Chemicals used in Paper Industry

Presented by
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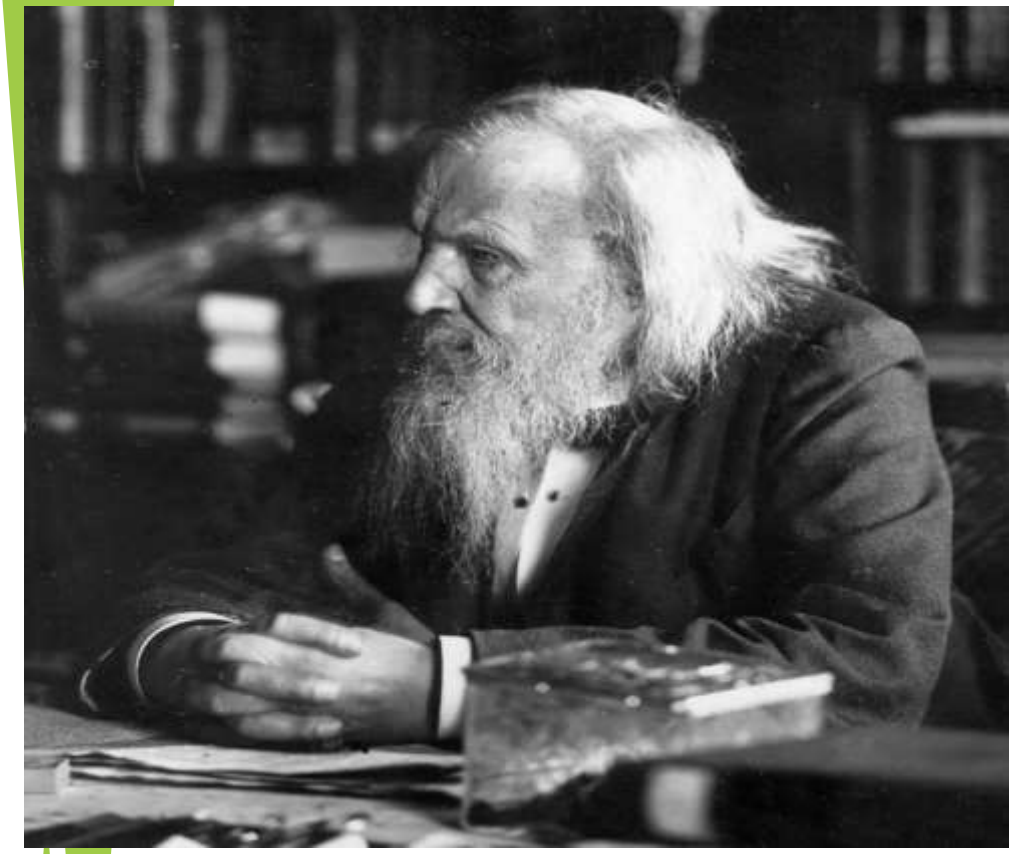
As for me, all I know is that I know nothing

- Socrates

Outlines:

General view of pulp and paper manufacturing
Pulp and paper industry of india
Chemicals used in Paper Industry
Pulping and bleaching Process
Different types of starches and wet- end chemical additives
Retention Aid
Optical brighteners
Biocides
Enzymes
Fillers
Coloring materials
Defoamers
Sizing chemicals



Dmitri Ivanovich Mendeleev was born in the village of Verkhnie Aremzyani, near Tobolsk in Siberia on 8 February 1834 and died 2nd February 1907.

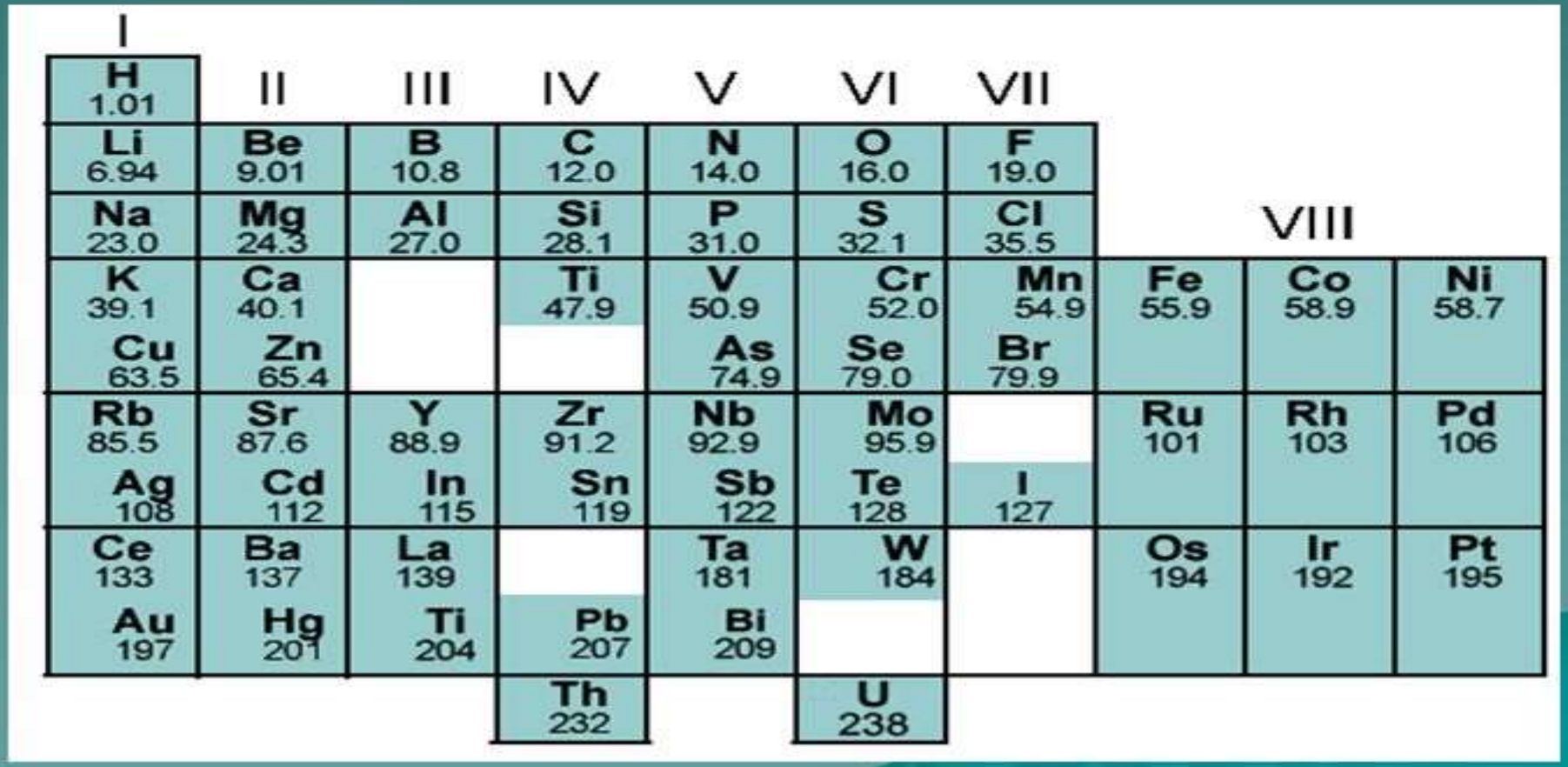
Between 1859 and 1861, he worked on the capillarity of liquids and the workings of the spectroscope in Heidelberg. Later in 1861, he published a textbook named *Organic Chemistry*. This won him the Demidov Prize of the Petersburg Academy of Sciences.

In 1863 there were 56 known elements with a new element being discovered at a rate of approximately one per year.

