STICKIES AND ODOUR CONTROL IN PAPERMAKING

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ANMOL POLYMERS

Agenda

01 Introduction

02 Problem of Stickies in Paper

03 Stickies Control

04 Problem of Odour in Paper

05 Odour Control

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Introduction

Today, most paper manufacturers have started producing paper in a closed loop system in order to conserve water and energy.

However this achievement has led to some problems as well. Prime among them has been the Problem of 'Stickies and Odour' in Paper.

Paper manufacturers today have to utilize different types of waste paper from various sources as fibre furnish in the production process. These recycled papers are often contaminated with pressure sensitive or hot melt adhesive, tapes, seam bindings, labels, decals, stamps, stickers, starch, etc.

These adhesives as well as other 'contaminants' are collectively responsible for both **'stickies' and 'odour' in Paper.**

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02

Problem of Stickies in paper

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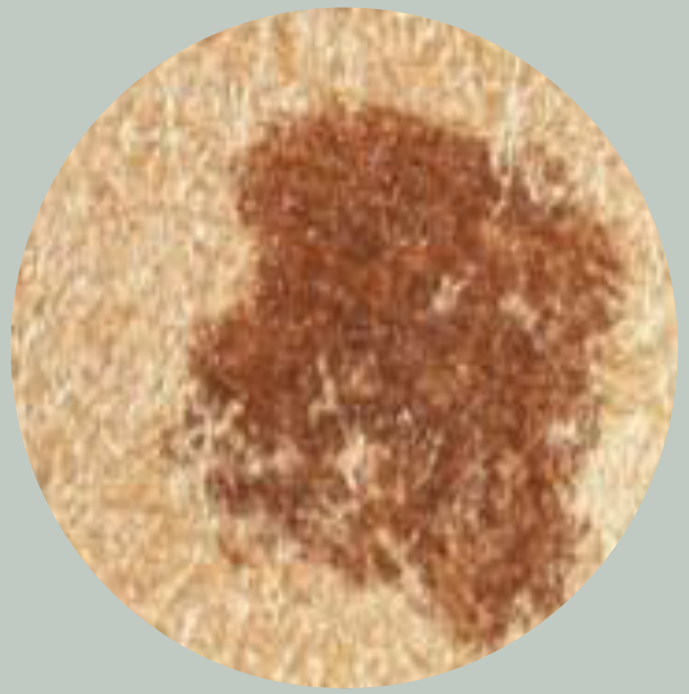
Problem of Stickies

- Stickies are a diverse mixture of synthetic polymeric organic materials which are generally found in the recycled papermaking water circuit.
- Stickies are liberated from recycled fibers in the pulping process due to mechanical and thermal energy.
- Much of these are removed in the screening , cleaning , washing & floatation de-inking processes.
- However some of the ‘tacky’ forming material remain in the furnish which builds up to form ‘sticky deposits’.



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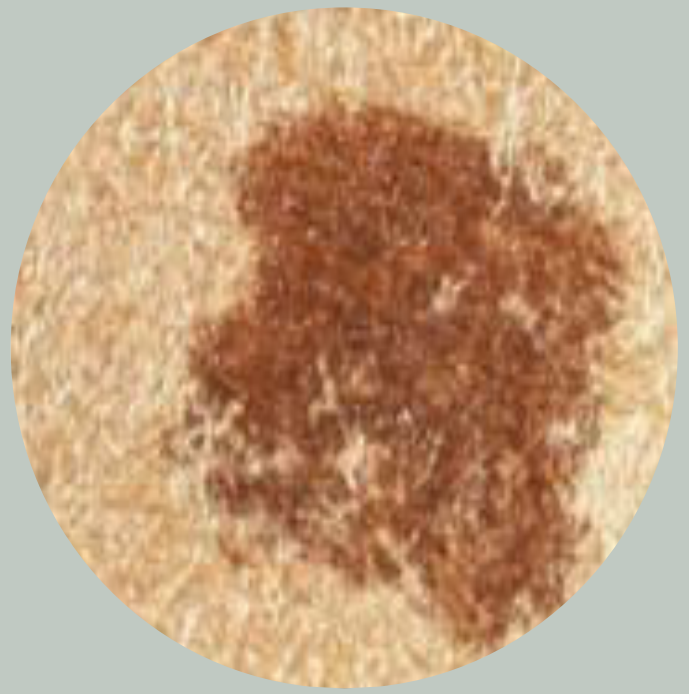
Problem of Stickies

- Such deposits can lead to frequent ‘paper breaks’, affect life of felts & fabric and cause downtime due to frequent ‘wash-ups’ and ‘boil-outs’.
- Depending upon the size, stickies are segmented as ‘micro-stickies’ (able to pass a sieve of 100 or 150 µm) or macro-stickies (particles retained on the screen)
- Particles smaller than 1 µm remain in ‘colloidal’ stage and are called ‘potential stickies’.
- In this Paper ,we try to address the problem of ‘potential stickies’



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Sources of Stickies

- Pressure sensitive Adhesives/ Hot Melt Stickies
- Adhesives -Binders, Lubricants, Gums, Starch, Seals, Tapes, stc
- Waxes
- Latex from Coated Book Stock
- Microbial growth
- Chemicals additives- AKD, Starch, DSR, Guargums, etc.
- Scale deposits - calcium phosphates, Chlorides, Silica, etc.

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Hot Melt Stickies

Hot Melt Stickies are the major cause of problem of Stickies.

By definition, hot melts are adhesives, which are applied in a molten state in order to form a bond upon cooling.

