



Indian Pulp & Paper Technical Association

# GREEN, BIOBASED TECHNOLOGIES FOR RECYCLED PAPER INDUSTRY

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# *Presentation Summary*

- Technologies at glance
- Green Chemistry Solutions & Key Contributors
- Biobased technologies for Paper industry
- Key Mechanisms as Technology Drivers
- Results & Discussion
- Technology case studies
- Key Benefits

# *Biobased Technologies presented in paper*

## ✓ *Oxidative Bleaching Enhancer*

- Improvement in oxidative bleaching efficiency
- Reduction in bleaching chemicals (10-20%)

## ✓ *Stickies control*

- Works as a solvent, surfactant & dispersing agent
- No encapsulation required
- Reduction in paper breaks by 25-30%

## ✓ *Microbial based deposit & odor control*

- Live microbe-based program
- Reduce unwanted microbial growth by >95%
- Reduce volatile fatty acids by >60%

# Research focus

## Improved water quality

- ✓ Reducing microbial growth
  - ✓ Reducing COD
- ✓ Improving ORP & oxygen availability



Improved  
water  
quality

## VFA & Odor reduction

- ✓ Reducing microbial growth
- ✓ Improving water ORP conditions



Chemical  
reduction

## Chemical reduction by

- ✓ Improving key process stages, Oxidation
- ✓ Elimination of Hypo & biocides



Process  
efficiency

## Increased process efficiency

- ✓ Reducing cleaning cycle
- ✓ Reducing paper breaks
- ✓ Improving machine runnability



VFA & Odor  
Reduction

# Key Mechanisms as Technology Drivers

## Live Microbe based

1. Slime reduction by- Novel consortium of microbes
2. H<sub>2</sub>S reduction by- A unique class of sulphur metabolizing microbes
3. Maintains positive ORP

## Renewable Plant based

1. Biobased dispersant-
  - Breaks slime and biofilm
  - Disperse macro stickies into micro stickies
  - Avoid aggregation
2. Source of oxidizing agent-
  - Organic acids as precursor for peracid formation
  - Catalyst for oxidation boosting mechanism
  - Reduces consumption of oxidation chemicals

# Result & Discussion

# Oxidative bleaching enhancer- Lab studies

Furnish- ONP (60%) + OMG (40%)

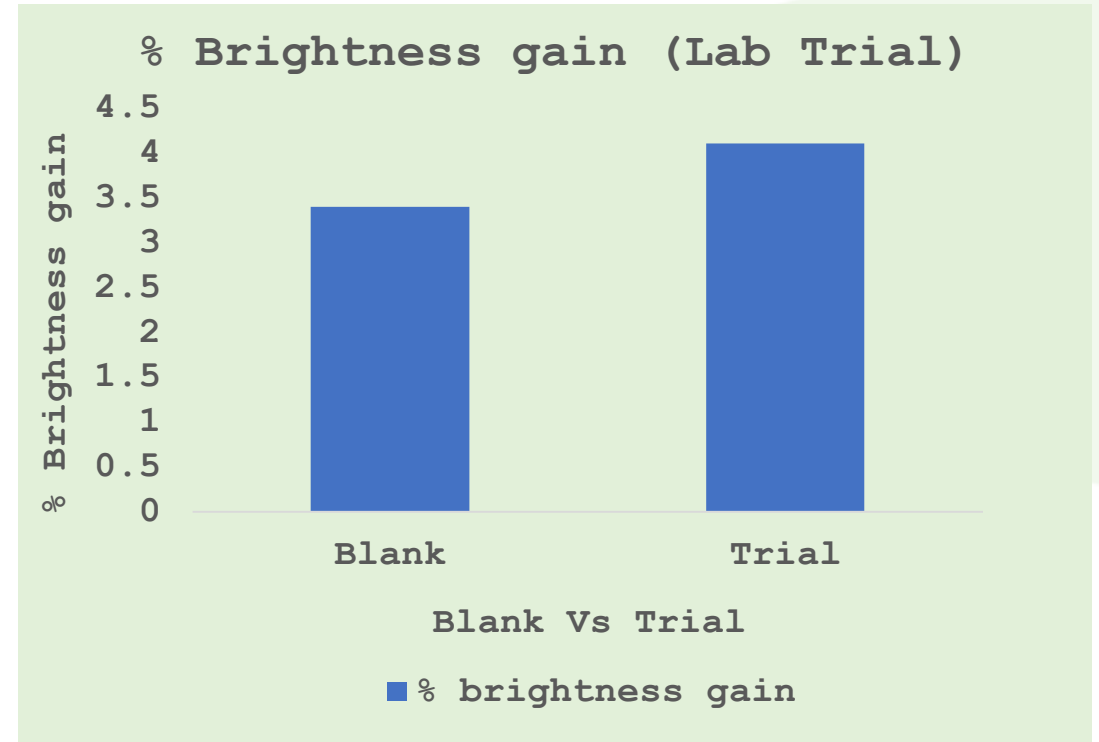
Dosage- 250-300 g/t

## Chemicals

- NaOH (100gpl)- 0.3%
- H<sub>2</sub>O<sub>2</sub> (as such)- 2%
- EDTA (100gpl)- 0.2%
- Na<sub>2</sub>SiO<sub>3</sub> (100gpl)- 2%
- Pulping consistency- 15%
- Temperature- 60 deg. C
- Time- 60 mins

