

Tackling Water contaminations – ClO₂ Technology

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IPPTA

58th Annual General Meeting and Seminar – 2023

Hyderabad

17-18 March 2023

Challenges and Issues in Indian Paper Industry

- Extremely closed systems (ZLD) have low turnover rates. This leads to increased water temperature, decrease in the dissolved oxygen (DO) level in the water.
- Paper machine systems usually support significant growth of microbes due to congenial and favourable conditions persisting, such as pH, elevated temperature, high nutrient levels make paper mill a perfect breeding ground for microbial growth
- Development of anaerobic conditions and subsequent problems such as the accumulation of VFA and foul odour.
- Major Factors responsible for the problems are-trend towards increased use of recycled waste paper/fiber,
- Additive, alkaline/ neutral sizing and water system closer resulting in reduced solid and liquid discharge

Source & Reasons for Microbial growth

☀️ Microorganism/ Bacteria

May cause Technical, Economic and Hygienic loss.

☀️ Build up of Slime- $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$ at Key Process Positions

If uncontrolled- can accumulate and eventually break away.

☀️ Algae

Oxygen depletion to delay Biological control, Process issue

☀️ Fungal

May creat Hygiene issues

Monitoring Tools

- ⊕ **ORP – Oxidation Reduction Potential, mV**
- ⊕ **TBC – Total Bacteria Count, CFU**
- ⊕ **VFA – Volatile Fatty Acids, ppm or mg/l**

ORP- Oxidation Reduction Potential

- ◆ ORP- or REDOX, is Oxidation & reduction Status of Solution based on collective electron activity within Solution.
- ◆ Reduction is the gain of electrons, so reducers donate electrons to other molecules
- ◆ Oxidation is loss of Electrons, so Oxidant accept electrons from other molecules.
- ◆ Negative ORP indicates that Substance is reducing agent. Lower ORP reading indicates more anti Oxidant Solutions.
- ◆ Back Water ORP in virgin grade to be maintained 250-300 where as in recycled Furnish 0-100 Mv.

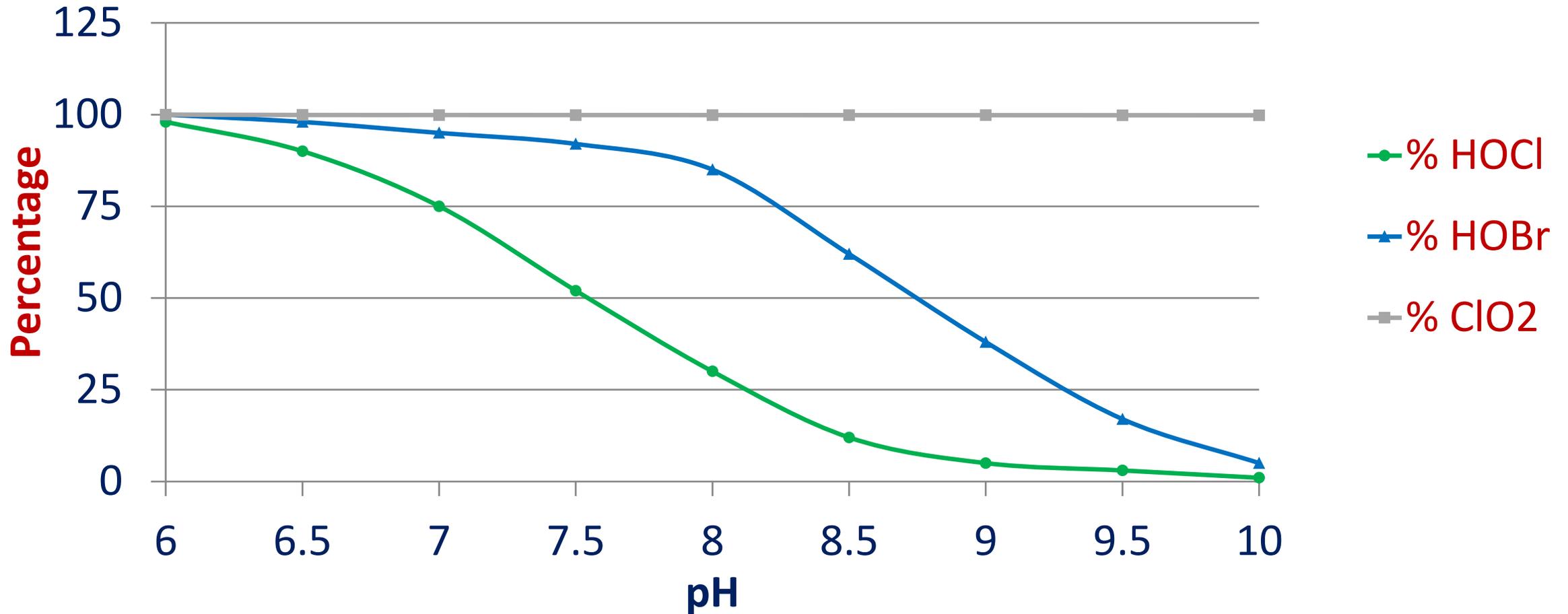
Chlorine dioxide

ClO₂ Selectivity

Doesn't react with

- ⊕ Ammonia
- ⊕ Ammonium salts
- ⊕ Alkanes
- ⊕ Alkenes
- ⊕ Alkynes
- ⊕ Alcohols
- ⊕ Primary Amines
- ⊕ Glycols
- ⊕ Ethers
- ⊕ Unsubstituted aromatics
- ⊕ Most organic Compounds
- ⊕ Starch
- ⊕ Organic Acids
- ⊕ Diols
- ⊕ Saturated aliphatic