Hot melt adhesives are commonly used in paper and board converting applications such as magazine and bookbinding, bag ending, and case and carton sealing.

When paper containing hot melts is recycled, passing through pulpers and other high shear mechanical processes, the hot melts are sheered and broken down into particles.

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Nature of Contaminants

Suspensions	Particles > 1 Micron . Can be removed by screening /cleaning.
Microbiological growth	Can be tackled with an effective Bio-control programme.
Colloids	Particles between 10^{-3} and 1 Micron.
Solubles	Organic compounds of high MW Size: 10^{-2} to 10^{-3} Micron
Ionic Solutions	Inorganic compounds in form of ions < 10^{-3} Micron.

- In a closed water circuit, ion concentration reaches precipitation points and contributes to 'colloidals'.
- Together they constitute 'COLLOIDALS' which are the 'POTENTIAL STICKIES '.

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Colloidals

The Colloidals are of diverse nature and can constitute of the following :

- Wood extractives, Soluble adhesives, White pitch, Ink, Hydrolysed Sizing Agent, Bio-film, Scale etc.
- Colloids can be destabilized and removed by chemical coagulation.
- However not all of it can be removed and therefore we have the 'stickies' problem.
- **If the balance can be all 'mopped-up'**, we can have a cleaner system , with less chances of 'Stickies formation' later in the system.

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03

Stickies Control in paper

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Stickies Control – A Holistic Approach

1. Good screening And Cleaning
2. Timely Boil outs
3. Use of Coagulants And Flocculants
4. Effective Bio Control Programs
5. Bio Film Dispersants
6. Wire passivation
7. **Use Of Scavengers**

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Use of Scavengers - Bentonite

Due to the diverse constitution of sticky forming colloidals, it makes practical sense to use ‘scavengers’ like Bentonite.

- Bentonite works on the principle of ‘adsorption’.
- It is largely independent of the ‘charge’ in the system.
- It is a natural clay product derived from various mines.
- It is activated by chemical treatment in order to impart specific functionalities.
- It has property of ex-foliation when dispersed in water. The clay opens up into nano-plates which provides a large surface (1gm produces 800 sq.m)
- The large surface area serves to adsorb all colloidals and potential stickies.

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Not all Bentonites are same

For Bentonite to function as an effective scavenger in Papermaking, it must be from a right source (mine), suitably activated and dispersed under high shear before using.

- Mining & Activation

Mineral Sourcing : ***It is important that Bentonite is sourced from the right mine.***

Activation : ***Alkaline activation to introduce Na ions***. This allows hydration and inter-crystalline swelling called ex-foliation, which produces the large surface area.

- Preparation:

Dispersion of the Bentonite under high shear at the user's end determines that it will ex-foliate fully.

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Not all bentonites are same

Bentonite Brand	Bentonite Source	Fixation of Hydrphobic Particles (%)	Whiteness ISO
1	Bulgaria	17	45
2	Turkey	9	55
3	North Africa	34	72
4	Bavaria	19	55
5	England	17	60
6	Indonesia	5	62
7	China	12	53

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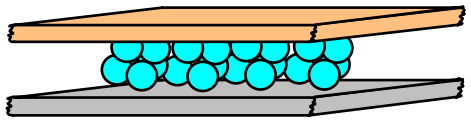
Bentonite activation