## Output parameters checked

- %Brightness (ISO)
- %Brightness gain



- ✓ Optimum dosages: 250-300 g/t
- ✓ Brightness gain of 4.1%

# Oxidative bleaching enhancer- Mill case study

Furnish- Mixed (ONP+OMP+MOW)

Dosing point- Dump tower

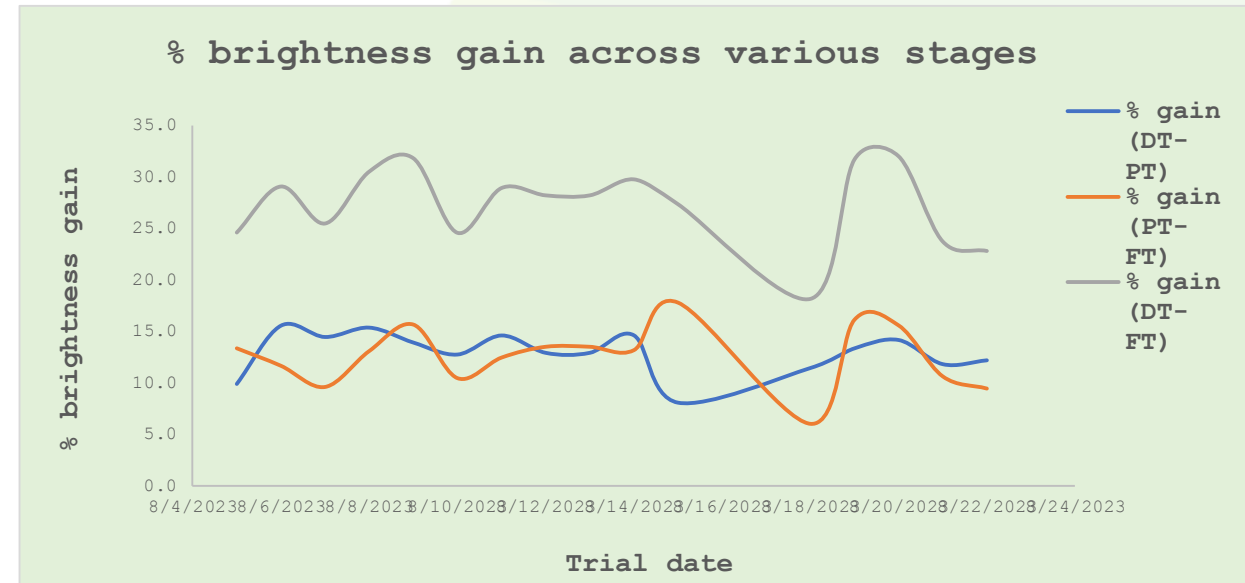
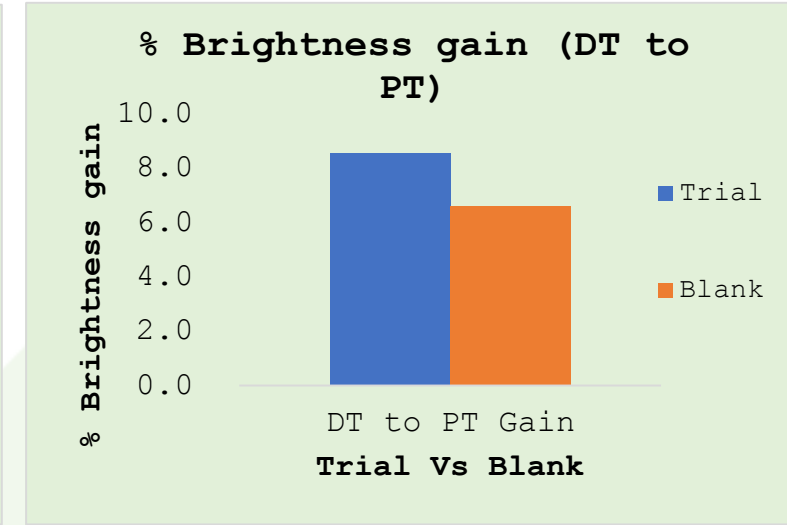
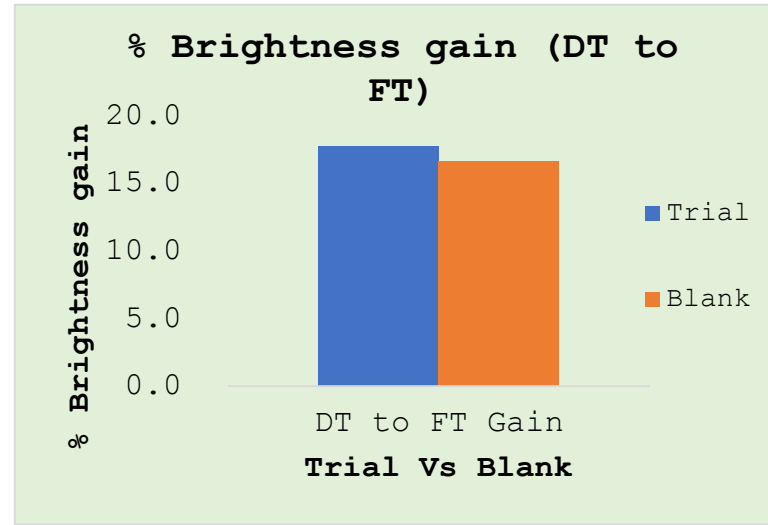
Dosage- 200-300g/t

