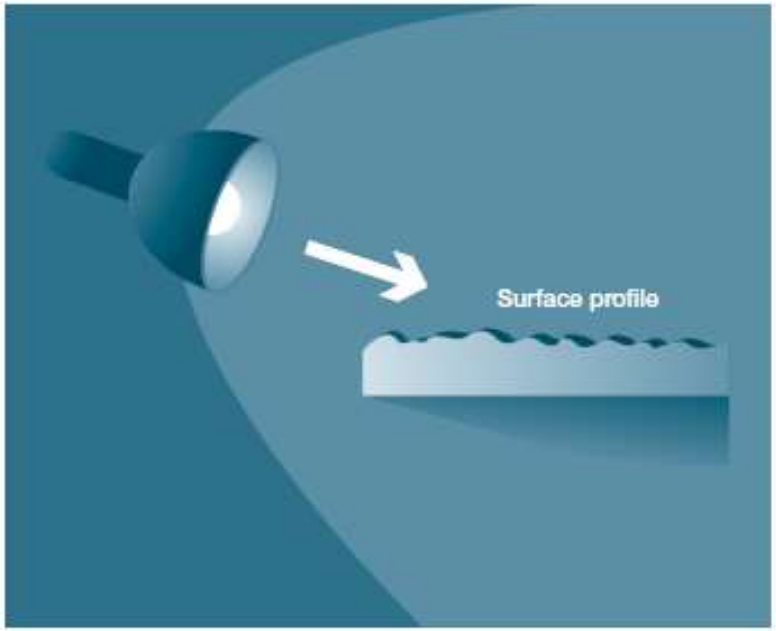
Surface smoothness is assessed in terms of surface roughness. The lower the value the smoother the surface.

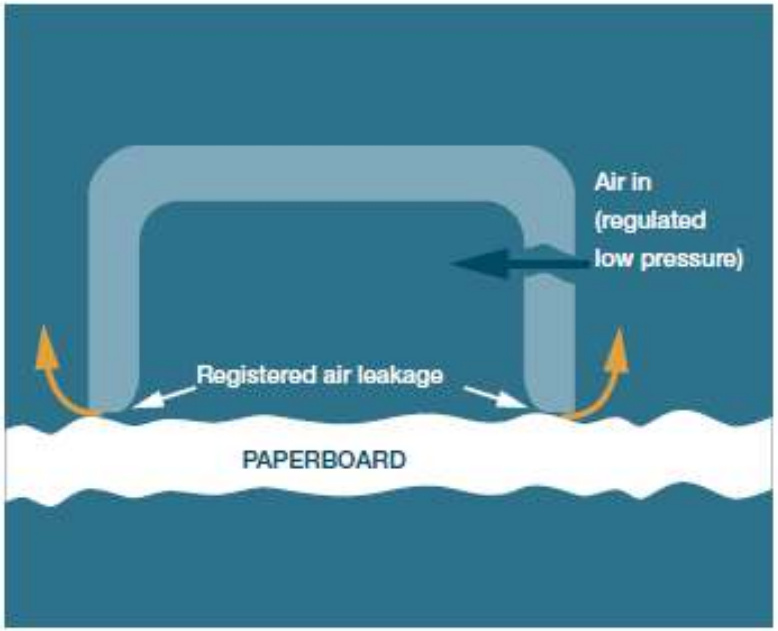
The most commonly used method and instrument for the assessment of coated paperboard surface roughness today is the PPS, (Parker Print-Surf) roughness tester. The test result is expressed in micrometers.

For uncoated surfaces the Bendtsen method and instrument is found to be more suitable . The readings are given as total leakage of air in ml/min.