Air-dry

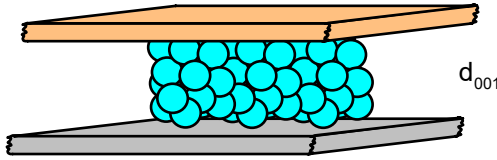
Hydrated

Calzium-Bentonite

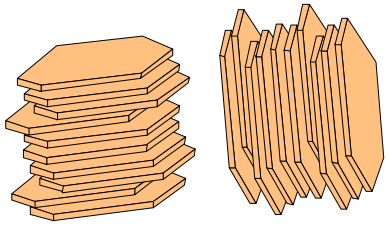


⊕ = Ca^{2+}-Ions

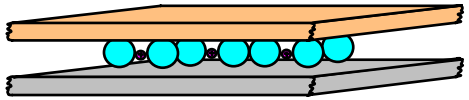
d_{001}: 1,5 nm



d_{001}: 2,0 nm

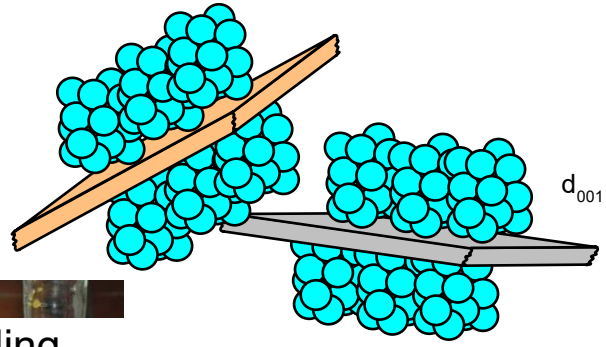


Sodium-Bentonite



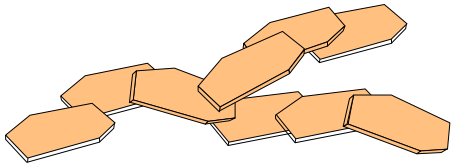
⊕ = Na^{+}-Ions

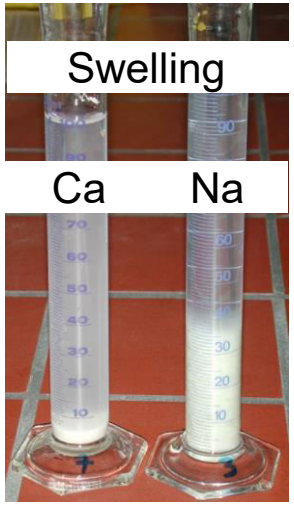
d_{001}: 1,2 nm



d_{001}: ∞

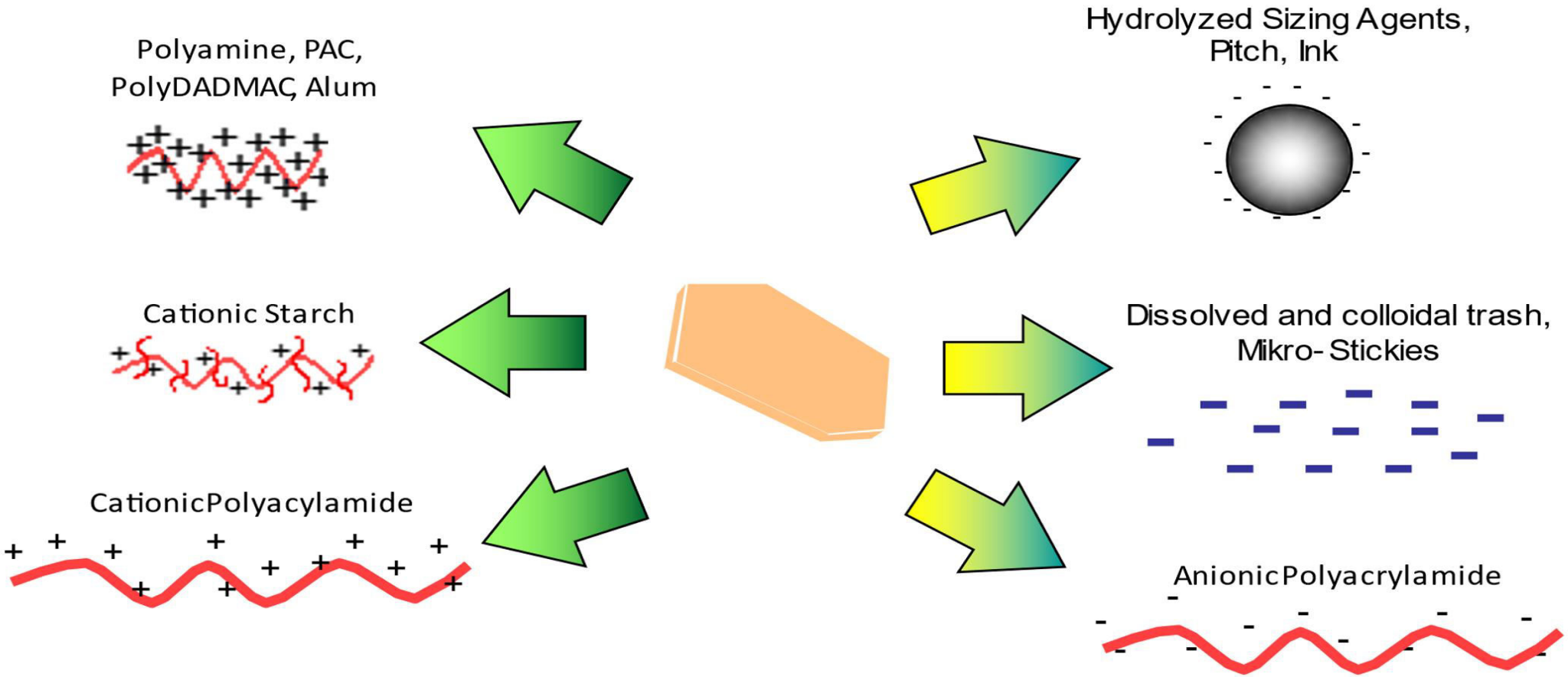
Exfoliation





Exfoliated smectite particles provide a high specific surface area -> up to 800m²/g!

Interactions of activated Bentonite



Exfoliated smectite particles provide a high specific surface area up to 800m²/g

Bentonite Preparation - Procedure

- **Use of fresh water**
- **Conc. Of Prepared Soln. : 1.5 to 3%**
- **Use of high speed agitator with good shear . Min Speed : 1000 rpm**
- **Agitate for 20 minutes.**

A well ex-foliated solution exhibits thixotropic properties- becomes gel on standing and converts to liquid on shaking.