## Chemicals (Blank run)

- NaOH- 7.9kg/t
- H<sub>2</sub>O<sub>2</sub> - 14.9kg/t
- SHS- 4.9kg/t
- Na<sub>2</sub>SiO<sub>3</sub>- 11.4
- Quality- GSP

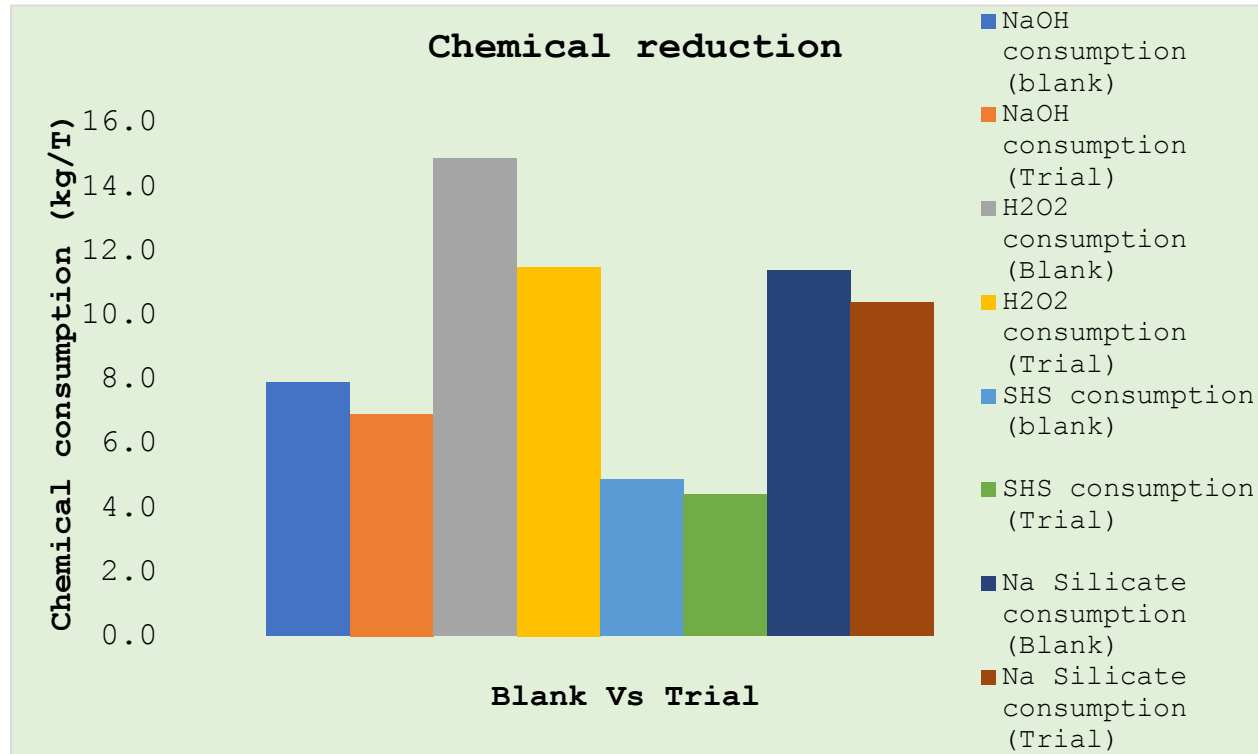
## Output parameters checked

- Across: Dump-Polcon-Final tower
- %Brightness (ISO)
- %Brightness gain
- Chemical reduction





## Chemical consumption comparison for blank Vs Trial run



## Technology benefits

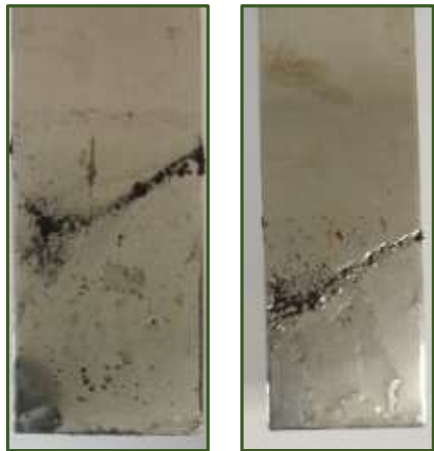
- ✓ A biobased bleach enhancer
- ✓ Effective chemical reduction at increased brightness gain
- ✓ Consistent brightness gain
- ✓ Improved fibre properties due to reduced chemicals

