IPPTA

Indian Pulp & Paper Technical Association

GREEN SOLUTIONS FOR PULP AND PAPER INDUSTRY

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GREEN CHEMISTRY THAT DELIVERS

17 March 2023

Presentation Summary

- Paper Processing & Environmental concerns
- Green Chemistry Solutions & Key Contributors
- Biobased technologies for Paper industry
- Key Mechanisms as Technology Drivers
- Results & Discussion
- Technology case studies
- Key Benefits

Paper Processing & Environmental Concerns

Cooking Process	• Sulphur gas emissions • Higher chemical consumption
Delignification	• Higher O2 consumption • High COD/TDS water as effluent
Bleaching	• Bleaching chemical consumption • High COD/TDS water as effluent
Paper machine	• Microbial growth, Slime, Odor • Pith, Pitch, Stickies
Kraft Paper	• Microbial growth, VFA, Odor • High COD/TDS effluents

Environmental concerns

Demand for a green solution

Biobased Technologies
An Innovative solution for Paper industry

Key contributors

- ✓ **Environment friendly raw materials**
  - Plant based
  - Fermentation based
- ✓ **Environment friendly manufacturing process**
  - Ambient conditions
  - Room temperature processes
  - Low energy consumption
  - Zero air and land pollution
  - Microbial & bio-based processes
- ✓ **Biodegradable products**

Biobased Technologies for Pulp & Paper

✓ ***Cooking Enhancement & Odor control***

- Reduction in active alkali
- Reduction in sulphurous gas emissions & odor (60-70%)
- Reduction in H Factor (time & temperature)

✓ ***Efficient Delignification & Bleaching***

- Improvement in delignification efficiency (5-7%)
- Reduction in bleaching chemicals (10-15%)

✓ ***Microbial Growth, Slime, Deposit & Odor control***

- Reduce process downtime

Key Mechanisms as Technology Drivers

Live Microbe based

1. **Competitive inhibition-** A group of beneficial microbes put together in a novel consortium
2. **Sulphur sequestration-** A unique class of sulphur metabolizing microbes

Renewable Plant based

3. **Bio-dispersion-** Biobased materials to reduce surface tension, enhanced impregnation & facilitate dispersion of hydrophobic contaminants
4. **Biosorption-** Adsorption, chelation, complexation, transport & ion exchange through biosorbent process
5. **Bio Delignification-** A biobased oxidation for lignin break down
6. **Microbial retardation-** A selective growth control for gram (-) bacteria

Each biobased mechanism in combination with the others, offers a unique solution

RESULTS & DISCUSSION

Case Study – Cooking Enhancement & Odour Control

Biobased mechanisms-

1. Bio-dispersion
2. Sulphur sequestration

Parameter	Blank	Biobased Trial
AA (%)	20.5	19.05
Fine Screens Reject (MT/Day)	7.96	7.59
Discharge Kappa No	17.8	17.3
PO2 Kappa No	9.47	8.91
ODL Efficiency	43	48
P2 ISO Brightness (%)	28.84	30
H Factor	700	550
Final Pulp Viscosity Cps	9.24	9.6
Cooking Temperature (deg. C)	164	153
H2S concentration (ppm) @ Discharge tank 1	447.6	145.35
Biobased product 1 Dosage per T of Pulp	0	0.40
Biobased product 2 Dosage per T of Pulp	0	0.25

AA reduction by 7%

Kappa reduction by 0.5 points & screen rejects by 4.5%

Brightness gain of 1.16 points

Improved pulp viscosity & ODL efficiency

Reduction in H Factor & temperature

> 60% reduction in H2S emissions & substantial reduction in odour

Case Study – Field trial – Cooking Enhancement & Odour Control

BLANK DATA

- ✓ Blank data recorded- 31/08/22 to 26/10/22 (56 days)
- ✓ Avg. Active alkali- 20.5%
- ✓ Avg. Kappa no.- 17.8
- ✓ H-Factor- 700 (164 deg. C.)

TRIAL DATA

- ✓ Trial data period- 27/10/22 to 25/01/23 (90 days)
- ✓ Avg. Active alkali- 19%
- ✓ Avg. Kappa no. 17.3
- ✓ H-Factor- 550 (153 deg. C.)