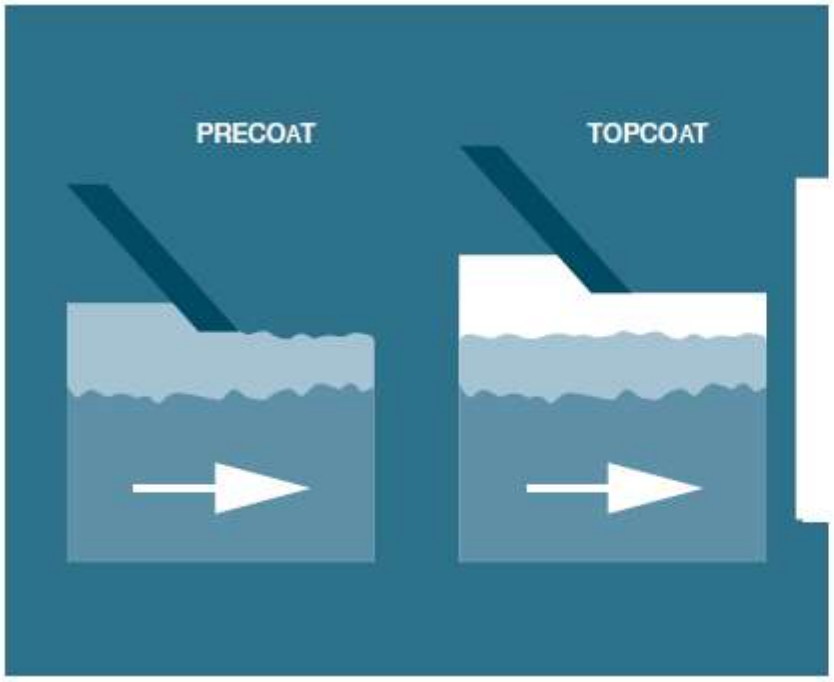
The measuring principle for both the methods is based on recording of air leakage between the paperboard surface and reference surface of the instrument.