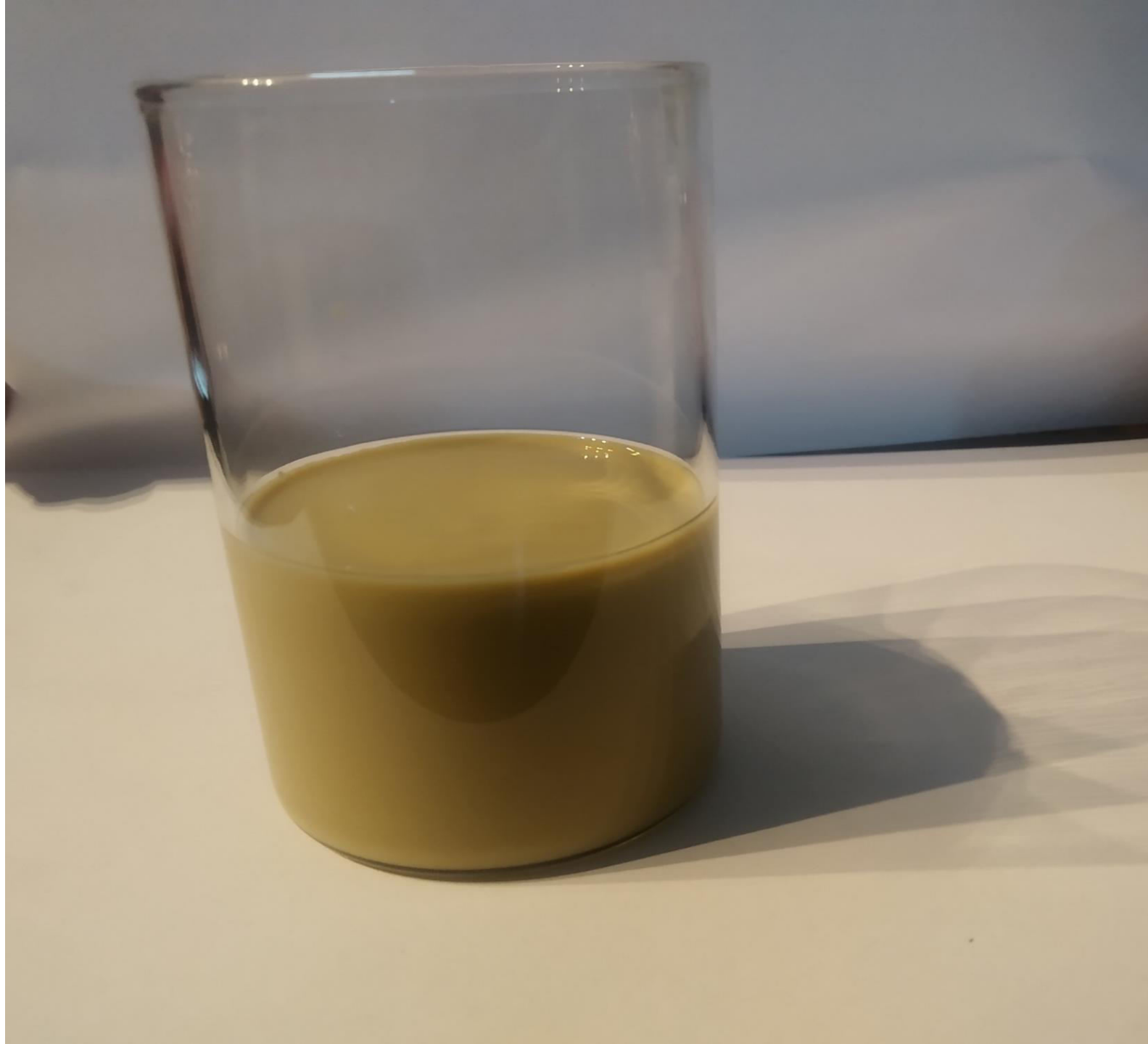
Bentonite Preparation

This sample of Bentonite exhibits good ex-foliation.

After 48Hours, the solution has swollen and exhibits

Thixotropic behaviour ie. gels while stationary and becomes liquid when shaken.

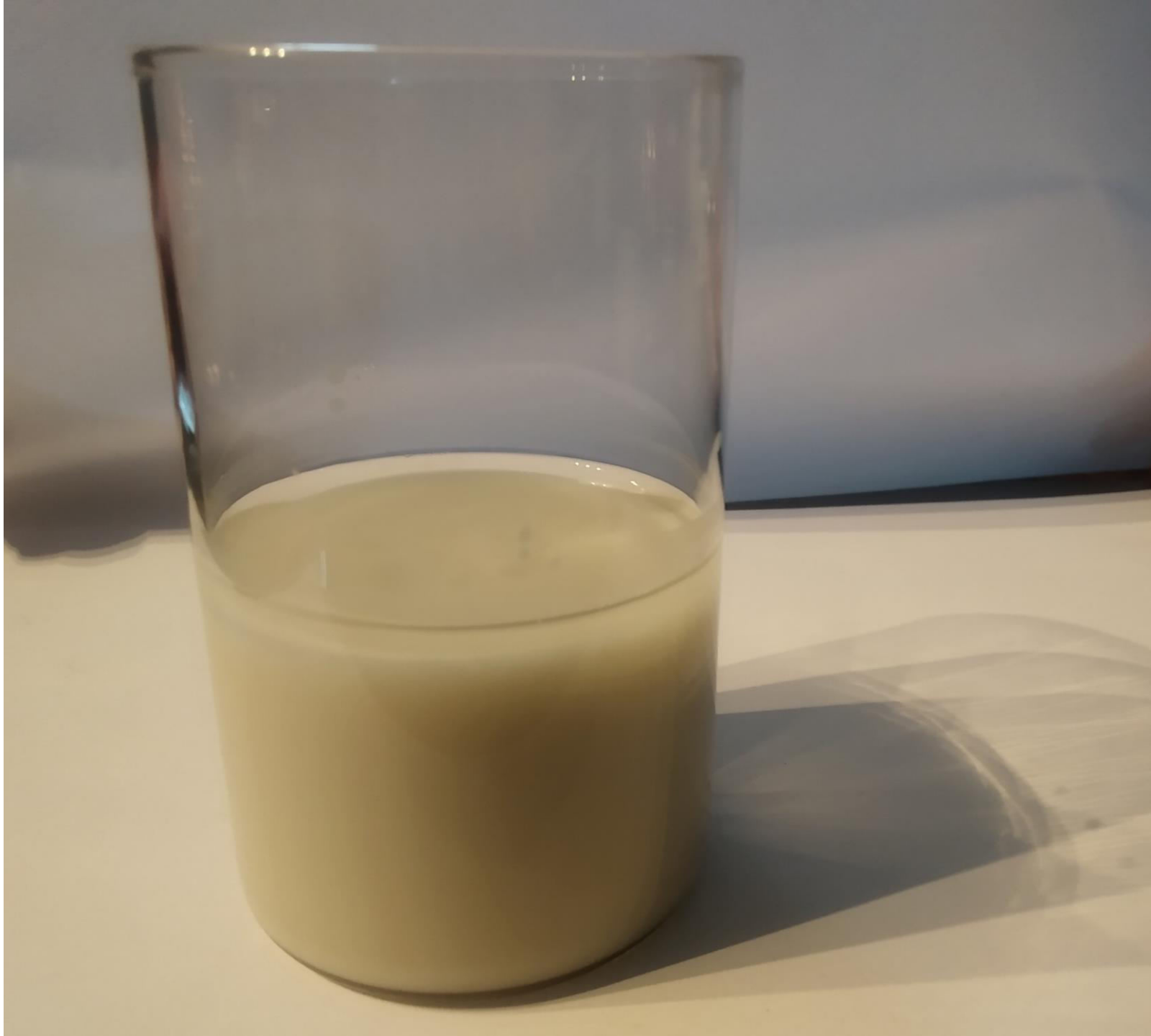
The surface area has maximised for adsorption of potential Stickies.