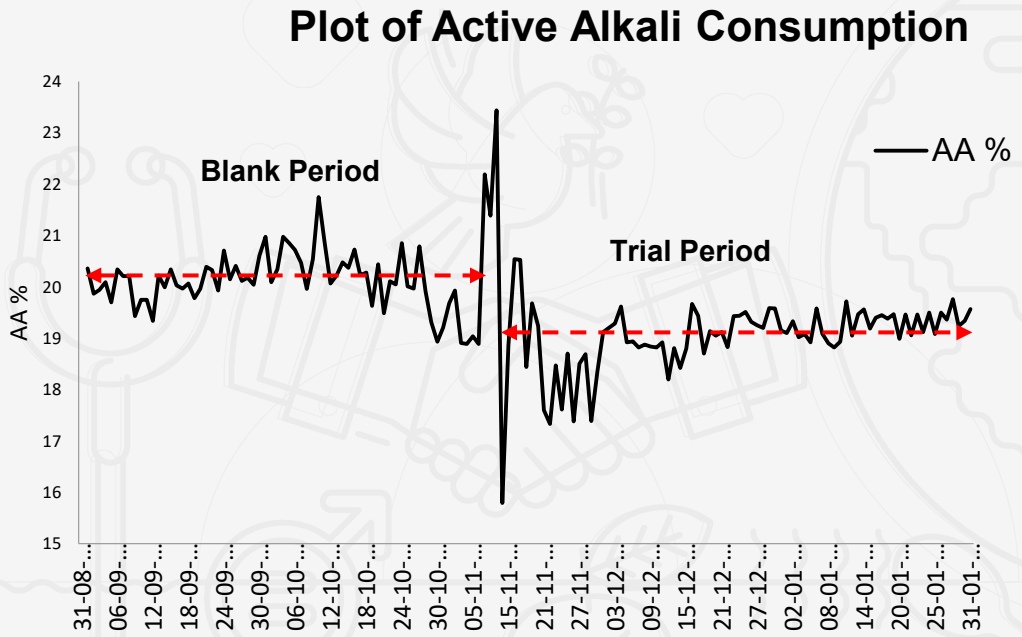


Fig. 1: Active alkali consumption (Blank period: 31/08 to 26/10/22; Trial period: 27/10/22 to 25/01/23)

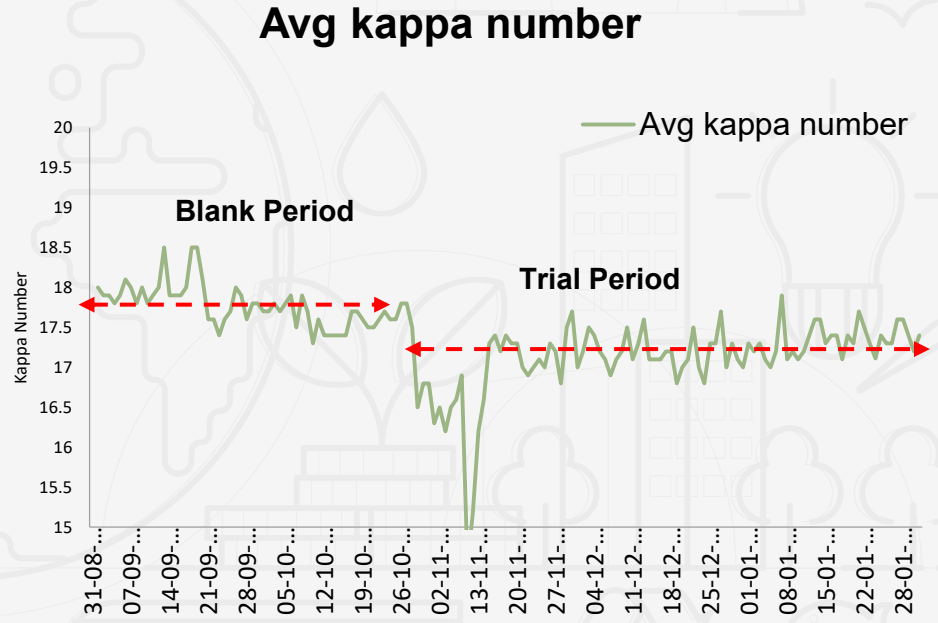


Fig. 2: Avg. Kapp No. (Blank period: 31/08 to 26/10/22; Trial period: 27/10/22 to 25/01/23)