Dissociation of Disinfectants



pH influence on dissociation of common disinfectant

ClO₂ Selectivity

Amount available
for disinfection

Amount "inactivated"
by pH effect

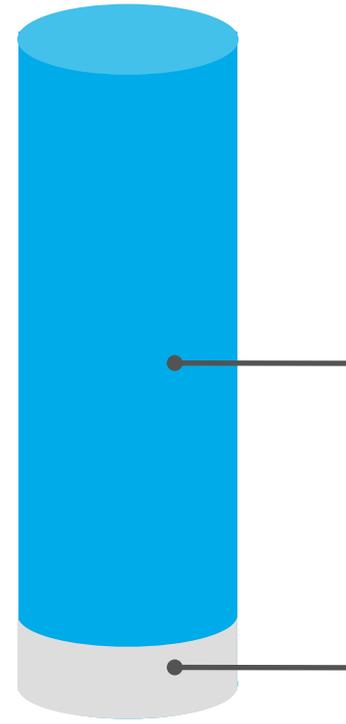
Amount consumed
by organics



Cl₂

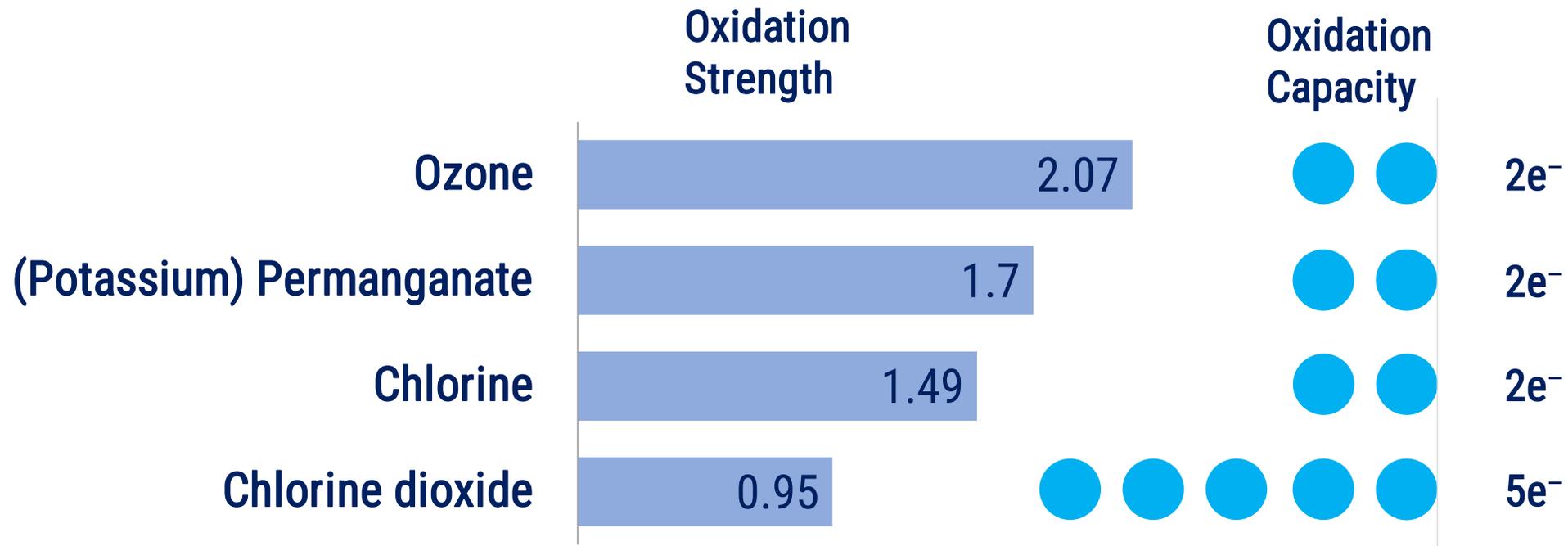
Amount available
for disinfection

Amount consumed
by organics



ClO₂

Advantage of ClO₂



Less Oxidation Strength,
less corrosive;

more oxidation capacity,
less chemical qty required

ClO₂ Selectivity

ClO₂ do react with

- ◆ Iron & Manganese, precipitates has to be filtered
 - ◆ 1 mg Iron consumes 1.2 mg ClO₂
 - ◆ 1 mg Manganese consumes 2.5 mg ClO₂
 - ◆ Excellent pre treatment option for dissolved metal ion removal
- ◆ Nitrite is oxidized to Nitrate, Sulfide to Sulfate & Sulfur
 - ◆ 1 mg nitrite consumes 2.9 mg ClO₂
 - ◆ 1 mg sulfide consumes 2.1 mg ClO₂
- ◆ Excellent wastewater treatment option for algae bloom control & Odour control

Biofilm menance

- ❑ Bacteria tend to attach to surfaces and grow Biofilm.
- ❑ Once settled in a Biofilm, they became very resistant to common biocides

To summarize...