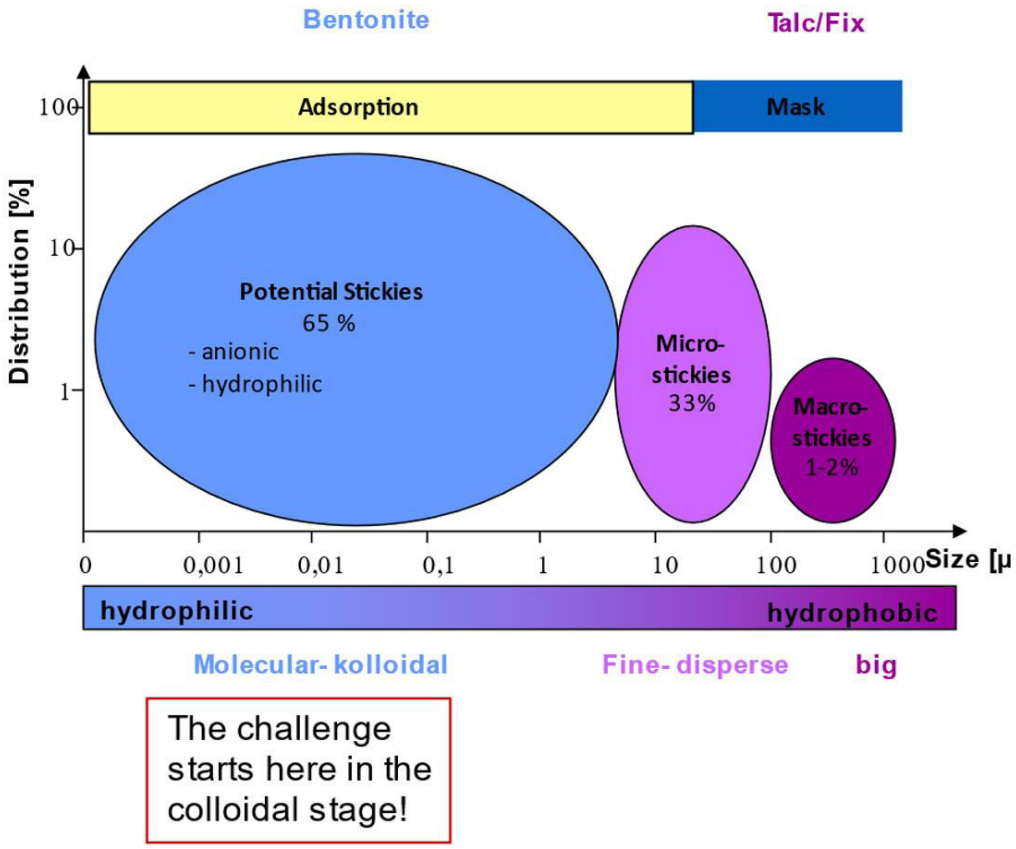
Bentonite Preparation

This sample of white Bentonite displays poor ex-foliation.

After 48 Hours, it is still watery and shows a phase separation.



Bentonite as Pitch – Sticky Control



Source: PTS

Bentonite as a Nano Particle is of a similar size, and particles with similarities. These colloids get fixed on the surface and are not able to react with each other and form visible sticky material. The system is Prevented from further buildup of agglomerates.

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Bentonite

Mode of Action

- From the diagram, it is clear that compared to Talc, Bentonite is able to capture 65% of potential stickies which are still in colloidal stage.
- Being a nano-particle, it is able to attract particles of similar size.
- Even after adsorption of the colloids, the bentonite nano-particles still remain below 1 Micron , so they are immune to shear forces in pumps , tanks and pipes.
- Hence, they are inert to any destructive forces on its way to the Paper machine.

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04

Odour Problem in paper

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Odour Problem in Paper

Most of all recycled paper manufacturers are making paper in a closed loop system and are using high quantity of Starch in paper. The waste paper available today has high level of contaminants.

This leads to microbial growth and due to this, the problem of bad odour is continuously rising in almost all papermills.

Anaerobic bacterial activity is the main cause of odour.