# Stickies & Deposit control- Lab studies (ProSc-F80)

✓ Furnish- 60% ONP & 40% OMG

1. Stickies dispersion

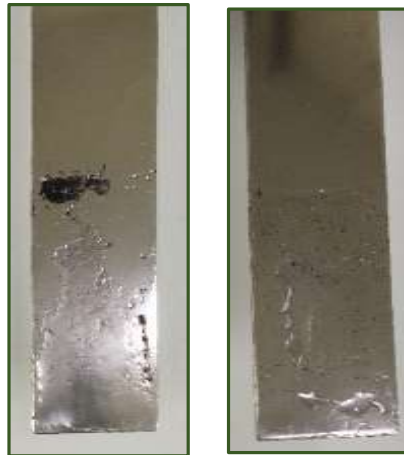
Without Coagulant



Blank

F80

With Coagulant



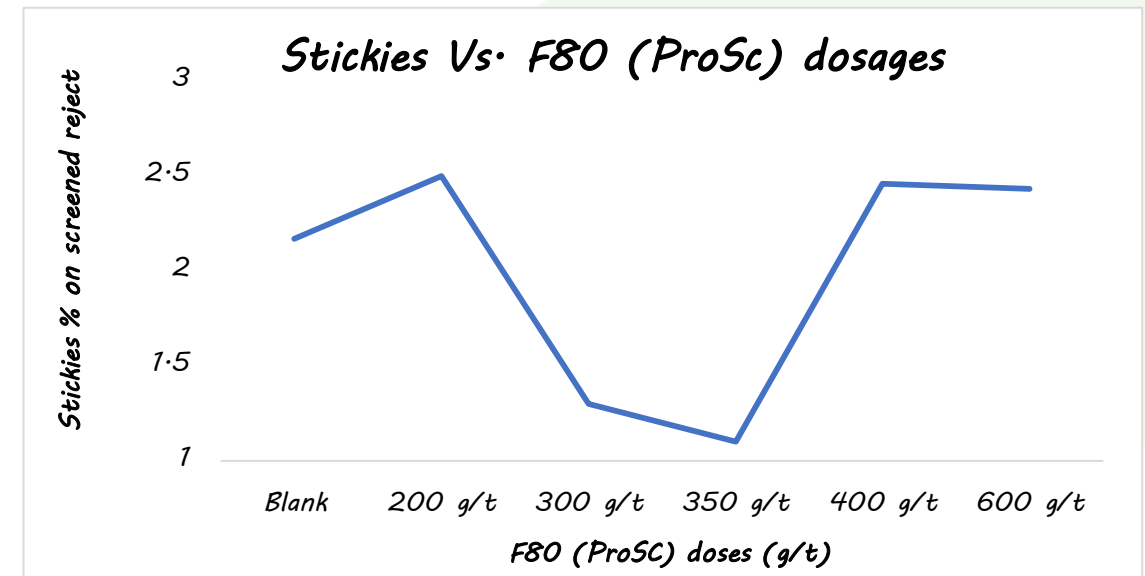
Blank

F80

- ✓ Stickies dispersion
- ✓ No redeposition in presence of coagulant

✓ Method- Coupon deposition method

2. Stickies conversion from macro to micro



- ✓ Optimum dosages: 300-350 g/t
- ✓ Effective conversion from macro to micro stickies

✓ *Furnish- Coated magazines wastepaper*

✓ *Product dosing point- Post flotation*

*Pulping details*

- *NaOH- 15 kg/t*
- *Na<sub>2</sub>SiO<sub>3</sub>- 10 kg/t*
- *Surfactant- 350 g/t*
- *Pulping time- 20 min*
- *Temperature- 50 deg. C*
- *Flotation time- 6 min.*

*Output pulp parameters*

- *Macro stickies*
- *Brightness (ISO)*
- *Cleanness (ERIC)*
- *Process water turbidity*

Chemicals (dose)	Parameters  Unit  Test method	After Treatment			
		Macrostickies	Brightness	ERIC	Process water turbidity
		mm <sup>2</sup> /kg	% ISO	ppm	NTU
		Instrumental method (Pulmac master screen)	IS-1060 part-I	Tappi T-567	Instrumental method (Turbidity meter)
Control (0 g/t)		17583	65.5	1668	79.7
FK (200 g/t)		12461 <b>(-29.1%)</b>	65.6	1641	80.0 <b>(+0.4%)</b>
FK (400 g/t)		6237 <b>(-64.5%)</b>	65.8	1621	82.4 <b>(+3.4%)</b>
FK (600 g/t)		5635 <b>(-68.0%)</b>	66.2 <b>(+0.7 pt.)</b>	1617	91.0 <b>(+14.2%)</b>
F80 (200 g/t)		15063 <b>(-14.3%)</b>	65.6	1672	107.4 <b>(+34.8%)</b>
F80 (400 g/t)		7823 <b>(-55.5%)</b>	65.8	1630	109.2 <b>(+37.0%)</b>
F80 (600 g/t)		5744 <b>(-67.3%)</b>	66.1 <b>(+0.6 pt.)</b>	1621	110.6 <b>(+38.8%)</b>