Case Study – Field trial – Delignification and Bleaching

Biobased mechanisms-

1. Bio-sorption
2. Biobased delignification

Field studies

1. Total dosages- 270 gms /T of BD pulp
   1. DD2 repulper- 200 gms /T
   2. D1 Inlet- 70 gms /T
2. Furnish details
   1. Eucalyptus & Casurina
3. Trial phases
   1. Phase I- 60 days
   2. Phase II- 58 days

Parameter	Blank	Biobased Trial
D0- H2SO4	21.9	21.7
D0- ClO2	7.7	7.1
EoP- NaOH	17.1	**16.2**
EoP- H2O2	8.4	8.6
D1- H2SO4	4.6	4.6
D1- ClO2	5.4	5.2
H2SO4 (D0+D1)	26.5	**26.3**
ClO2 (D0+D1)	13.1	**12.3**
Biobased Product Dosage at DD2 repulper	0	200 gm
Biobased Product Dosage at D1 inlet	0	70 gm

ClO2 reduction by 6.9%

NaOH reduction by 5.3%

Brightness maintained between 85.5-86.5

Case Study – Delignification and Bleaching

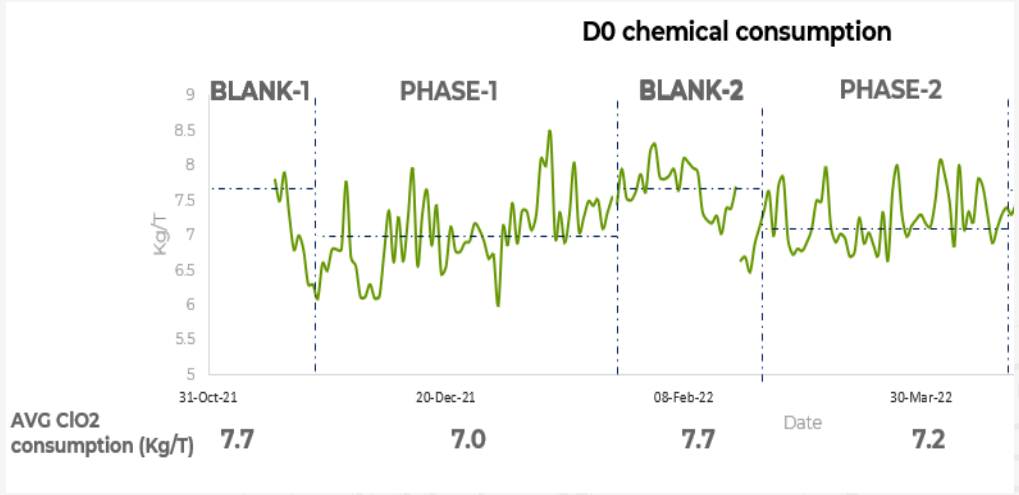


Fig. 1: ClO2 consumption at D0 (Blank period Vs Trial period)