In 1907, Mendeleev died His last words were to his physcian: "Doctor, you have science, I have faith,"

Mendeleev's Periodic Table (1869)

Mendeleev arranged the elements on his table in order of **increasing** atomic **mass**.



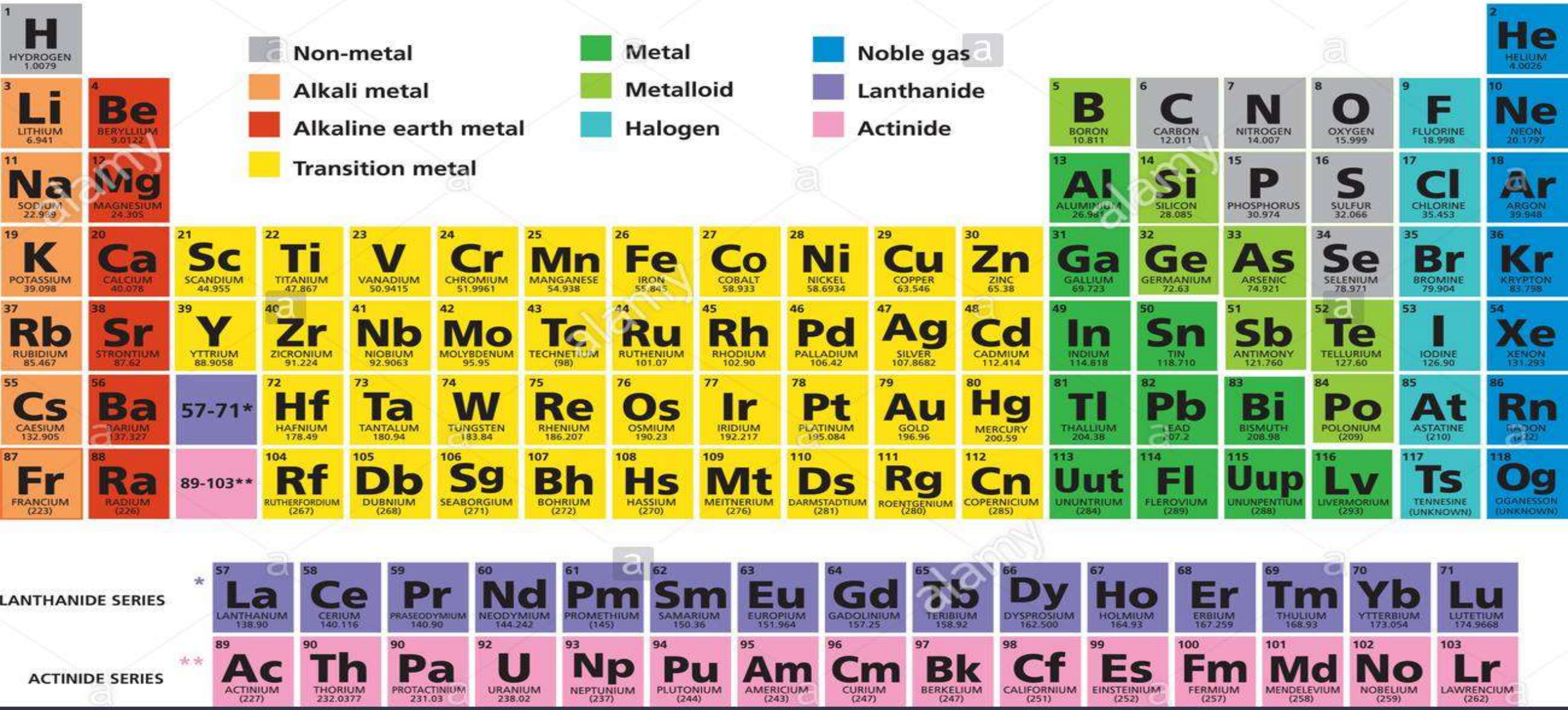
I	II	III	IV	V	VI	VII			
H 1.01									
Li 6.94	Be 9.01	B 10.8	C 12.0	N 14.0	O 16.0	F 19.0			
Na 23.0	Mg 24.3	Al 27.0	Si 28.1	P 31.0	S 32.1	Cl 35.5		VIII	
K 39.1	Ca 40.1		Ti 47.9	V 50.9	Cr 52.0	Mn 54.9	Fe 55.9	Co 58.9	Ni 58.7
Cu 63.5	Zn 65.4			As 74.9	Se 79.0	Br 79.9			
Rb 85.5	Sr 87.6	Y 88.9	Zr 91.2	Nb 92.9	Mo 95.9		Ru 101	Rh 103	Pd 106
Ag 108	Cd 112	In 115	Sn 119	Sb 122	Te 128	I 127			
Ce 133	Ba 137	La 139		Ta 181	W 184		Os 194	Ir 192	Pt 195
Au 197	Hg 201	Ti 204	Pb 207	Bi 209					
			Th 232		U 238				

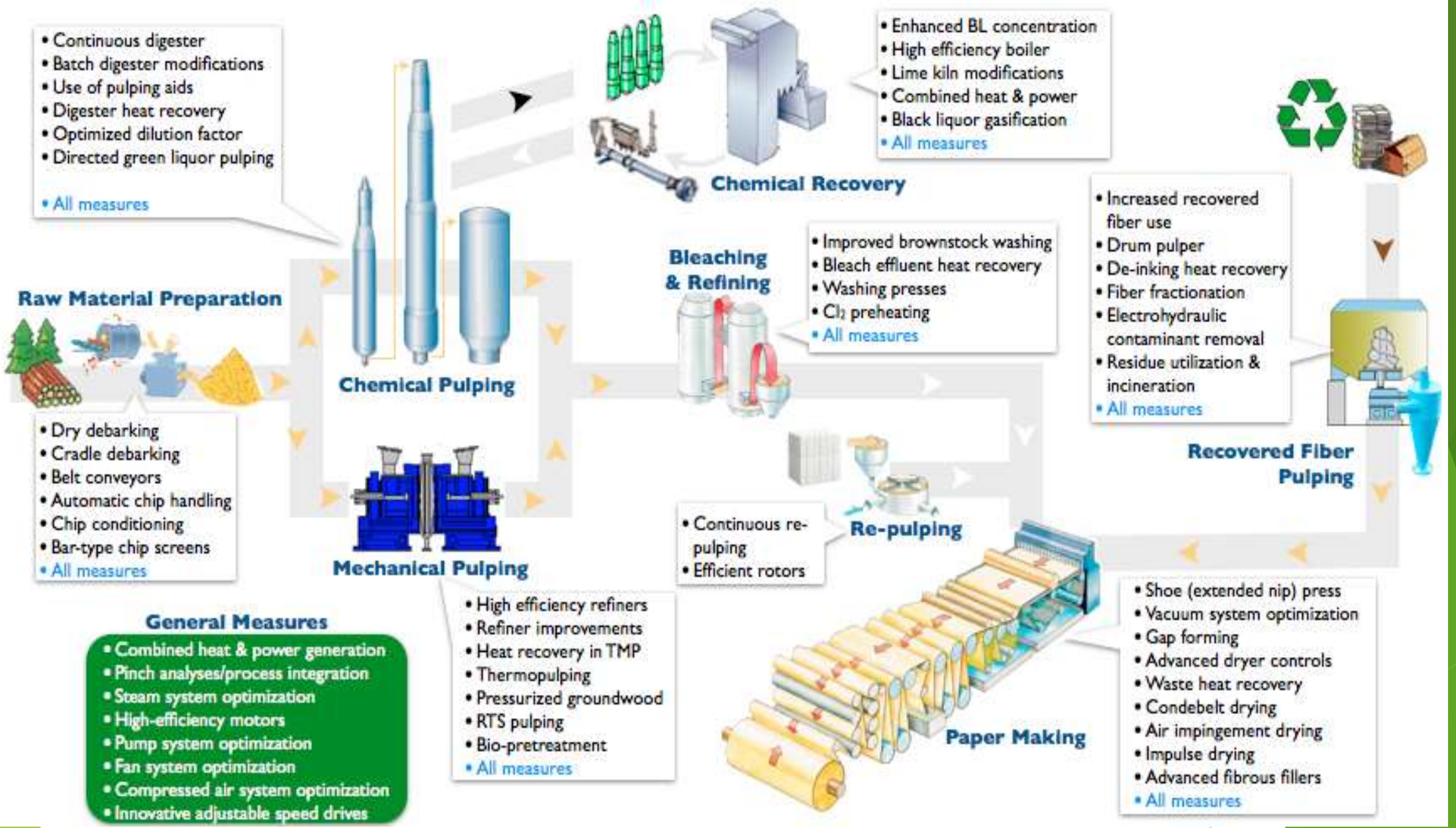
Mendeleev's Early Periodic Table, Published in 1872