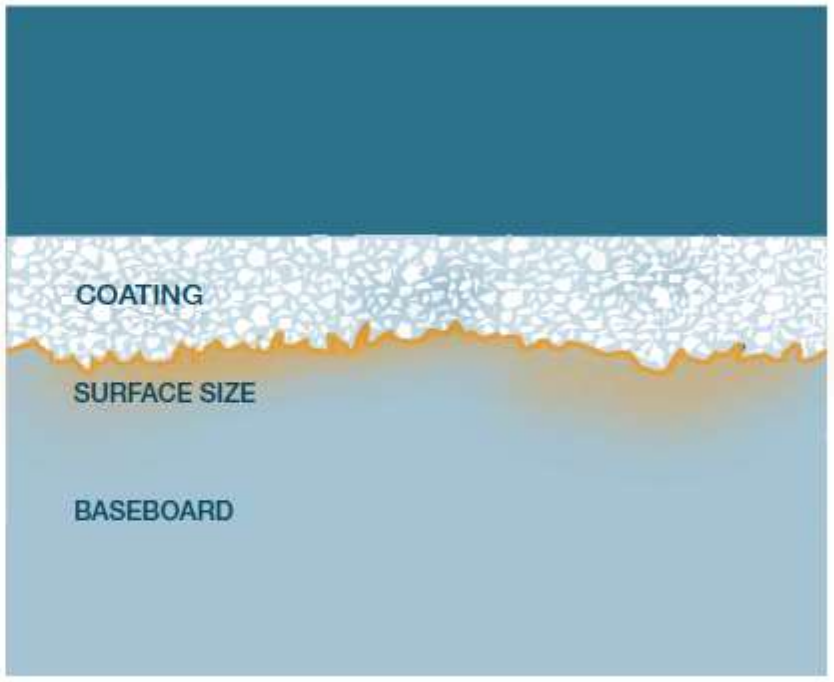
Smoothness Attributes





Type of Coating Impacting Smoothness





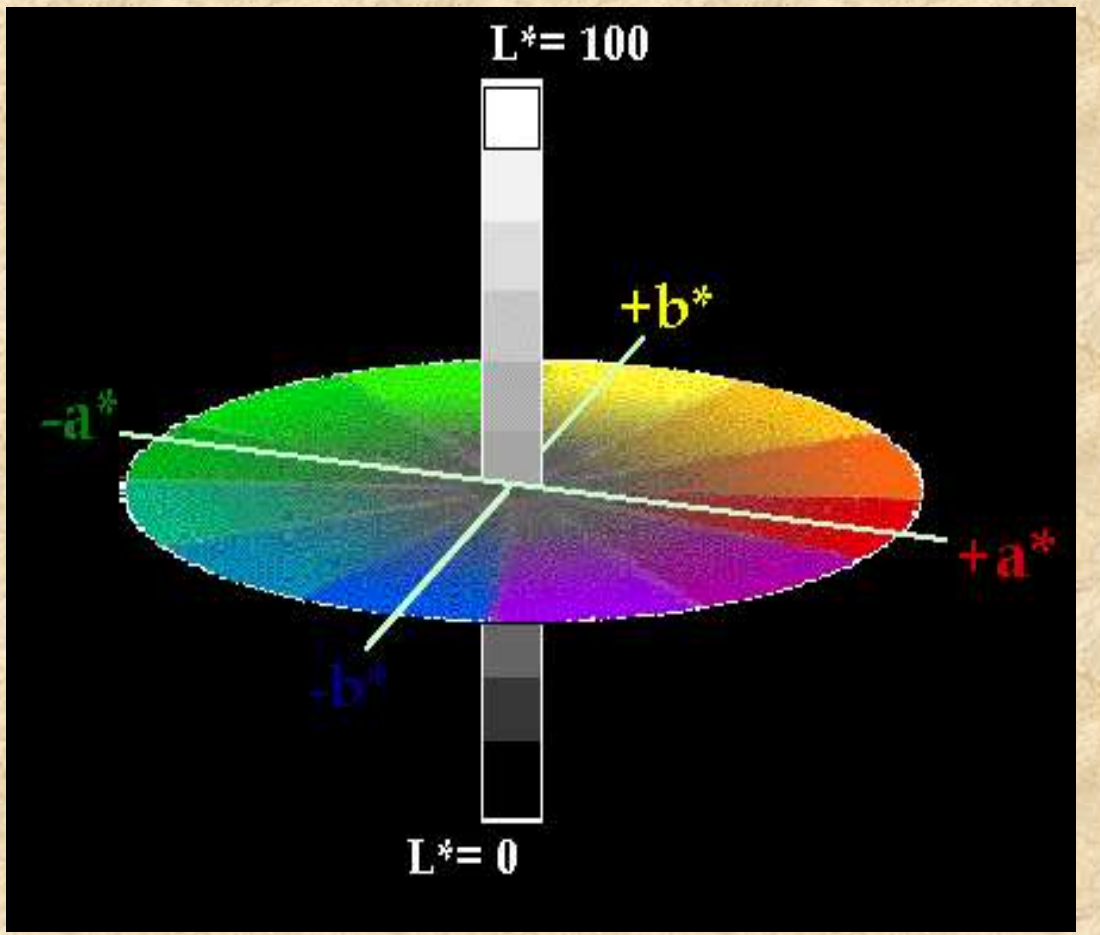
Critical Coated Paper Properties

Critical property	Significance	Reasons for deviation
Gloss	The amount of light reflected from the paper board at an angle equal to the incident rays is called as gloss. Higher the vale better the gloss. The significance are 1. Good visual apperance 2. Good appearance after printing and varnishing 3.Good appearance after lamination	1.Poor calendaring of the paper board 2.Coating pigment particle size and distribution 3.Types of pigments in top coat 4) MG effect on the surface
Ink Absorption (K&N)	This is the indicative test for the ink absorption during printing. Ink Set off , Low print gloss, Rough printing can be controlled by controlling ink absorption	1.Too much or too low binder in coating 2. Coating particle size/ distribution 3.Types of pigment used 4.Too much binder migration 5.Types of pulp/waste paper used in the furnish
Porometrique ink test	The significance of the test is to find out the print uniformity. Patchy or Rough printing can be controlled by controlling uniform ink absorption	1.Glassy surface due to friction 2. orange peel effect due to poor base board formation 3.Lumpy base board formation 4.Coating particle size/Distribution 5.Improper drying (Moisture)