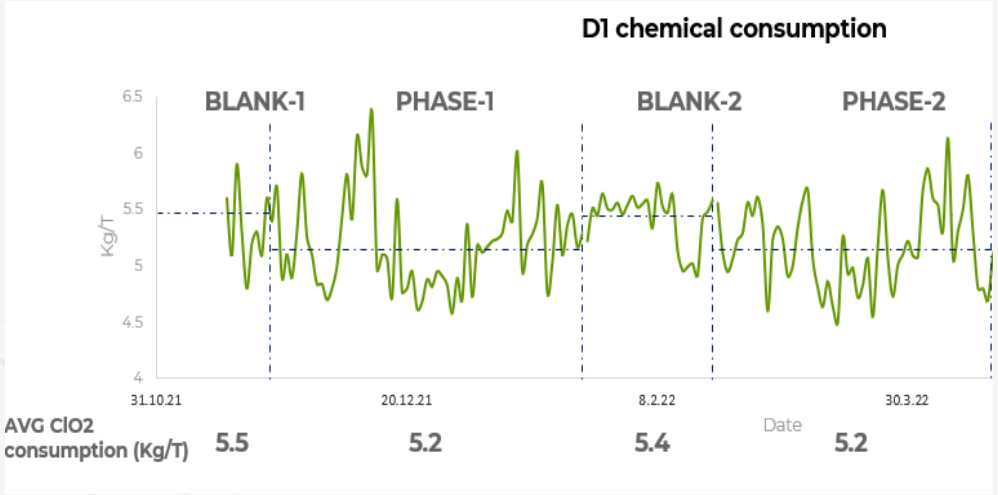


Fig. 2: ClO2 consumption at D1 (Blank period Vs Trial period)

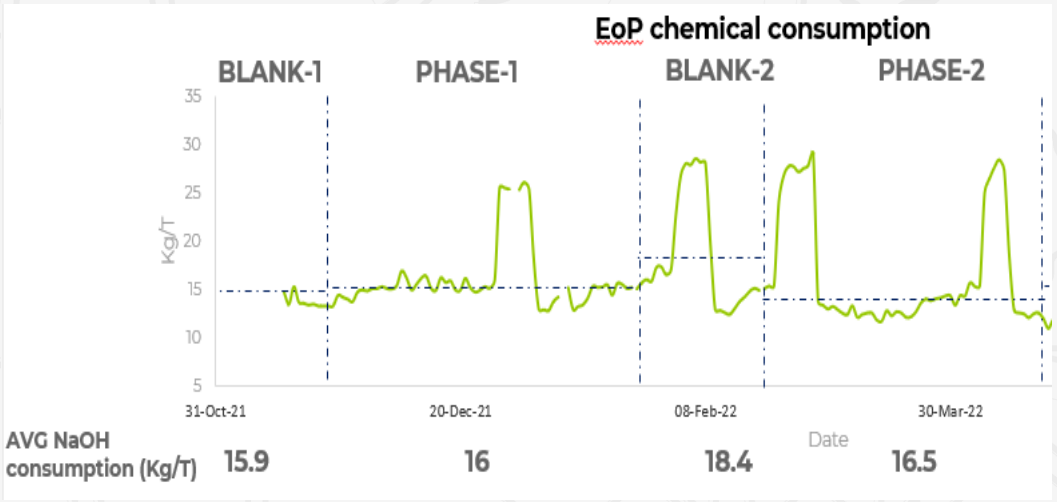


Fig. 3: NaOH consumption at EoP (Blank period Vs Trial period)

- ✓ Consistent ClO2 reduction at both D0 & D1 stage
- ✓ Substantial reduction of Caustic at EoP stage
- ✓ The EoP spikes are due to the D0 bypass