TABELLE II

REIHEN	GRUPPE I. — R^2O	GRUPPE II. — RO	GRUPPE III. — R^2O^3	GRUPPE IV. RH^4 RO^2	GRUPPE V. RH^3 R^2O^5	GRUPPE VI. RH^2 RO^3	GRUPPE VII. RH R^2O^7	GRUPPE VIII. — RO^4
1	H=1							
2	Li=7	Be=9,4	B=11	C=12	N=14	O=16	F=19	
3	Na=23	Mg=24	Al=27,3	Si=28	P=31	S=32	Cl=35,5	
4	K=39	Ca=40	—=44	Ti=48	V=51	Cr=52	Mn=55	Fe=56, Co=59, Ni=59, Cu=63.
5	(Cu=63)	Zn=65	—=68	—=72	As=75	Se=78	Br=80	
6	Rb=85	Sr=87	?Yt=88	Zr=90	Nb=94	Mo=96	—=100	Ru=104, Rh=104, Pd=106, Ag=108.
7	(Ag=108)	Cd=112	In=113	Sn=118	Sb=122	Te=125	J=127	
8	Cs=133	Ba=137	?Di=138	?Ce=140	—	—	—	— — — —
9	(—)	—	—	—	—	—	—	
10	—	—	?Er=178	?La=180	Ta=182	W=184	—	Os=195, Ir=197, Pt=198, Au=199.
11	(Au=199)	Hg=200	Tl=204	Pb=207	Bi=208	—	—	
12	—	—	—	Th=231	—	U=240	—	— — — —