*Note: Minus sign (-) denotes %age reduction and positive sign denotes %age improvement*

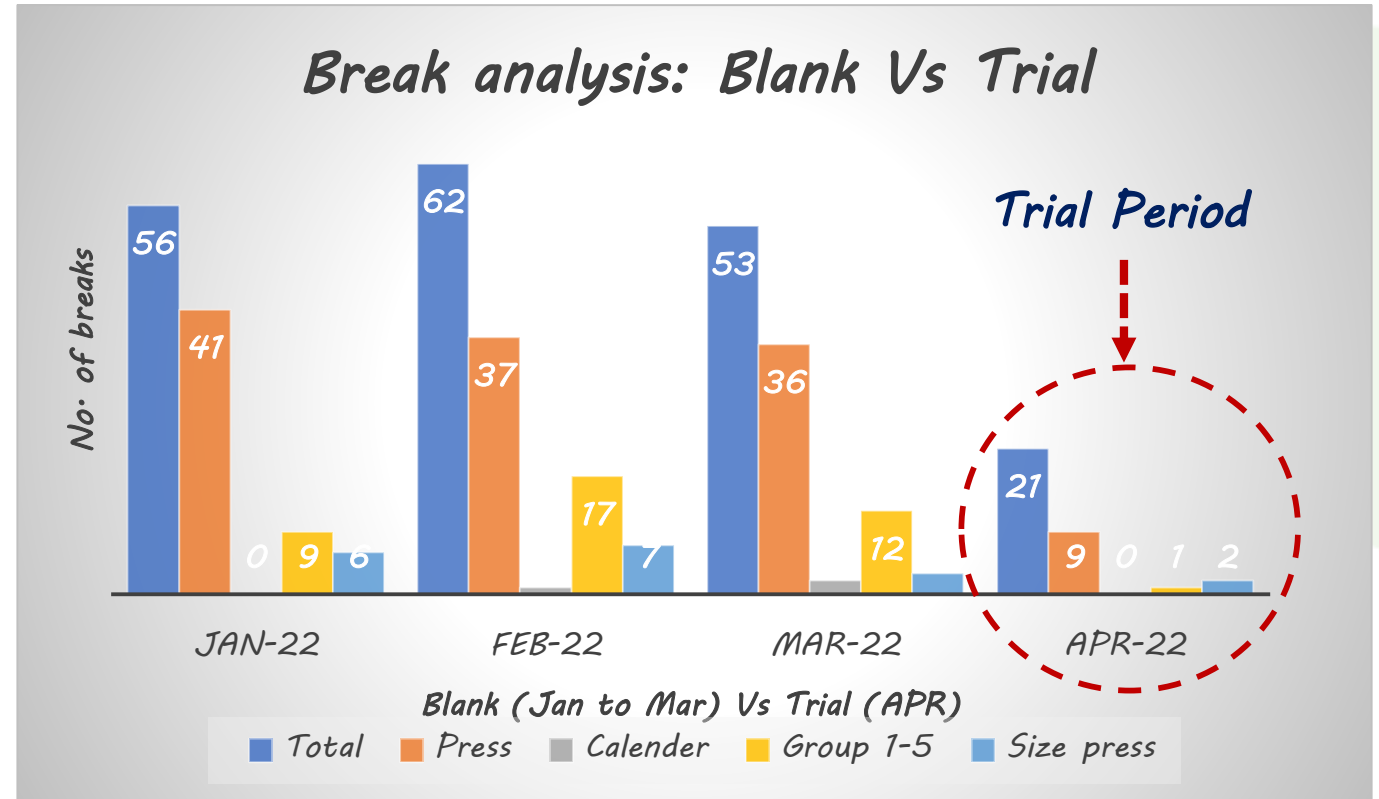
# Mill case study- Writing & Printing mill

F80 dosages: 250g/t

## Process Details

- Mill- Paper Machine
- TPM- 7500
- Quality- Writing & Printing
- GSM Range- 57- 120
- Sizing- Alkaline sizing
- Back Water pH- 7 to 7.5
- ASH%- 16 to 25
- Fresh Water M3 /Day- 2500
- FPR %- 80- 85
- FPAR %- 50 - 55
- Filler - GCC