Critical Coated Paper Properties

Critical property	Significance	Reasons for deviation
Brightness	Brightness measures the amount reflectance of a specific wavelength of blue light(457nm). Brightness values are expressed in %. Higher the value better the brightness. The significance are 1) Good visual appearance 2) Better printing appearance.	1. Amount of coating applied 2. Types of pulp/waste paper in the furnish 3.Coating pigment brightness
L,a, b	L,a,b are the colour co-ordinates which indicates L=100 white L=0 black, a + red a - green b + yellow b - blue. The significance of the L,a b are 1. Helping in fixing the base board shade 2. By controlling l,a, b values, the desired print shade can be achieved.	1.Type of pulp/waste paper in the furnish 2) Depending on dye usage 3)Coating pigment optical properties 4)Amount of coating applied on the paper board surface

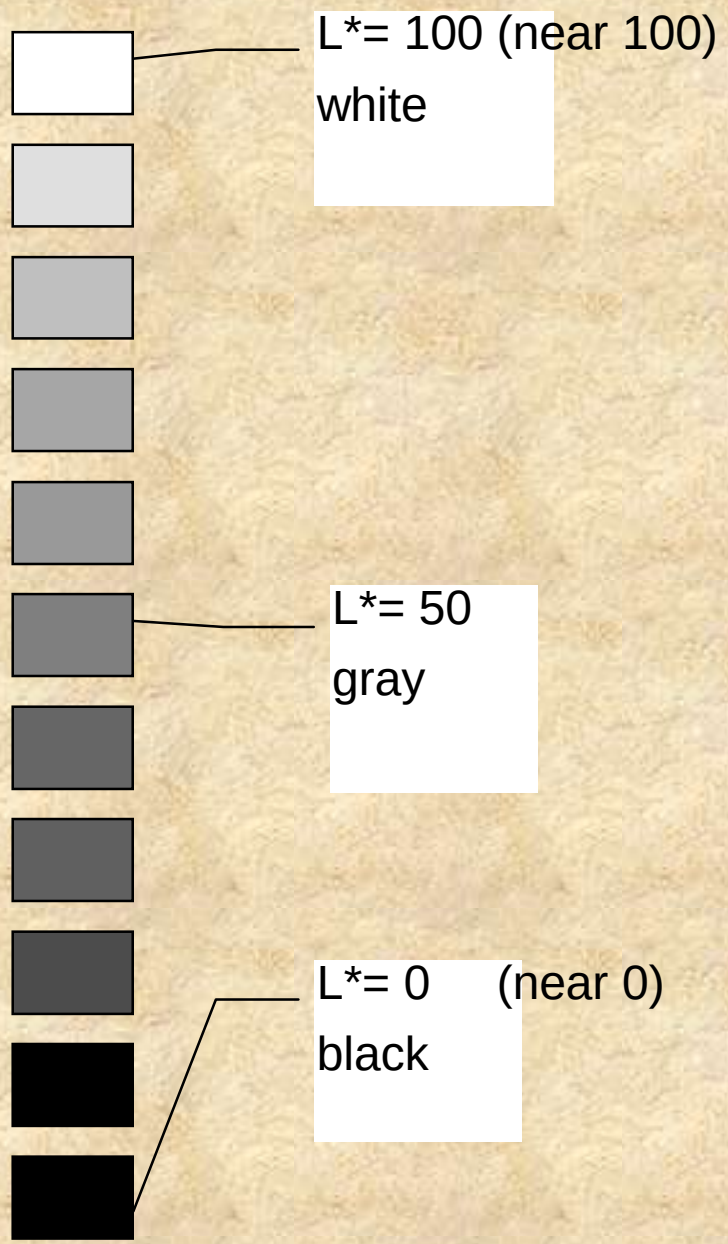
CIElab Colour Space



CIElab colour scale identifies object colour using three coordinates (L*a*b*).