Periodic Table of the Elements

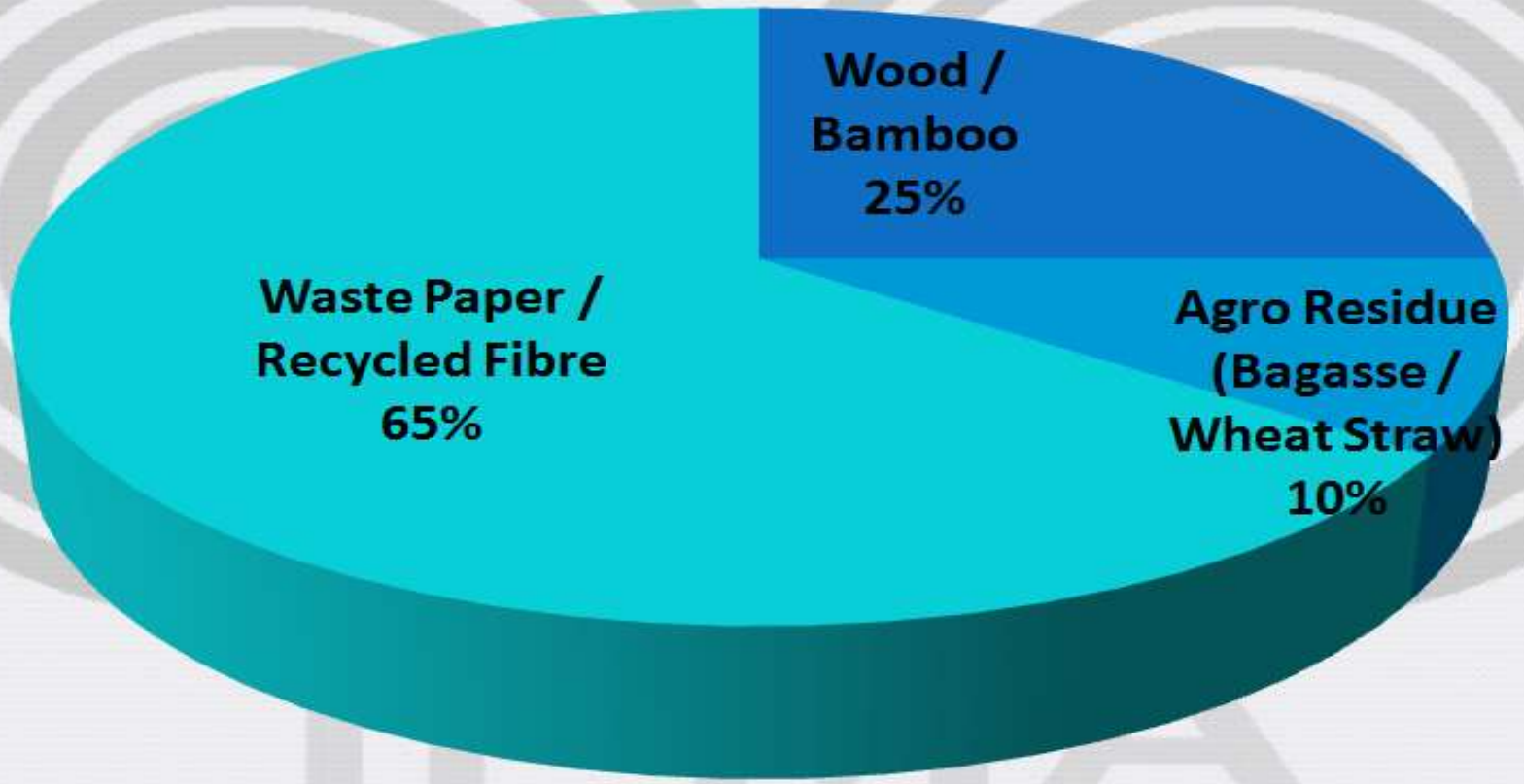




General view of pulp and paper manufacturing

Pulp & Paper Industry of India

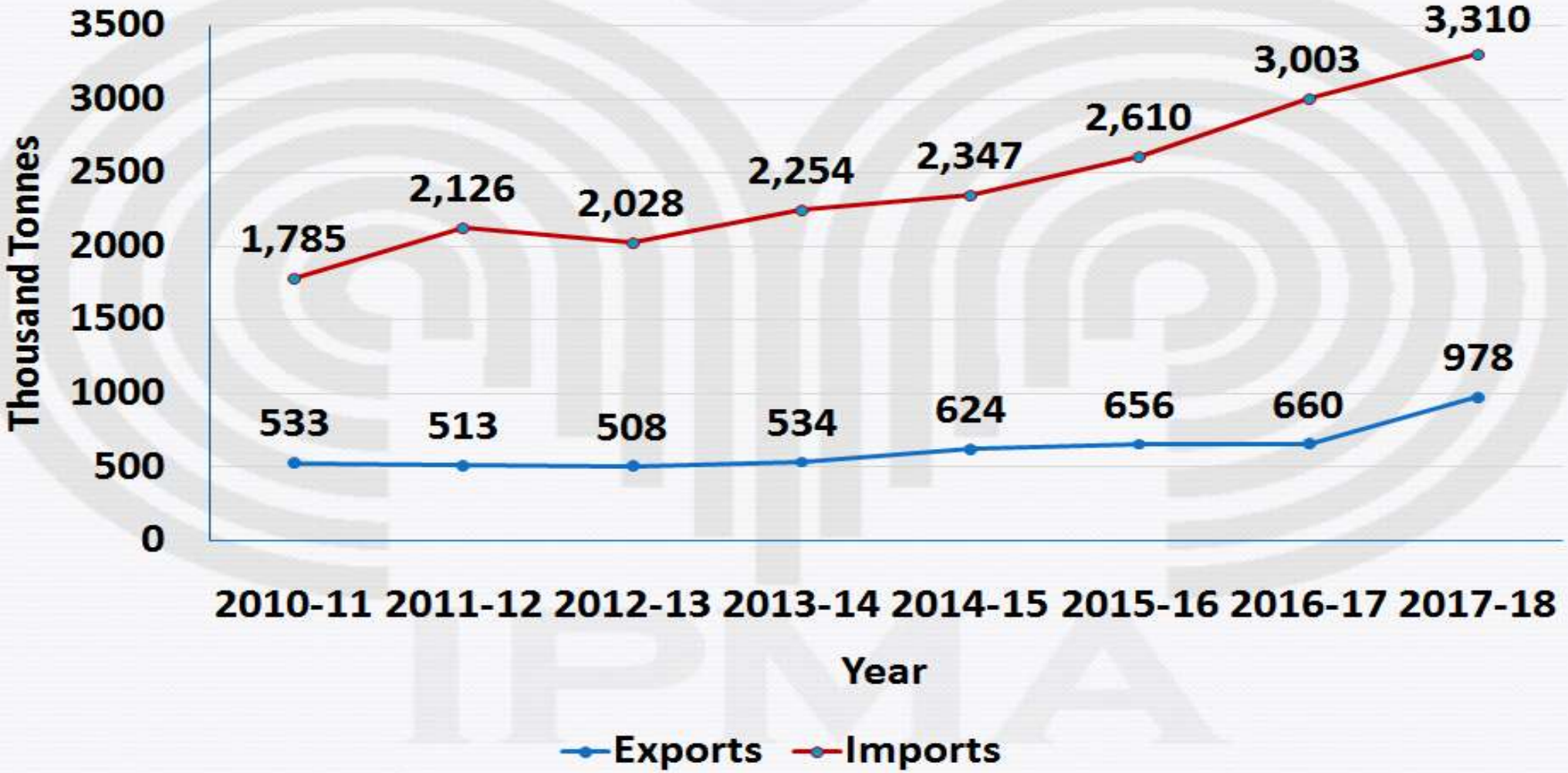
Estimated Production in Terms of Raw Material Used



Source: CPPRI

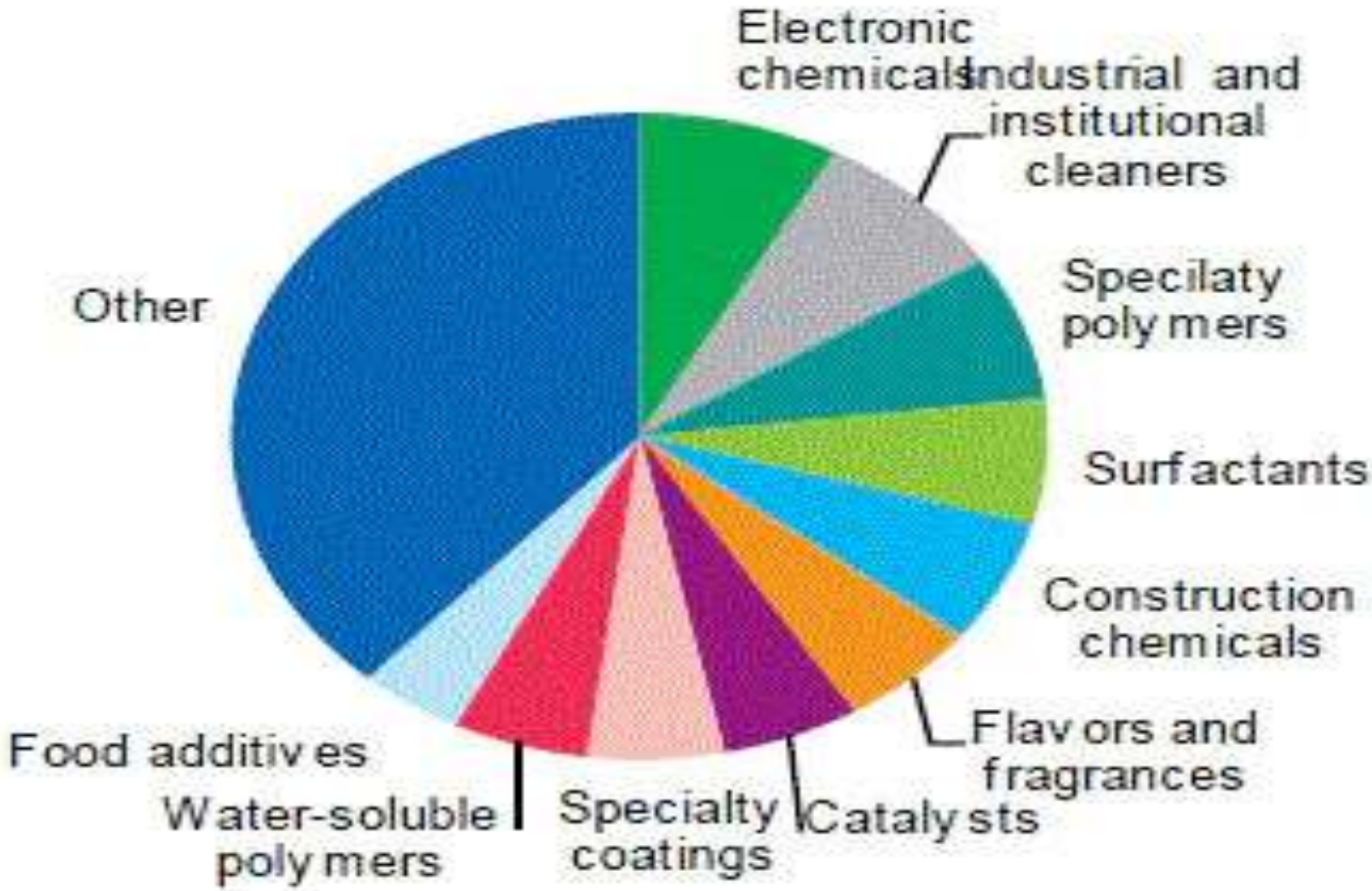
Pulp & Paper Industry of India

Exports & Imports of Paper, Paperboard & Newsprint



Source: DGCI&S

Global specialty chemicals market size by sector—2016



Source: IHS Markit

Total value = $556 billion

Overview of the global paper chemicals market

Market research analysts at **Technavio** predict that the global paper chemicals market will grow steadily at a **CAGR of close to 4% by 2021**.

This market research analysis identifies the increasing demand for high-performance chemicals by paper manufacturers as one of the primary growth factors for this market.

The increasing demand for packaged commodities and the growth of the e-commerce industry will create a significant demand from the packaging industry.