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Types of Odour in Paper

Volatile Fatty Acids (VFA)

Acetic Acid : Vinegar odour
Butyric Acid : Rancid butter odour
Propionic Acid : Stale cheese odour

Sulfate Reducing Bacteria (SRB)

Hydrogen Sulfide : Rotten eggs odour

The odour tends to change on storage due to slow oxidation of the Fatty Acids.

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Bio Control Program

1. Periodic Boil outs
2. Ensure aeration and avoid stagnancy in water circuit.
3. Use of Oxidising & Non-oxidising Biocides.
4. Monitoring effectivity using measurement tools : ORP ; Residual Oxygen etc.
5. Using Bactaslydes to check presence of SRB , TBC , and Fungal spores.

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Measures to Control Odour in Paper

Use of Slow-release Biocides

- Even with an effective Bio-control programme, there are some fungal spores which are persistent and can even survive the heating zone of the paper machine. They have a tendency to develop fully later.
- Hence It is observed that paper is odour-free while leaving the mill , but odour develops on prolonged storage or in overseas shipment.
- The Solution is to have "Slow release Biocides" which can afford long term protection.
- We have collaborated with a Research based company to introduce "**Micro-encapsulated Biocides**".
- The actives which are encapsulated, are a mixture of synthetic and natural Biocides to effectively prevent odour developing on stor

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Micro Encapsulated Biocides

- Micro-encapsulation is a patented technology.
- The micro –capsules are sized between 5 to 20 microns, and are delivered as a water dilutable slurry.
- The outer shell is composed of a thermosetting polymer which is heat stable upto 275° C. The core contains the 'actives'.
- The micro-capsules are very 'ductile' while in wet condition and do not break. It becomes brittle when dry to release the 'actives'.
- The actives are a mixture of '*environmentally safe*' synthetic and natural Biocides to effectively prevent odour developing on storage.
- Delivers 'deposits' on surface, which provides slow effusion of active Biocides , which are **dermatologically safe.**

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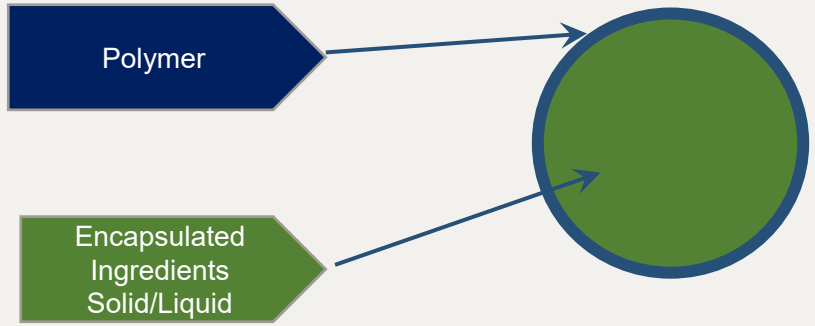
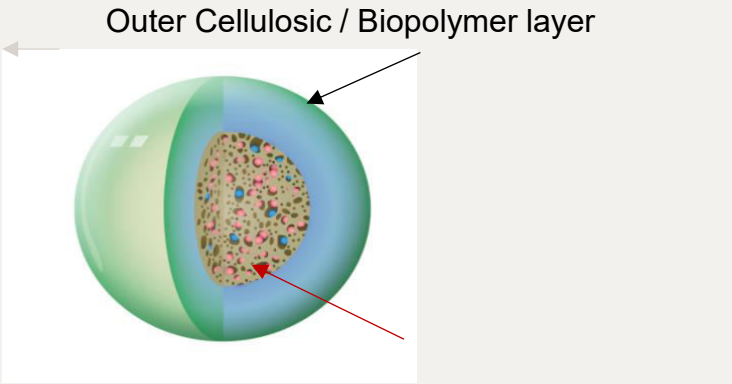
Micro Encapsulated Biocides

Polymer Capsules



High Loading, Performance

Bio-Polymer Capsules



Biocompatible / Biodegradable

Shell & core encapsulation is essential for precise, controlled, release & application performance