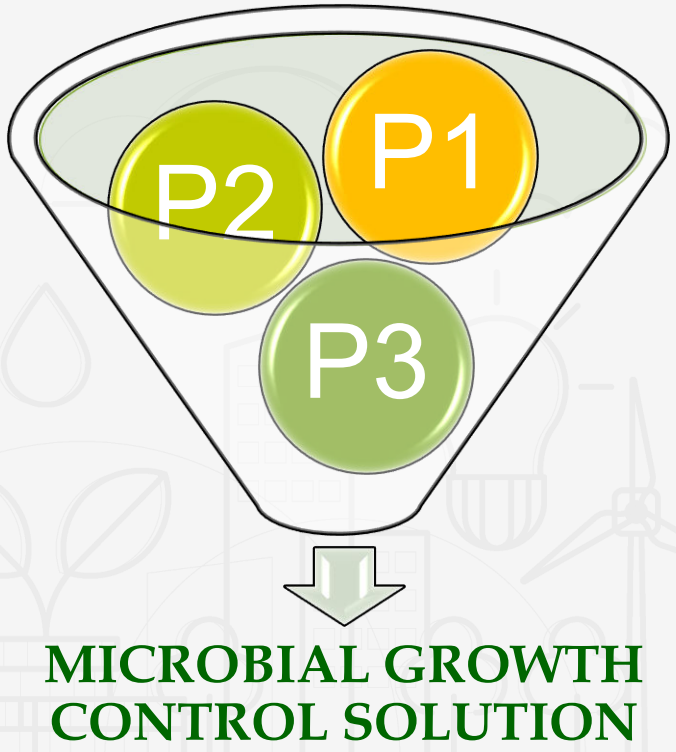
MB, Deposit, Slime & Odor Control

Biobased mechanisms-

1. Competitive inhibition- **Live microbes**
2. Microbial retardant
3. Bio-dispersant

} **- Plant based**

- ✓ A **combination mechanism** for effective control
- ✓ Live Probiotic microbes for **competitive inhibition- P1**
- ✓ **Microbial growth retarder** for selective control of g(-ve) growth- **P2**
- ✓ **Bio-dispersant** to wipe out the existing microbial growth- **P3**
- ✓ **100% biodegradable** and faster digestion of BOD, COD and other organics



MB, Deposit, Slime & Odor Control Lab Studies

Control Lab Studies

1. Contaminant microbes used for study
    1. *E. coli (bacteria)*
    2. *Aspargilus niger (fungus)*
2. Parameters studied
    1. Zone of inhibition
    2. MIC studies
3. Incubation period
    1. Bacteria- 24 hrs
    2. Fungus- 72 hrs