Dosing point: DLP receiving chest



50% reduction of the breaks due to sticky deposits

Boil out was found to be extended by a period of 30-45 days

## Microbial reduction analysis: E-Coli & Pseudomonas

Sample point	Before Trial		After Trial	
	TBC	E. Coli	TBC	E. Coli
Fresh water	10 <sup>2</sup>	-	10 <sup>1</sup>	-
Broke chest	10 <sup>4</sup>	-	10 <sup>1</sup>	-
DIP Receiving chest	10 <sup>4</sup>	-	10 <sup>1</sup>	-
Blend chest	10 <sup>4</sup>	-	10 <sup>1</sup>	-
Head box	10 <sup>4</sup>	10 <sup>4</sup>	10 <sup>2</sup>	10 <sup>2</sup>
Silo	10 <sup>4</sup>	10 <sup>4</sup>	10 <sup>2</sup>	10 <sup>2</sup>
Excess white water	10 <sup>4</sup>	-	10 <sup>1</sup>	-
Cloudy water	10 <sup>4</sup>	-	10 <sup>1</sup>	-
Cloudy water	10 <sup>4</sup>	-	10 <sup>1</sup>	-
Super clear water	10 <sup>4</sup>	-	10 <sup>1</sup>	-

>90% reduction in the total bacterial count & 99% reduction in the E. Coli was observed during F80 application

## *Technology benefits*

- ✓ *Single product works as a solvent, surfactant & dispersing agent*
- ✓ *Effective dispersion and conversion from macro to micro form*
- ✓ *No aggregation of stickies even with coagulant chemicals*
- ✓ *No encapsulation required*
- ✓ *Reduces paper breaks by 50%*
- ✓ *Increases machine runnability & productivity*

# Biobased deposit & odor control- Lab studies

## Control Lab Studies

### 1. Contaminant microbes used for study

1. *E. coli* (bacteria)
2. *Aspargillus niger* (fungus)

### 2. Parameters studied

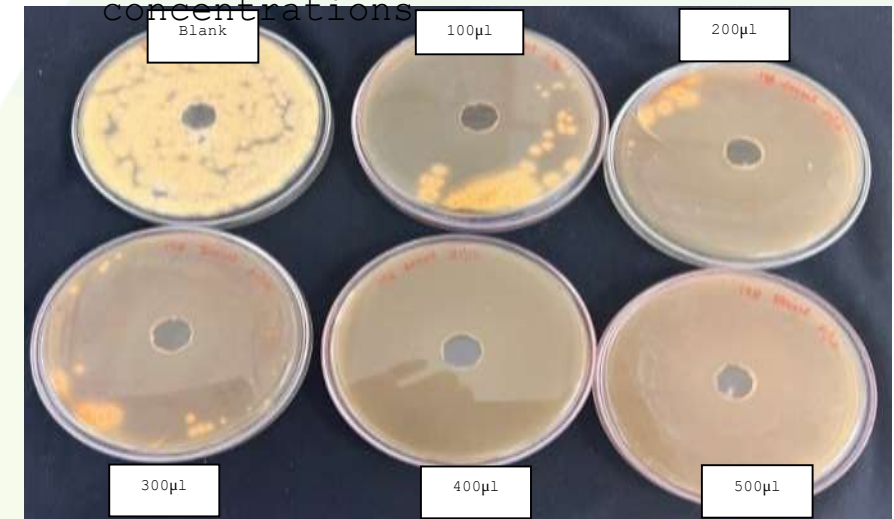
1. Zone of inhibition
2. MIC studies

### 3. Incubation period

1. Bacteria- 24 hrs
2. Fungus- 72 hrs



**Fig. 1:** Zone of inhibition study with *E. Coli* at different concentrations



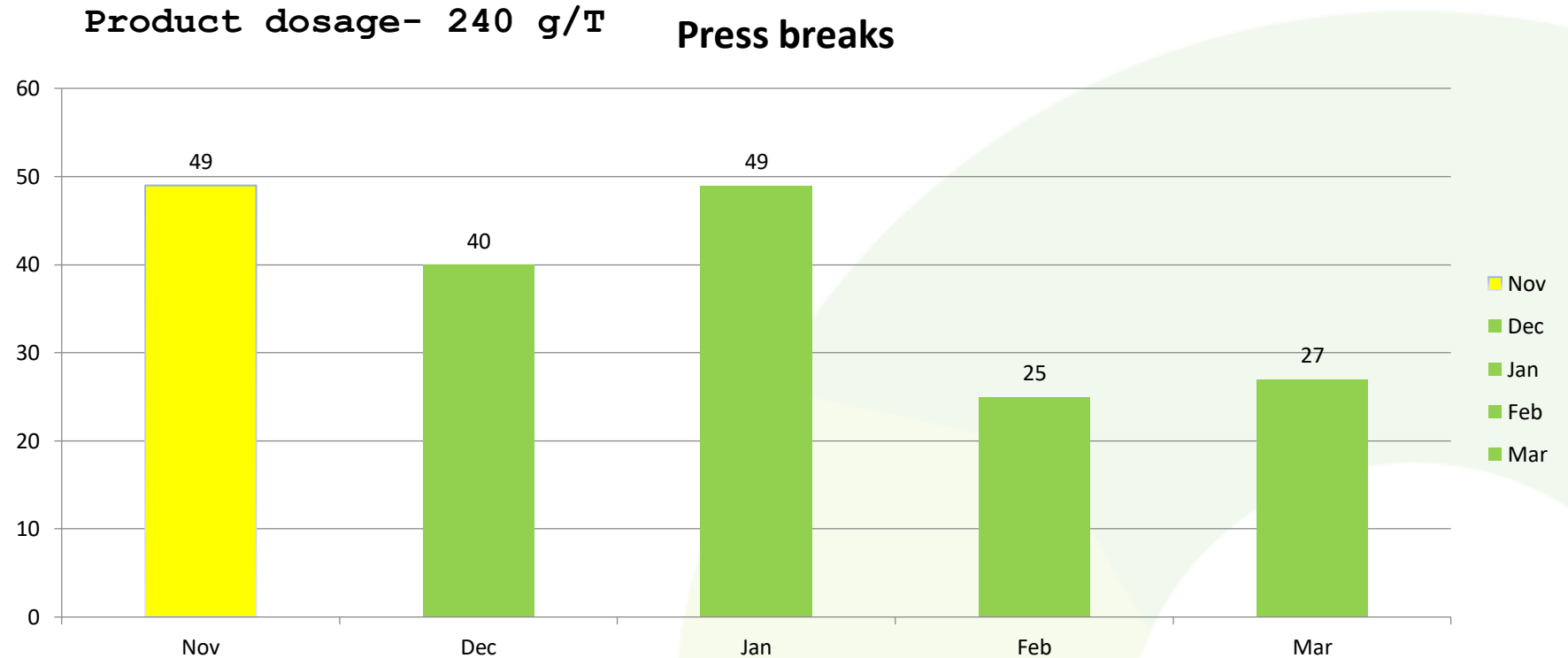
**Fig. 2:** Zone of inhibition study with *A. niger* at different concentrations