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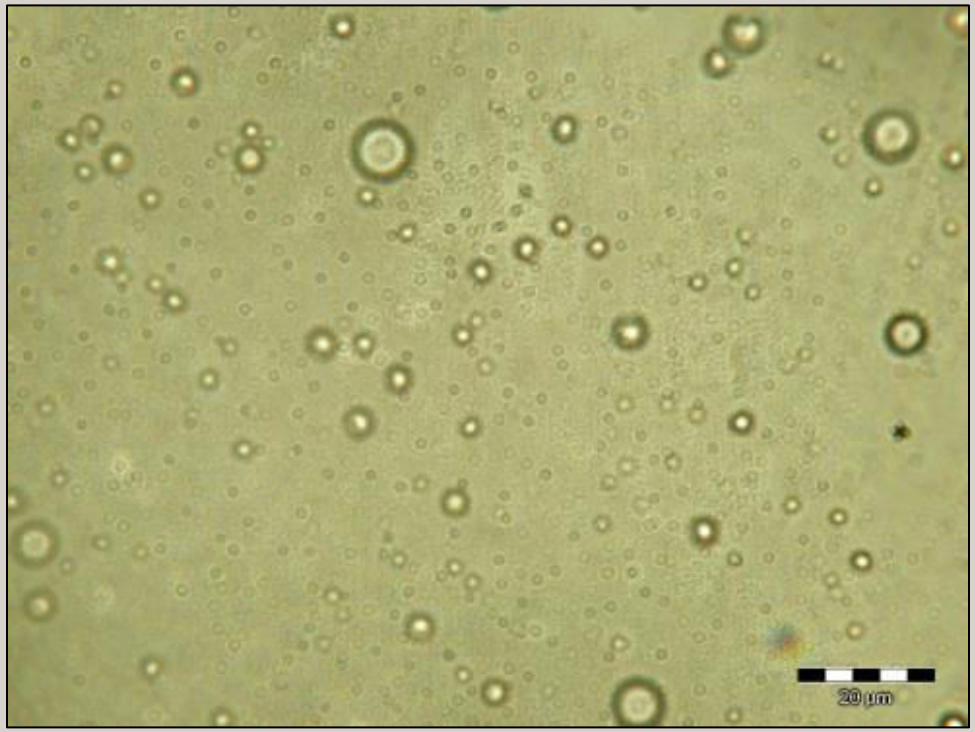
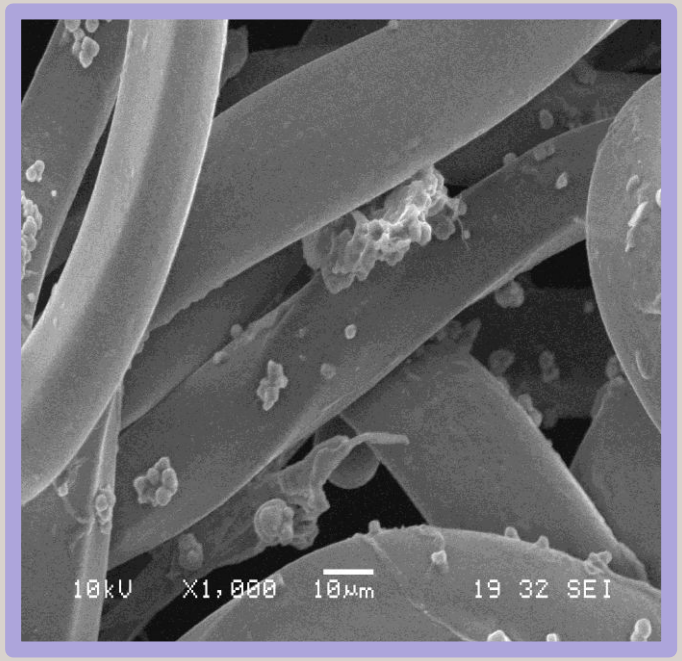
Shell & Core – Polymer around an oil droplet



Microscopy Image of Encap Slurry



SEM Image of deposition on Paper

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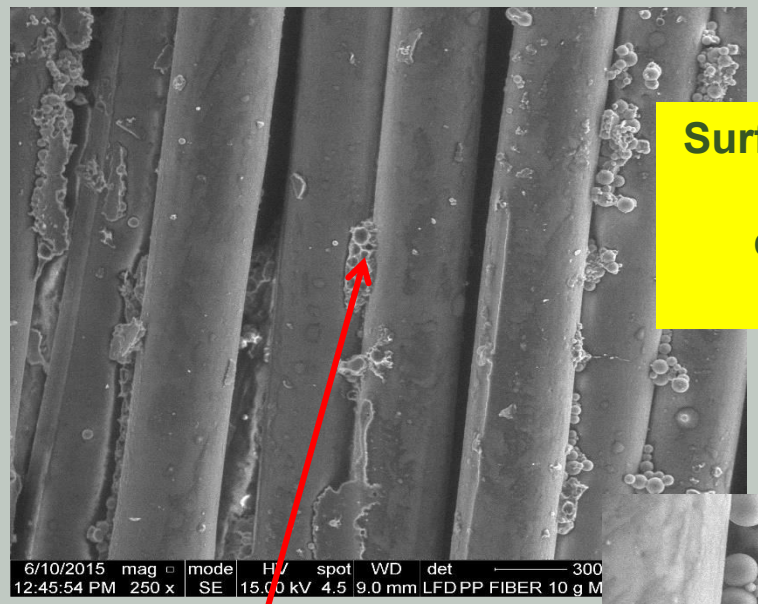
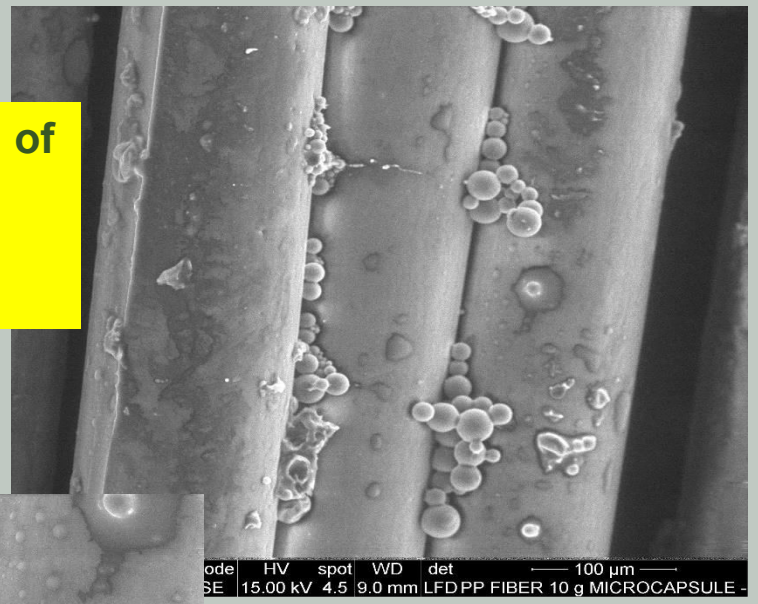
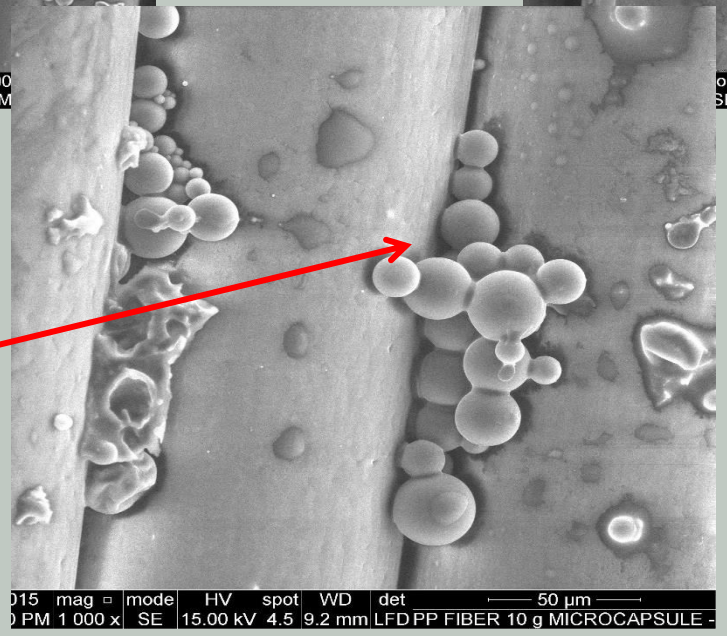
Capsule Deposition on Cellulosic Fibres