COLOUR SPACE

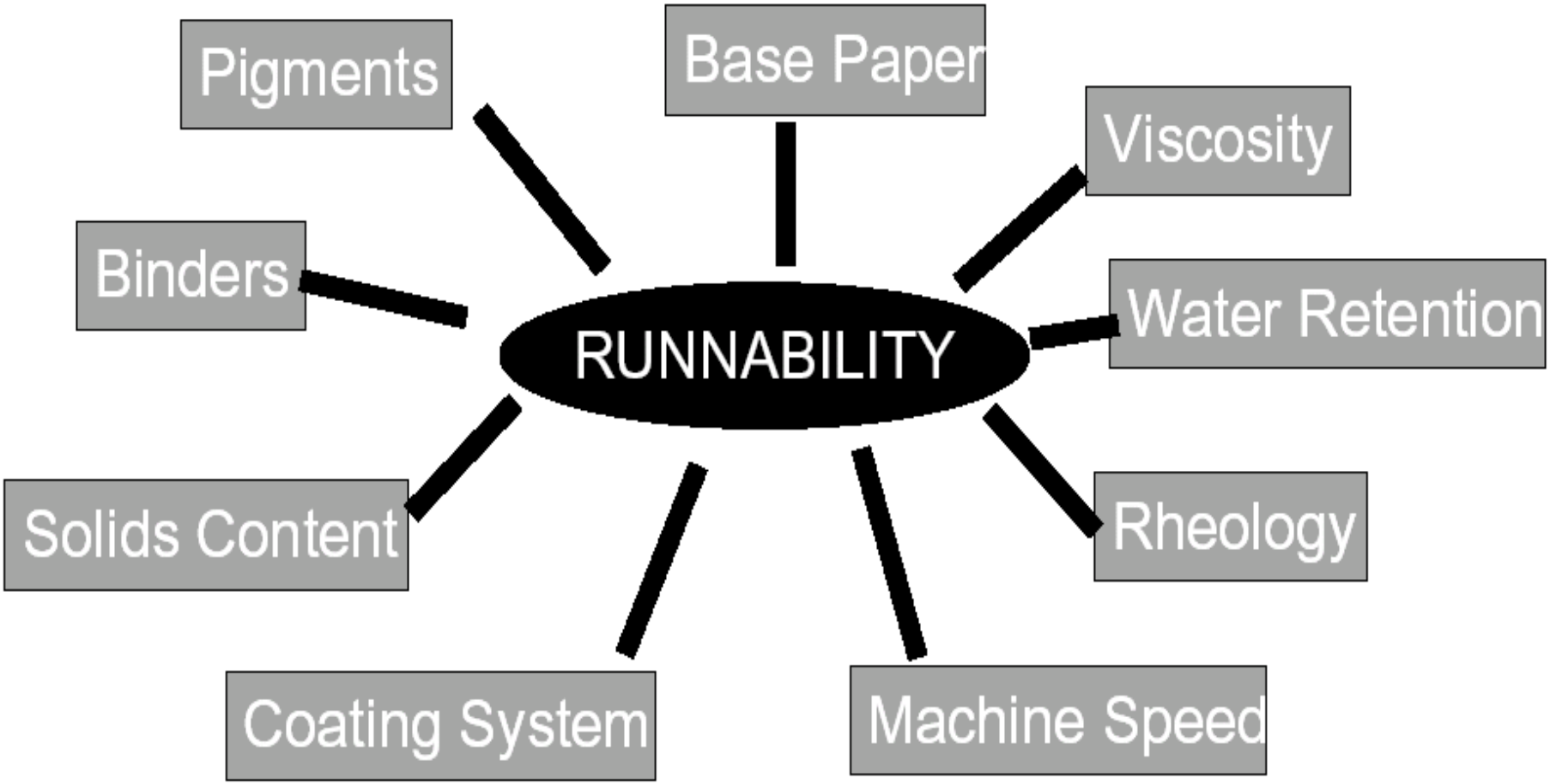
L* = Lightness



Critical Coated Paper Defects

Coating defects	Causes
Poor Coverage (Poor hiding power)	• Insufficient coat weight • Low Viscosity / Low Solis • Incorrect mixing ratio of Chemicals
Bar Jumping	• High viscosity / Solid
Backing roll impression	• Backing roll damage – Excess chemical pass on particular place • Sticking foreign material on Backing roll – Less coating on Particular place
Blade lines	• Impurities in Coating Slurry • Impurities on base board • Damaged blade / Worn out blade
Blade rubbing	• High solid / Viscosity of Tray solution /Batch
Uneven coating	• Coating slurry flow variation / Ununiformed flow in tray • Applicator roll speed variation / uneven loading • Paper GSM / Caliper variation • Backing roll uneven surface • Blade / Bar damage / Worn out
Coating Lumps	• Holes / Lumps in base paper. • Damage in Backing roll • Dried coating slurry in the tray / lines/Storage tanks

Factors Affecting Coated Paper Quality



Factors Affecting on Coated Sheet Properties

1- **The base sheets** (fiber types, sheet formation, internal sizing, and basis weight)

2- **Coating materials** (pigment types, binder types, water retention aids, lubricant, and defoamers)

3- **Coating formulations** (ratios of coating components, solids, and pH's)

4- **Coating process** (coating application types and speed)

5- **Coating weights**

6- **Drying conditions** (dryer types, drying temperature, drying time, and final moisture level.) etc.

Base Board Properties affecting Coating Quality

Base paper characteristics have a strong effect on the quality of coated paper and board .The main properties are as follows:

- ✓ **Strength Properties: To guarantee a good run ability of paper web in coating different strength properties are needed. Because base paper is wetted in coating units, it requires good temporary wet strength.**