Chemicals used in Paper Industry

Common Name	Chemical Name	Chemical Formula	Used For
Agalite or Talc	**Silicate of Magnesia**	**MgO-32%, SiO2-42%**	**It gives paper a greasy or soapy feel. and enables it to take a high finish.**
AKD	**Alkyl Ketene Dimer**	**C4H4O2**	**Sizing**
Alabaster or Annaline	Anhydrate Calcium Sulfate	CaSO4	Paper Loading material
Alganic Acid	Alganic acid or Na-Alginate	Na-(C6H8O6)n	Coating and surface treatment
Alum	Sulfate of Alumina	Al2(SO4)3.18H2O	For alkaline sizing along with Rosin
Albarine	Natural Sulfate of Lime	CaSO4.2H2O - 100%	A calcium salt that is used for a variety of purposes including: building materials.
Animal Glue			Pigment coating Binder
Barium Carbonate	Barium Carbonate	BaCO3	Coating Pigment
Blanc fixe, fast white, pearl white or permanent white	Barium Sulfate	BaSO4	Filler, Coating Pigment

Common Name	Chemical Name	Chemical Formula	Used For
Casein	Casein		Pigment coating Binder. Casein is a heterogeneous globular, amphoteric phosphoprotein
Chlorine Dioxide	Chlorine Dioxide	ClO2	In Pulp Bleaching
Chlorine Gas	Chlorine	Cl2	In Pulp Bleaching and water treatment
Clay or Kaolin	Kaolinite	Al2Si2O5(OH)4	As filler
Dolomite	Calcium Magnesium Carbonate	CaMg(CO3)2	Filler, Coating
DTPA	Diethylene Triamine Penta Acetate	C14H33N3O10	Used for chelation (removal of transition metals from pulp).
EDTA	Ethylene Diamine Tetra acetic Acid	C10H16N2O8	Used for chelation (removal of transition metals from pulp).
Enzyme			Used in Deinking
FSA	Formamidine Sulphuric Acid or Thiourea Dioxide	CH4N2SO2	Post Deinking bleaching

Common Name	Chemical Name	Chemical Formula	Used For
Guar Gum	Natural Polymer		Dry Strength Additive
Gypsum or Mineral White or Plaster	Natural Sulfate of Lime	$CaSO_4.2H_2O$	Gypsum board
Hydrogen Peroxide	**Hydrogen Peroxide**	**H_2O_2**	**In Pulp Bleaching**
Hypochlorous Acid	**Hypochlorous Acid**	**HOCl**	**In Pulp Bleaching**
Lime	**Calcium Oxide**	**CaO**	**Alkaline Pulping Process Chemical Recovery, Bleaching**
Lime Stone	**Calcium Carbonate**	**$CaCO_3$**	**To make Precipitated $CaCO_3$, is used as Filler and in Coating**
Magnesium Bisulfite	Magnesium Bisulfite	$Mg(HSO_3)_2$	Used in Sulfite pulping
Magnesite	**Magnesium Carbonate**	**$MgCO_3$ -100%**	**Filler for cigarette paper**
Milk of Lime	**Calcium Hydroxide**	**$Ca(OH)_2$**	**For causticizing of green liquor**

Common Name	Chemical Name	Chemical Formula	Used For
Milk of Magnesia	Magnesium Hydroxide	Mg(OH)2	
Oxygen	**Oxygen**	**O2**	**In Pulp Bleaching**
Ozone	**Ozone**	**O3**	**In Pulp Bleaching**
Polyvinyl Alcohol (PVA)	**Polyvinyl Alcohol**	**[CH2CH(OH]n**	**Pigment coating Binder**
Rosin	Abietic Acid	C19H29COOH	Sizing
Rosin Soap	Sodium Abietate	C19H29COONa	Sizing
Salt Cake	**Sodium Sulfate**	**Na2SO410H2O**	**Makeup chemical in sulfate pulping chemical recovery (Na2SO4. ---Na2S)**
Satin		CaO.Al2O3.3CaSO4.31H2O	Brightly white pigment
Soap/ Fatty Acid			Deinking
Sodium Bisulfite	Sodium Bisulfite	NaHSO3	Used in Sulfite pulping

Common Name	Chemical Name	Chemical Formula	Used For
Soda Ash	**Sodium Carbonate**	**NaHSO3**	**Makeup chemical in alkaline pulping chemical recovery (Na2CO3 +Ca(OH)2---2NaOH+CaCO3**
Sodium Aluminate	Sodium Aluminate	Na2Al2O4	Used in conjunction with alum to control pH
Sodium Bisulfite	**Sodium Bisulfite**	**NaHSO3**	**An acid type cooking liquor chemical component sometimes used to neutralized residual chlorine in the pulp during the bleaching process.**
Sodium Chlorate	**Sodium Chlorate**	**NaClO3**	**Used to generate Chlorine Dioxide**
Sodium Dithionite	**Sodium Hydrosulfite**	**Na2S2O4**	**Bleaching**
Sodium Hypo-chlorite	**Sodium Hypo-chlorite**	**Na2S2O4**	**Bleaching**
Sodium Peroxide	**Sodium Peroxide**	**Na2O2**	**Bleaching**
Sodium Silicate	**Sodium Silicate**	**Na2SiO3**	**In waste paper deinking for wetting, peptization, ink dispersion, peroxide stabilization.**
Sodium Sulfide	**Sodium Sulfide**	**Na2S**	**Active chemical in kraft/sulfate cooking liquor**
Sodium Thiosulfate	**Sodium Thiosulfate**	**Na2S2O3**	**Bleaching**

Common Name	Chemical Name	Chemical Formula	Used For
Sodium tripolyphosphate	Sodium tripolyphosphate	Na5P3O10	Dispersant
Starch	**Starch**	**Comprised of glucose units linked together by oxygen bridges called glycosides**	**Wet and dry end additive**
Sulfur	Sulfur	S	To make HSO3 for bi-sulfite pulping
Surfactant			Used in deinking, Used as debonders in fluff pulp manufacture.
Titania	**Titanium Dioxide**	**TiO2**	**Filler to increase the opacity and brightness of paper. Used in coating also.**
Anatase	**Titanium Dioxide**	**TiO2**	**Grade of titanium oxide paper coating pigments which is water dispersible.**
Zinc Hydrosulfite	Zinc Hydrosulfite	ZnS2O4	Bleaching Chemical
Zinc Sulfide	Zinc Sulfide	ZnS	Pigment
Zinc White	Zinc Oxide	ZnO	Pigment

Pulping Process

- Kraft process – uses caustic soda and sodium sulphide
- Sulfite process – uses sulphurous acid
- Soda pulping – uses sodium hydroxide

Kraft Process

- Process entails treatment of wood chips with hot water, sodium hydroxide and sodium sulphide (white liquor).

- Breaks the bond that binds lignin, cellulose and hemicellulose

Sulfite process

- Various salts of sulfurous acids are used like sulfites or busulfites depending upon the pH

- Lignin is extracted from wood chips in digestors

Soda Pulping

- Sodium hydroxide is used along with anthraquinone which helps in reduction in degradation of carbohydrate
- Pulp with low trear strength is produced than sulfite and kraft process

Bleaching - definition

Removal of colored residual lignin from chemical pulp (usually kraft) to increase its brightness, cleanliness and other desirable properties, while preserving the strength (cellulose integrity) and carbohydrate yield (cellulose and hemicellulose) of the unbleached fiber.