Surface modification of fiber at 10 % concentration of microcapsule





Microcapsule

Good adhesion of microcapsule on fiber And paper

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Slow Release Anti Bacterial Finishes

- Long lasting application of slow release biocide.
- Tested at NABL certified labs in India.
- Testing being done using AATCC 147/ ISO 20645:ISO protocols. Staphylococcus Aureus (Gram+), K. Pnueomoniae (Gram –ve) for Anti-bacterial activity.
- AATCC 30: Specific testing done using Candida albicans & Aspergilius Niger for anti-fungal activity.

Carbamate chemistry: Broad anti-fungal properties.

Aromatic Oils : Have antifungal activity as well as odour masking properties.

Carbamate + Cinamon Oil : As per our tests this is most suitable for eliminating odour in kraft paper

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Visual Methods of checking Anti - Microbial Efficacy on Kraft Paper

Procedure

1. Take two kraft paper of same size and Label them (as Control and experiment).
2. On the kraft paper which labelled as ‘control’, apply a layer of Sterilized RO water through a sterilized brush.
3. On the kraft paper which is labelled as ‘Experiment’, apply a layer of **Anti- Microbial capsules** through a sterilized brush.
4. Keep it to completely dry, for 1 day.
5. On Day 2, when the paper becomes completely dry, sprinkle a few drops of water on both the kraft papers.

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Visual Methods of checking Anti - Microbial Efficacy on Kraft Paper

6. Hold Bactaslyde 101 by its cap and cover both media surfaces with the Kraft paper (hold the slide between two layers of the test material like a sandwich).
7. Hold it for 20 – 25 seconds.
8. Put the slide back in its tube and close tightly.
9. Keep it in the dark place for 48- 72 hours at a normal room temperature.

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Bacteria takes around 18- 24 hours to produce visible colonies

Control: showing Bacterial growth after 24 hours on TBC slide

Treated Exp: Not showing bacterial growth after 24 hours

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Yeast and fungi growth can be seen by naked eye after 72 hours

Control: showing Fungus growth after 72 hours

Treated Exp: Not showing Fungus after 72 hours

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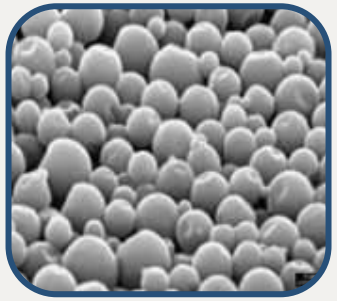
AATCC 147- Anti Bacterial Efficacy Test

Sample	Organism	Growth under specimen	Conclusion	Result
Untreated	Staph. Aureus	Growth	No Antibacterial activity	Fails
	K. Pneumoniae	Growth	No antibacterial activity	Fails
Treated with 02 GPL	Staph. Aureus	No Growth	Bacteriostatic, antibacterial activity	Passes
	K. Pneumoniae	No Growth	Bacteriostatic, antibacterial activity	Passes
Treated with 5 GPL	Staph. Aureus	No Growth	Bacteriostatic, antibacterial activity	Passes
	K. Pneumoniae	No Growth	Bacteriostatic, antibacterial activity	Passes
Treated with 10 GPL	Staph. Aureus	No Growth	Bacteriostatic, antibacterial activity	Passes
	K. Pneumoniae	No Growth	Bacteriostatic, antibacterial activity	Passes

Capsule Wall
Modified Aminoplast Polymer

Encapsulated Ingredients



3-15µm

ductile when wet
brittle when dry

Typical Ingredients

- Heat Stable Fragrance/EO
- Long Lasting Anti-bacterial
- Long Lasting Anti fungal
- Long Lasting Anti viral
- Delivered Essential Oils
- Flame Retardants

Useful when long lastingness is desired

Active release found after testing even upto 5 years after application on various surfaces

Thank You

Shiva Sharma

Director

Anmol Polymers Pvt. Ltd

IPPTA for giving us the opportunity to present our studies and to all the distinguished members present today.

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Solutions for Pulp & Paper Industry
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