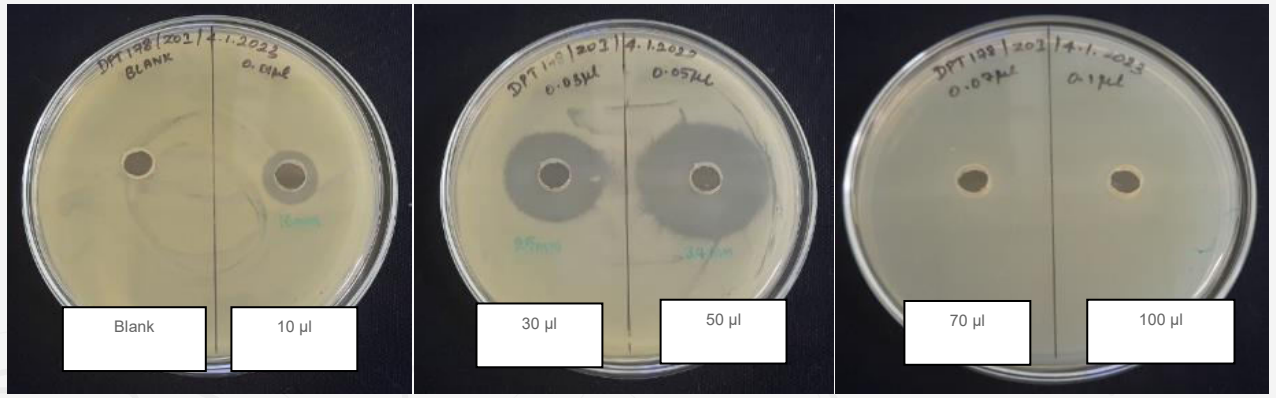


Fig. 1: Zone of inhibition study with *E. Coli* at different concentrations

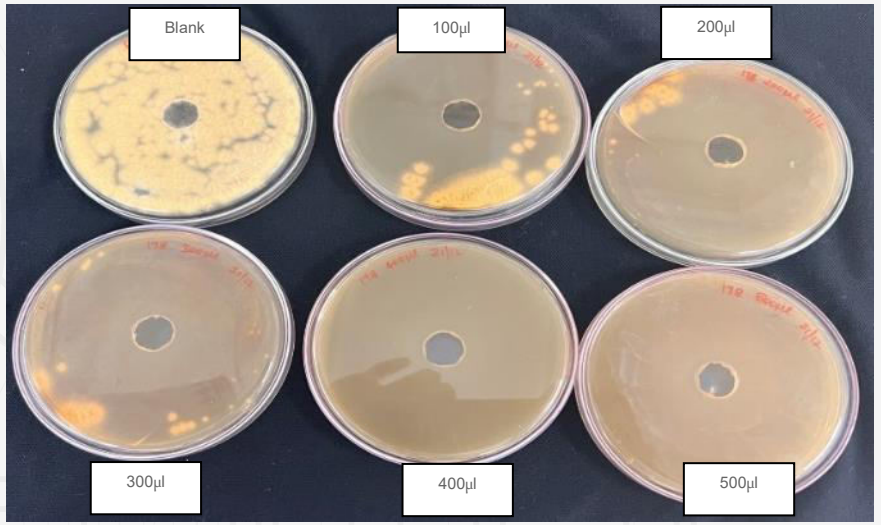


Fig. 2: Zone of inhibition study with *A. niger* at different concentrations

- ✓ 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

Case Study – MB, Deposit, Slime & Odor Control

Field studies

1. Conducted in recycled Kraft 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 at different water locations
- ✓ VFA concentration during blank- 2000 to 3000 ppm
- ✓ VFA reduced to 700-800 ppm
- ✓ Complete elimination of hypo & biocides

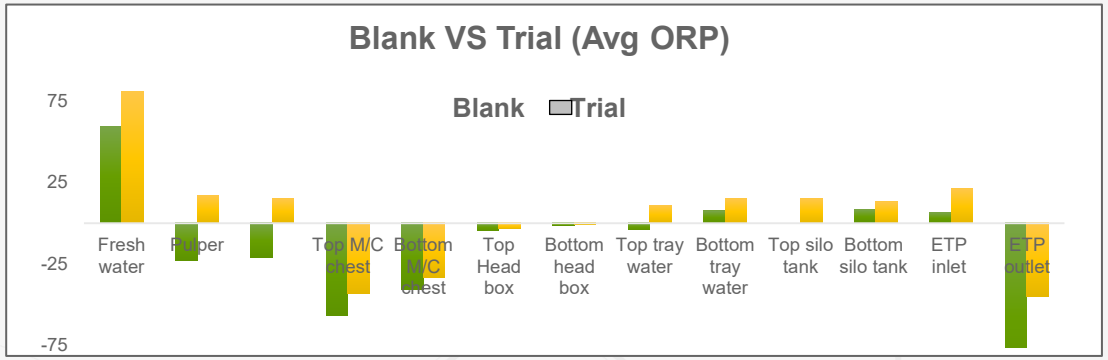


Fig. 1: ORP trend from complete water system

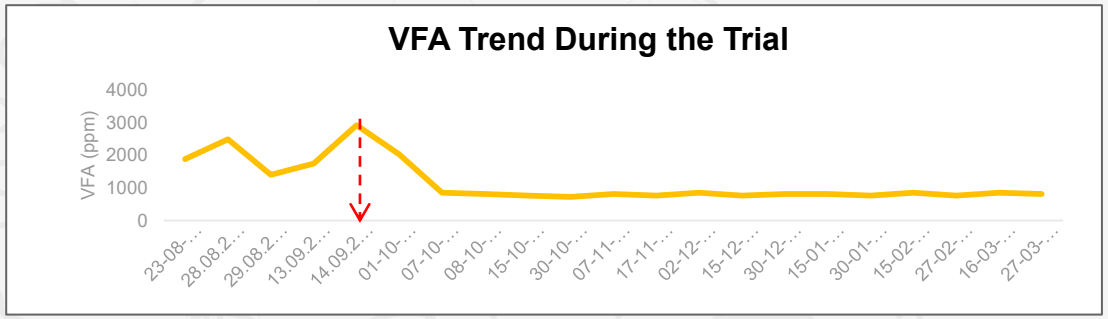


Fig. 2: Average paper VFA during 6 months of the trial

Fig. 3: Slime formation on the machine parts (Left- Before trial, Right- After trial)

Case Study – MB, Deposit, Slime & Odor Control

Study of antimicrobial properties on Paper mill effluent sample

- ✓ Effluent sample source: Recycle kraft paper mill
- ✓ Treatment hours: 4 hrs
- ✓ Media used: Nutrient Agar
- ✓ Test parameter: Colony counts through spread plating
- ✓ Plate incubation time: 24 hours