Chemical treatment to:

- Increase brightness
- Improve cleanliness
- Improve brightness stability
- Remove hemicellulose
- Remove extractives

Chlorine and Hypochlorite

- Chlorine replaces hydrogen on the aromatic rings of lignin
- Chlorine also attacks cellulose but around pH 7
- To avoid cellulose degradation chlorine is used at pH <1.5 for bleaching
- The main problem in using chlorine is the formation of organochlorine compounds

Chlorine Dioxide

- It is an unstable gas with moderate solubility in water

- Usually generated in aqueous solutions and used immediately because, it decomposes and is explosive in higher concentration

- Produced by reacting sodium chlorate with reducing agent like sulphur dioxide

- It is used in elemental chlorine free bleaching

Chlorine Dioxide

- Used at moderately acidic pH (3.5 to 6)
- Its use minimizes the production of organochlorine compounds
- It is currently the most common bleaching method worldwide

Oxygen

- Attacks deprotonated phenolic lignin groups which are very electron rich substrates as it is unreactive in nature
- Reaction is carried out at very basic condition of pH > 12
- Opens rings and cleaves side-chains to produce mixture of small oxygenated molecules
- The main problem with this chemical is reverse aldol reaction which along with bleaching cleaves cellulosic ring too.

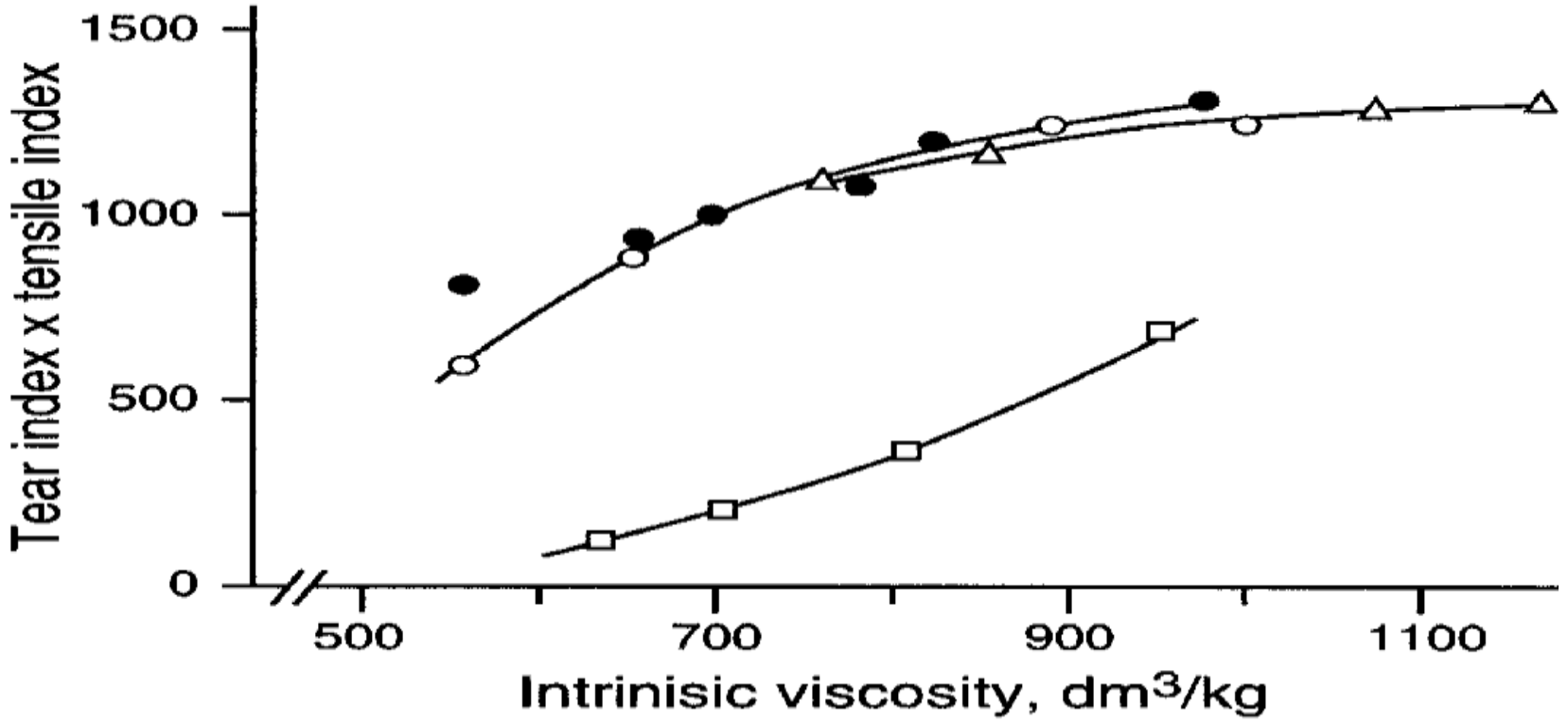
Hydrogen Peroxide

- Attacks deprotonated phenolic rings
- Acts at both high pH and temperature
- Sometimes is used in the same stage with oxygen

Ozone

- Very powerful oxidizing agent
- It performs selective bleaching so that the cellulose is not degraded
- Reacts with carbon-carbon double bonds in lignin including those within aromatic rings

Non-Linear Relationship of Strength to Viscosity



Δ Conventional bleaching of conventional pulp

O Conventional bleaching O-delignified pulp

□ Acid hydrolysis of bleached pulp

Bleaching Chemical Characteristics

- Equivalent Weight
- Efficiency
- Reactivity
- Selectivity
- Particle Bleaching Ability
- Environmental Implications

Equivalent Weight

- Bleaching is an oxidation process
- Bleaching chemicals are oxidizing agents
- One equivalent weight of a bleaching chemical is the weight of that chemical that is required to do a specified amount of oxidation.
- Equivalent weight is therefore an inverse measure of oxidizing power

Equivalent Chlorine

- Equivalent chlorine is another way of expressing a bleaching chemical's oxidizing power
- It is defined as the number of pounds (or kg) of chlorine that has the same oxidizing power as one pound (or kg) of the bleaching agent in question
- Equivalent chlorine is therefore a direct measure of oxidizing power

Efficiency

- Some of the oxidizing power of a bleaching agent is always wasted in side reactions
- Some bleaching agents are more prone than others to undergo wasteful reactions; conversely, some use their oxidizing power more efficiently than others
- Efficiency is a measure of the degree to which a bleaching agent's oxidizing power is used in desirable, lignin-degrading reactions

Equivalent Wt. and Efficiency
L=Low M=Med. H=High

Chemical	Equiv. Weight	Equiv. Chlorine	Efficiency
Cl2	35.5	1.00	H
ClO2	13.5	2.63	H
O2	8	4.44	L
H2O2	17	2.09	L
NaOCl	37.2	0.93	M
O3	8	4.44	H

Reactivity and Selectivity

- Reactivity may be defined in terms of the fraction of the residual lignin that the bleaching agent is practically capable of removing
- Selectivity is the degree to which the bleaching agent can remove lignin without dissolving or damaging the other components of the fiber, cellulose and hemicellulose

Reactivity and Selectivity
L=Low M=Med. H=High

Chemical	Reactivity	Selectivity
Cl_2	H	H
ClO_2	M	H
O_2	L	M
H_2O_2	L	H
NaOCl	M	M
O_3	H	M

Particle/Dirt Removing Ability and Environmental Implications

- Different bleaching agents differ in their ability to remove dirt particles, a very important characteristic
- For good dirt removal, chemical reaction with lignin must be slow enough to allow time for diffusion of chemical into particles
- Different bleaching agents engender different levels of concern for the environment; whether the concern is justified may be irrelevant

Dirt and Environmental
L=Low M=Med. H=High

Chemical	Dirt Removal	Environmental Implications
Cl_2	H	H
ClO_2	H	M
O_2	M	L
H_2O_2	L	L
NaOCl	H	H
O_3	L	L