- ✓ Effective at as low as 10 ul for *E. Coli* & 100 ul for *A. niger*
- ✓ Complete inhibition at 70 ul for bacteria & 400 ul for fungus
- ✓ The combination technology is an efficient biological solution

# Deposit control case studies- Paper machine

## Process Details

- Mill- Paper Machine
- TPM- 7500
- Quality- Writing & Printing
- GSM Range- 57- 120
- Sizing- Alkaline sizing
- Back Water pH- 7 to 7.5
- ASH%- 16 to 25
- Fresh Water M3 /Day- 2500
- FPR %- 80- 85
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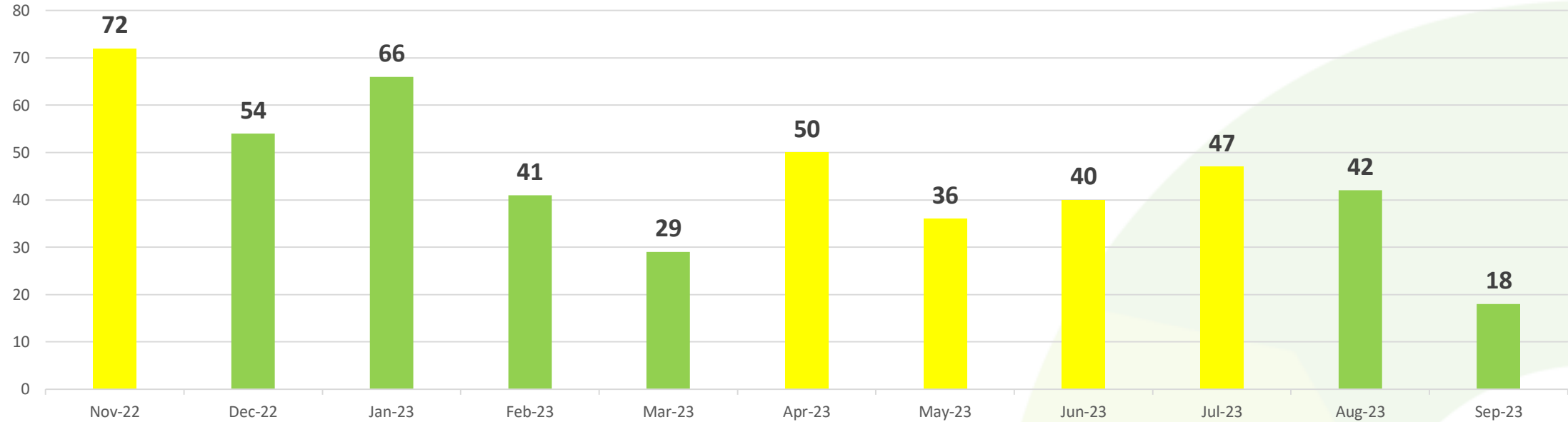


**> 50% Reduction in deposit breaks**



# Total breaks comparison

Total Breaks



**With Conventional Biocide**

**With Green Chemistry**

**With Conventional Biocide**

**With Green Chemistry**

**Over 50 % Total Break Reduction on continuous run**

# Mill case studies

## Mill process parameters

### 1. Recycled Mill

### 2. Total dosages- 550 gms /T of paper

- ✓ Pulper- 250 gms /T
- ✓ Silo- 100 gms /T
- ✓ Size press-100 gms/T
- ✓ ETP inlet- 100 gms/T