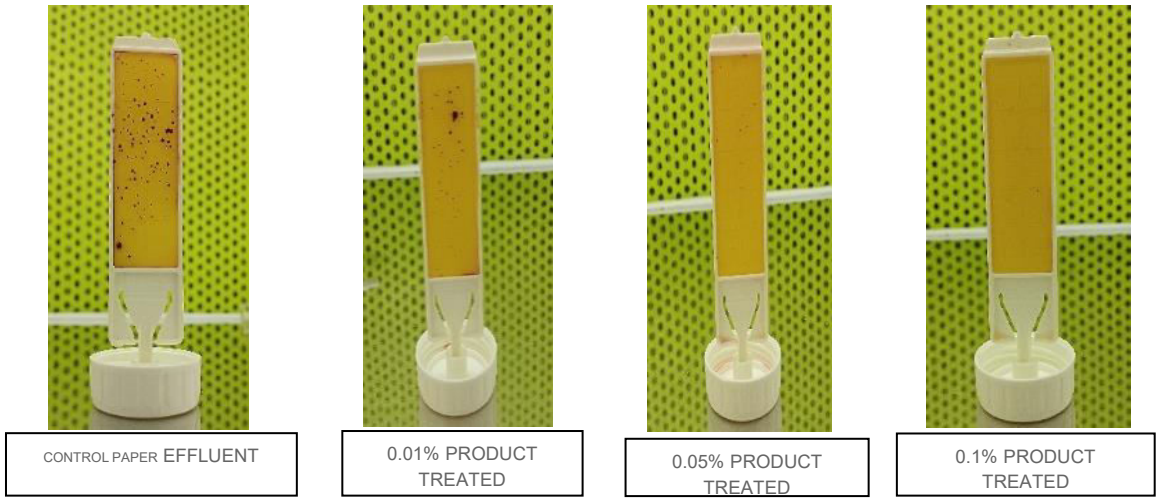


Fig 1. Bactaslyde TBC count at different product dosages

- ➢ Growth reduction from 10^5 to 10^2
- ➢ Indicating 99% reduction

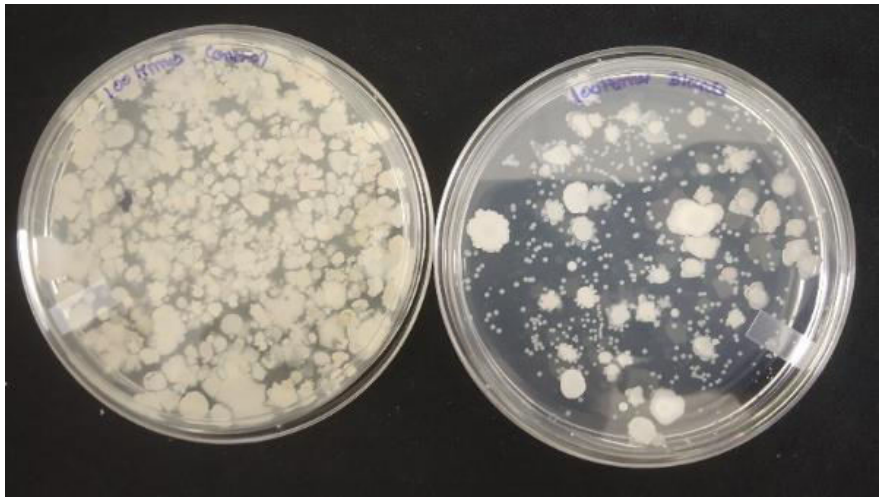


Fig 2. Nutrient plate of untreated effluent (Left) and treated effluent (Right)

Green Technology Unique Benefits

Technology benefits

- Stable at broad pH & temperature
- For virgin mills, recycled pulp mills & kraft paper mills

Environmental benefits

- Complete control over microbial issues
- Eliminates “Biocides” & “Hypo”
- Reduced mercaptans emission & bad odour
- Reduces non-environment friendly chemicals
- Reduces COD/BOD/AUX/SAR/TDS from effluent water

Process benefits

- For cooking, bleaching, odour control, slime, sticky & pitch
- Improves yield & brightness
- Improves fibre strength & pulp properties
- Reduces scale & corrosion issues

Green Technologies - A step towards sustainability

A Green gateway for mills

By Reducing/ Eliminating

- ✓ Hazardous chemicals
- ✓ Environmental issues
- ✓ Better utilization of water resources

Facilitates Mills to

- ✓ Reduce climate change impact
- ✓ Enter into Green Certifications
- ✓ Reduce carbon foot print

Makes World a Better Place for Future Generations

Thank you

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