Different types of wet-end chemical additives

Type of additive	Typical chemicals	Application
Sizing agents	Rosin size/alum, ketene dimers, alkyl succinic anhydride	Impart water penetration resistance to paper
Dry strength agents	Dry strength agents	Increase paper dry strength (tensile, stiffness, etc.)
Dry strength agents	Urea formaldehyde, melamine formaldehyde, polyamine resins	Impart increased strength to paper saturated with water
Fillers	Clay, talc, titanium dioxide, calcium carbonate	Improve optical and printing properties
Colouring agents	Dyes, coloured pigments, optical whiteners	Impart colours and tints to paper

Different types of wet-end chemical additives

Type of additive	Typical chemicals	Application
Retention aids	Cationic and anionic polyacrylamides, alum	Improve retention of fines and fillers
Defoamers	Proprietary chemicals	Improve drainage, sheet formation, cleanliness, prevent foam formation and deposit problems
Slime control agents	Proprietary chemicals	Control microbiological growth and associated deposit problems
Pitch control agents	Talc, alum, dispersants	Prevent deposition and accumulation of pitch
Drainage aids		Increase water removal rates on paper machine
Formation aids	High molecular weight anionic polymers, gums, polyacrylamides	Improve distribution of fibres by decreasing fibre-fibre flocculation
Acids and base		Control pH
Speciality chemicals		Corrosion inhibition, flame-proofing, antitarnishing

Retention Aid:

A Retention agent is added to bind fillers to the paper. Fillers, such as calcium carbonate, usually have a weak surface charge.

The retention agent is a polymer with high cationic, positively charged groups.

An additional feature of a retention agent is to accelerate the dewatering in the wire section of the paper machine.

Polyethyleneimine and polyacrylamide are examples of chemicals used in this process.

Optical brighteners

Optical brightening agents (OBAs), fluorescent brightening agents (FBAs), or fluorescent whitening agents (FWAs), are chemical compounds that absorb light in the ultraviolet and violet region (usually 340-370 nm) of the electromagnetic spectrum, and re-emit light in the blue region (typically 420-470 nm) by fluorescence.

The most common classes of compounds with this property are the stilbenes, e.g., 4,4′-diamino-2,2′-stilbenedisulfonic acid.

A white surface treated with an optical brightener can emit more visible light than that which shines on it, making it appear brighter.

Contd....

The global OBA production for paper, textiles, and detergents is dominated by just a few di- and tetra-sulfonated triazole-stilbenes and a di-sulfonated stilbene-biphenyl derivatives.

The stilbene derivatives are subject to fading upon prolonged exposure to UV, due to the formation of optically inactive cis-stilbenes.

They are also degraded by oxygen in air, like most dye colorants. All brighteners have extended conjugation and/or aromaticity, allowing for electron movement.

Some non-stilbene brighteners are used in more permanent applications such as whitening synthetic fiber.

Contd....

Brighteners can be "boosted" by the addition of certain polyols, such as high molecular weight polyethylene glycol or polyvinyl alcohol.

These additives increase the visible blue light emissions significantly. Brighteners can also be "quenched".

Excess brightener will often cause a greening effect as emissions start to show above the blue region in the visible spectrum.

End uses of optical brighteners include:

Detergent whitener (instead of bluing agents)

Paper brightening (internal or in a coating)

Fiber whitening (internal, added to polymer melts)

Textile whitening (external, added to fabric finishes)

Color-correcting or brightening additive in advanced cosmetic formulas (shampoos, conditioners, eye makeup)

Biocides/Slimicide

Definition:

A biocide is defined in the European legislation as a chemical substance or microorganism intended to destroy, deter, render harmless, or exert a controlling effect on any harmful organism by chemical or biological means.

Biocides are commonly used in medicine, agriculture, forestry, and industry.

Although most of the biocidal active substances have a relative high toxicity, there are also examples of active substances with low toxicity, such as CO2, which exhibit their biocidal activity only under certain specific conditions such as in closed systems, e.g. process where mixing is uniform such as broke chest, beaters, drop chest, head box, and especially in wire pit. For a good result from a slimicide correct dosage is also very important. A continuous addition is necessary with very dilute solution in the chest.

Contd....

Slimicide or antislime agent is a substance which is used as antimicrobial agents to kill slime-producing microorganisms in the papermaking process such as bacteria, slime, fungi and algae. It helps reducing production costs due to occasional breaks and shuts which save energy and time. Since paper can be manufactured under acidic or alkaline conditions,

The global demand on biocides for use in industrial and consumer goods was estimated at US$6.4 billion in 2008.

While biocides can have severe effects on human health and/or the environment, their benefits should not be overlooked. It is difficult to imagine hospitals, food industry premises without using disinfectants

Biocidal products must be used in an appropriate and controlled way.

Contd....

Benefits of slimicides/anti slime agent:

-Check of bacteria, slime, fungi, algae, yeast and mold growth and fibre degradation.
-Decrease paper web breaks and improve paper machine runnability.
-Prevents clogged piping, blockages, corrosion of equipment.
-Improves drainage, thermal transfer efficiency and flow.
-Slimicides can be act as a biocide and strong oxidizer and remove unwanted smell.
-Improve paper quality and increase productivity.

Application:

Slimicide ought to be added to a paper making process where mixing is uniform such as broke chest, beaters, drop chest, head box, and especially in wire pit. For a good result from a slimicide correct dosage is also very important with continuous addition.

Enzymes in the Pulp and Paper Industry:

Enzymes are proteins produced by all organisms. In recent years, tremendous research efforts have been made to reduce the amount of chlorine used for bleaching of kraft pulp after the pulping processes.

Chlorine-based (chlorine, chlorine dioxide, and hypochlorite) bleaching can result in the discharge of chloroorganics such as chlorinated phenols and chlorinated dioxins into the environment.

The main constituents of wood are cellulose, hemicellulose, and lignin. Research in the use of enzymes in pulp manufacture involves the degradation or modification of hemicellulose and lignin without disturbing the cellulose fibers.

Contd....

Xylanase:

-Pretreatment of kraft pulp with xylanase promotes a decrease in lignin content (kappa number) and a brightness increase of the treated pulp.
-Xylanase facilitates lignin removal with high specificity from lignin–carbohydrate complexes.
-Such enzymatic pretreatment has reduced the amount of chlorine needed to reach a target brightness in pulp in chemical bleaching by 20–30%.
-Pitch is the sticky resinous material in wood. The removal of pitch by chemical pulping and bleaching is not particularly efficient.

Lipases: Treatment with lipases has been found to be useful in reducing pitch deposits sincelipases hydrolyze the triglycerides in the wood resin to fatty acids and glycerol making the material less viscous.

Contd.....

Cellulase:

Removal of ink is an important part of waste paper processing.

Conventional deinking involves pulping of the paper in highly alkaline solution. It has been reported that cellulase enzymes can increase the efficiency of the deinking process.

But there is concern that treatment of the secondary fibers by cellulase may decrease the fiber strength.

Currently, cellulases are used to partially hydrolyze pulp to decrease its water retention capacity, which lowers time and energy input of the paper drying process

FILLERS (OR LOADERS)

- Today, the addition of fillers is regarded as an integral part of the paper making process.
- A large number of fillers are available to the papermaker, ranging from cheap, low-grade clays to the expensive titanium dioxide pigments.
- From a practical standpoint, both have their place in the paper industry.
- To be of practical interest as fillers, pigments must meet certain requirements.
- They should have a high degree of whiteness, a high index of refraction, small particle size, low solubility in water, and low specific gravity.

Contd....

FILLERS *OR* LOADERS

- **It is also desirable that the filler be chemically inert** to avoid unfavourable reactions with other components of the papermaking system.

- The filler should contain a minimum of impurities and it is of special importance that the grit content be low to avoid excessive wear of the wire and other processing equipment.