- ✓ **Basis weight, caliper, and moisture profiles in the cross and machine directions have a strong influence on the uniformity of coating, e. g., calendering very often controls caliper, which means that in the cross direction some parts of the web are pressed more than others to reach a uniform caliper profile**

- ✓ **Basis weight variations usually cause caliper variations, and will have a poor roll build up.**

- ✓ **Moisture variation will affect coating amounts with risks of wrinkles if moisture variations across the web are high. High moisture before coating can affect coating color penetration and the gloss of coated paper and, subsequently, ink settling in printing.**

Base Board Properties affecting Coating Quality

- ✓ ***Porosity***: **If porosity is very high, absorption of coating is also high and coating weight can increase dramatically and drying problems may also occur.**

- ✓ ***Formation***: **This property refers to small-scale basis weight variations in paper. There are areas that are denser and less absorbent to the coating than other areas. To reach uniform coating penetration, base paper requires even formation, otherwise mottling may occur in printing.**

- ✓ ***Smoothness***: **Smooth base paper gives a uniform and closed coated surface. The various coating processes have slightly different smoothness requirements.**

Summary

- Coating Process has gained significance in view increased customer demand for improved printability and print results.
- The selection of Pigment and Binder plays a important role in ensuring coating quality.
- Advancement in Coating Application systems reduce cost and improve quality.
- Advancement in Printing and Conversion technology has laid more emphasis in selection of coating chemicals and systems.
- Mills to invest on Quality Systems to ensure sustained quality output to customers.
- Mills need to take care of Environmental requirements while selecting the coating chemicals.

Thank You