### 3. Furnish details

- ✓ Indian OCC
- ✓ Imported

- ✓ 30-40% improvement in ORP value
- ✓ VFA during blank- 2000 to 3000 ppm
- ✓ VFA during trial- 700-800 ppm
- ✓ Complete elimination of hypo & biocides

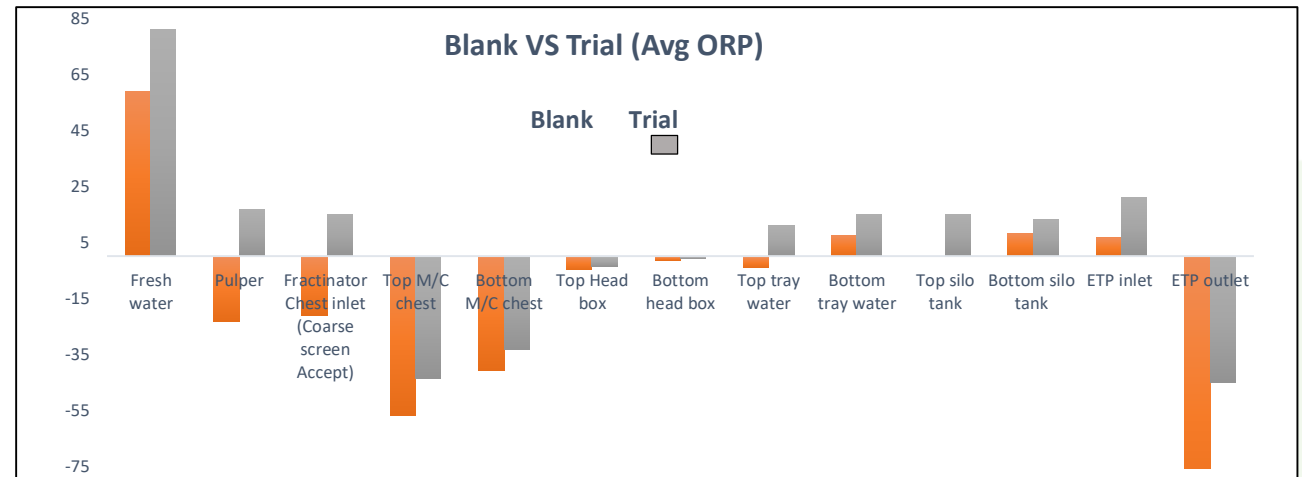


Fig. 1: ORP trend from complete water system

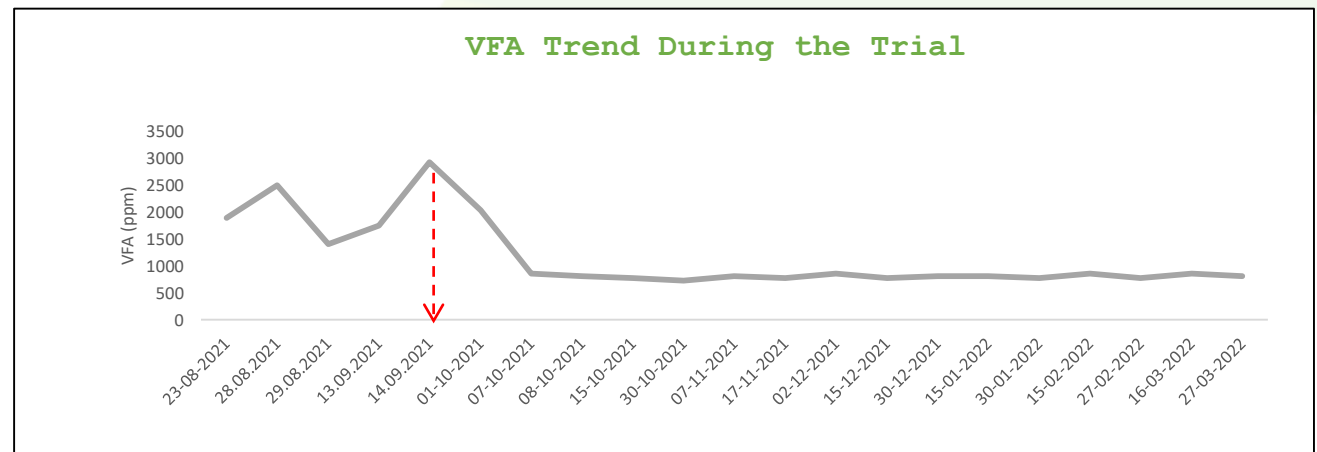


Fig. 2: Average paper VFA during 6 months of the trial

## *Technology benefits*

- ✓ Control biological slime in approach flow system including pipes and process equipment
- ✓ Eliminates “chemical” biocides & Hypo in the approach flow system
- ✓ Eliminates chlorine-based products in the application
- ✓ Reduction of toxic substances in the system and effluent
- ✓ Controls corrosion induced because of microbes & chlorine-based chemistry
- ✓ Reduces paper breaks because of slime deposits
- ✓ Maintains VFA & odor at reduced levels

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