- Unless the filler has very unusual properties, it must be cheap.

Contd....

Effect of Fillers on Sheet Properties

- **The principal object of adding fillers to paper is to improve the opacity and the brightness**.
- The **other properties** which are also affected favourably by the addition of fillers **are smoothness, ink absorption, softness, dimensional stability** etc.
- There may also be **other special reasons** for adding fillers, for example, the use of **CaCO3 is cigarette papers to regulate the rate of combustion and the use of carbon as a conducting agent in electrical conducting paper**.
- These special properties may also be obtained by incorporating the pigments in a coating layer.

Contd....

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Abrasiveness is defined as loss in mg of a standardized paper machine wire brass for the chute wires) after 6,000 cycles of the valley abrasion tester by pigment slurry.

TABLE Properties of Fillers			
Filler	**Reactive Index**	**Scattering Coefficient**	**Abrasiveness (mg)**
Clay	1.56	9.5-11.5	12-17
Talc	1.57	---	4-10-30
Cal. Carbonate			
Natural	1.65	17-24	2-10
Pptd.	1.658	28-36	2-7
Pptd.	---	**30**	**4-1.2**
Pearl filler	---	9.4	6-10
Baryta	1.64	7.8	3-4
Blanc fixe	1.64	14.3	1-2
Zinc sulphide	2.37	4.0	12
Anatase	2.55	43.51	12-44
Rutile	2.70	54-68	9.89

Colouring Materials

- There are two basic types of colouring materials: Dyes and Pigments.

Dyes are soluble - some are soluble in water; some are soluble in solvents such as alcohol and gasoline. Dyes can be of basic, acid, or direct type.

- **Pigments are insoluble**.
- White pigments, also called fillers, include clay, chalk, talc, and TiO2. These are generally naturally occurring materials finely ground and finely dispersed.
- The particle size may be as small as 1 to 2 μm. Examples of coloured pigments are chrome yellows-Molybdate oranges, chrome oranges ironoxides, chrome greens- Ultramarine.
- Pigments, inorganic or synthetic organic materials, have no affinity for the fibre.
- They are held on the fibre by alum.
- A pH of 5.5 or less is necessary for their full retention.

Colouring Materials

Basic dyes are salts which ionize when dissolved in water with the dye portion being cationic and the anion being a chloride, hydrochloride, sulphate, acetate or oxalate radical

Pigments in general have very good light fastness (i.e. colour does not fade in the presence of light).

- They do not granite the sheet (i.e. selectively dye one fibre darker than another).
- Large amounts of pigments weaken the sheet.
- Pigments are used extensively in colouring coating grades of papers.

Contd....

Colouring Materials

- Basic dyes have little affinity for cellulose fibres.
- But they have a strong affinity for lignin and other non cellulosic parts of the fibre.
- They are used in ground wood and unbleached furnishes.
- Basic dyes are bright and have high tinctorial value making them economical.
- The disadvantages of basic dyes are their low order of solubility and poor light fastness.
- Paper grades where these dyes are used include bags, wrapping, directory papers, yellow pages, newsprint, moulded pulp containers used for packing fruits, vegetables and eggs.

contd...

Colouring Materials

- Direct dyes are salts of dye acids, chemically similar to acid dyes but more complex and less soluble.
- All direct dyes are Azo dyes.
- They are called 'Direct Dyes' because of their direct affinity for paper fibre and are used for dyeing most grades of paper.
- Retention of direct dyes can be further improved by addition of alum.
- These dyes have an alkaline pH of 8 to 12.
- They are available dry power or in liquid form.
- Literally thousands of dyes have been synthesized over the years.
- For comparison of one manufacturer's dyes with another's each dye is assigned a colour Index (CI) number.

Contd....

Defoamers

A defoamer or an anti-foaming agent is a chemical additive that reduces and hinders the formation of foam in industrial process liquids.

The terms anti-foam agent and defoamer are often used interchangeably. Commonly used agents are insoluble oils, polydimethylsiloxanes and other silicones, certain alcohols, stearates and glycols.

Oil based defoamers: Oil based defoamers have an oil carrier. The oil might be mineral oil, vegetable oil, white oil or any other oil that is insoluble in the foaming medium, except silicone oil.

Water based defoamers: different types of oils and waxes dispersed in water base.

Silicone based defoamers: The silicone compound consists of a hydrophobic silica dispersed in a silicone oil. Emulsifiers are added to ensure that the silicone spreads fast and well in the foaming medium.

Contd....

Causes of Foam Formation

- There are two essential components of the foam formation; the presence of air and surfactant.
- Mechanical entrapment of air is due to the incorrect agitation or cascading of stock suspensions, air leakage in pumps, or excessive capacity of pumps.
- The surfactants can be introduced by mill water contaminated by detergents, residuals from pulping, bleaching or deinking, or by rosin size, retention aids dyestuffs, or other additives.
- The stability of foam depends up on the size of the bubbles, the nature of the surfactant, the pH and the temperature.
- Any visible foam is not as harmful as the non-visible foam.
- Spilled foam carries with it fibre fines, rosin size, and other collided materials. Presence of foam in the stock reduces the drainage rate of paper webs, spoils the formation (Thin spots of pin holes) produces foam spots in the sheet.

Hope for the future

Advances Toward Sustainability

Sustainable Forest Initiative Program

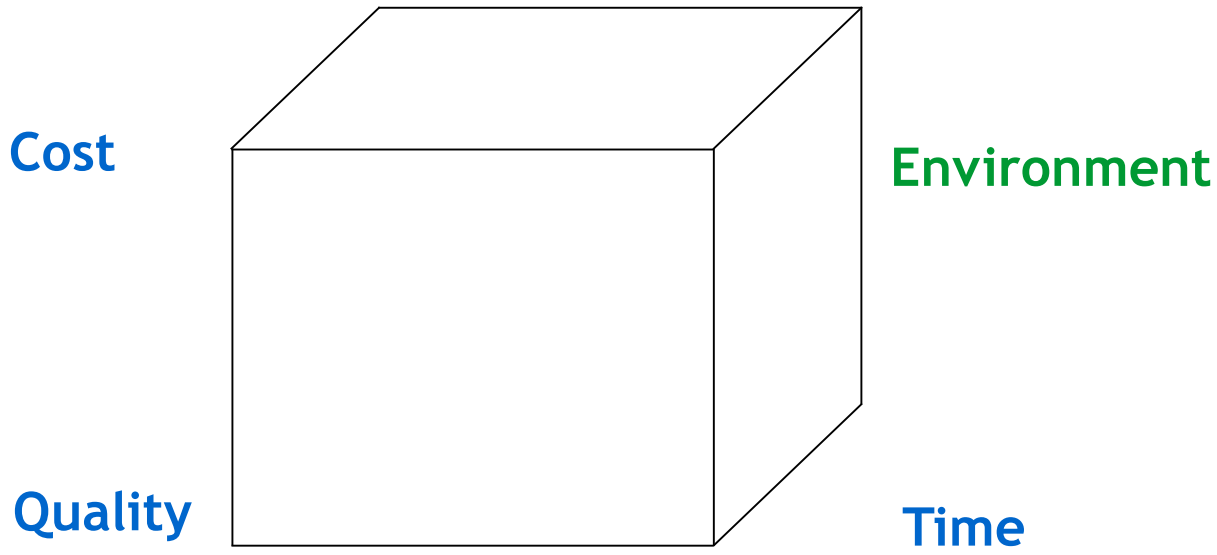
Recovery of Process Chemicals

Recycling of Process Water

Reduction of Dioxin Production

Make use of by-product Residue

Hope for the future



THANK YOU