- ✚ ClO_2 destroys Biofilm, chlorine / bromine do not
- ✚ ClO_2 Does not produce dangerous DBP as THM's, HAA5 or Bromates
- ✚ ClO_2 has a preferably higher oxidation capacity but a low oxidation strength (meaning lower corrosion, and lower consumption)
- ✚ Can Oxidize Sulphide to Sulphate, thus controlling foul smell.
- ✚ ClO_2 efficiency is not affected by pH

Chlorine dioxide generation Methods

Chlorite Acid method

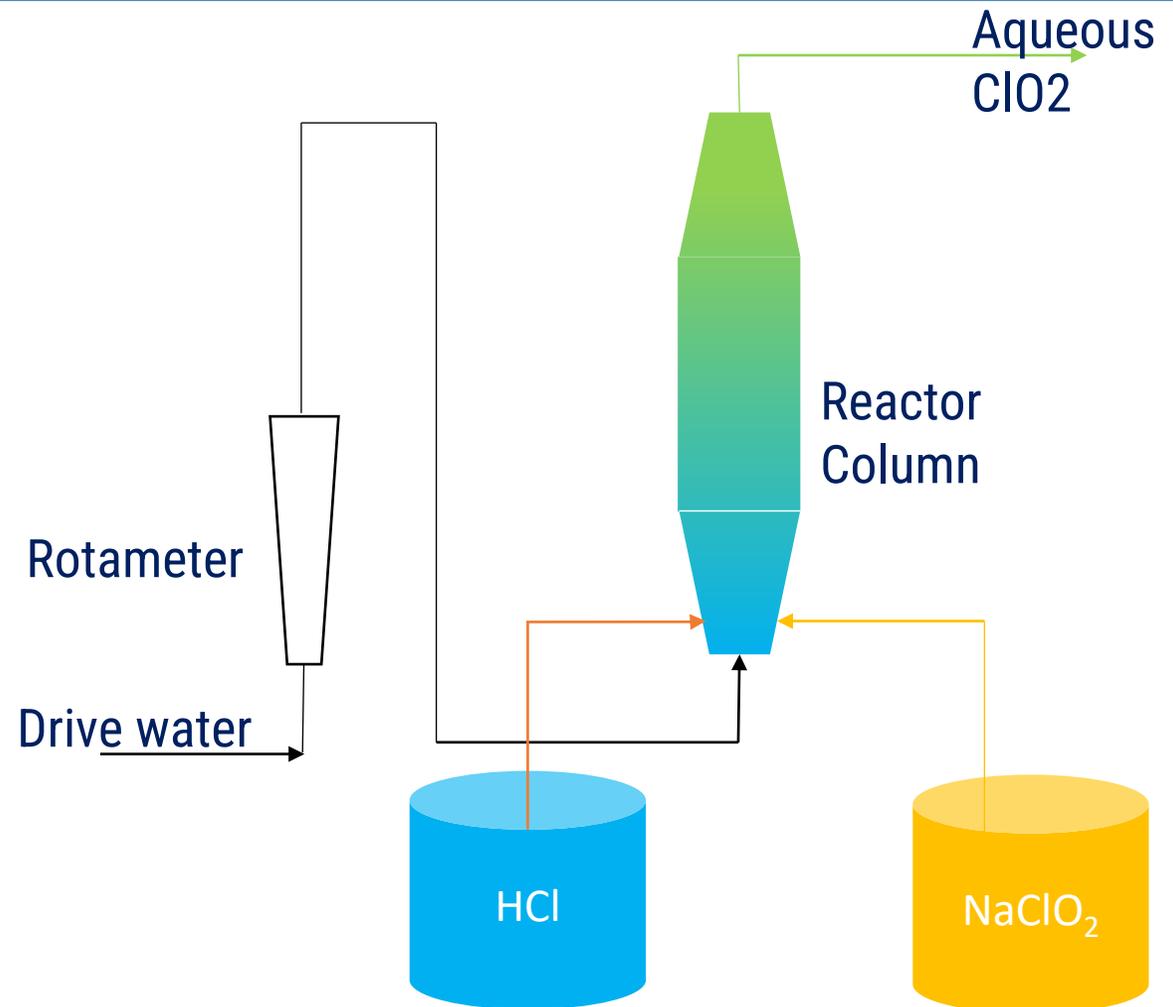


<u>Advantage</u>	<u>Disadvantage</u>
■ Only two chemicals needs to be handled	■ Max 80% reaction efficiency only
■ Easy to control the reaction	■ Higher cost of ClO ₂ generation
■ No THM formations	

Indion Chlorogen Generators – M2

Chemistry

Acid + NaClO₂



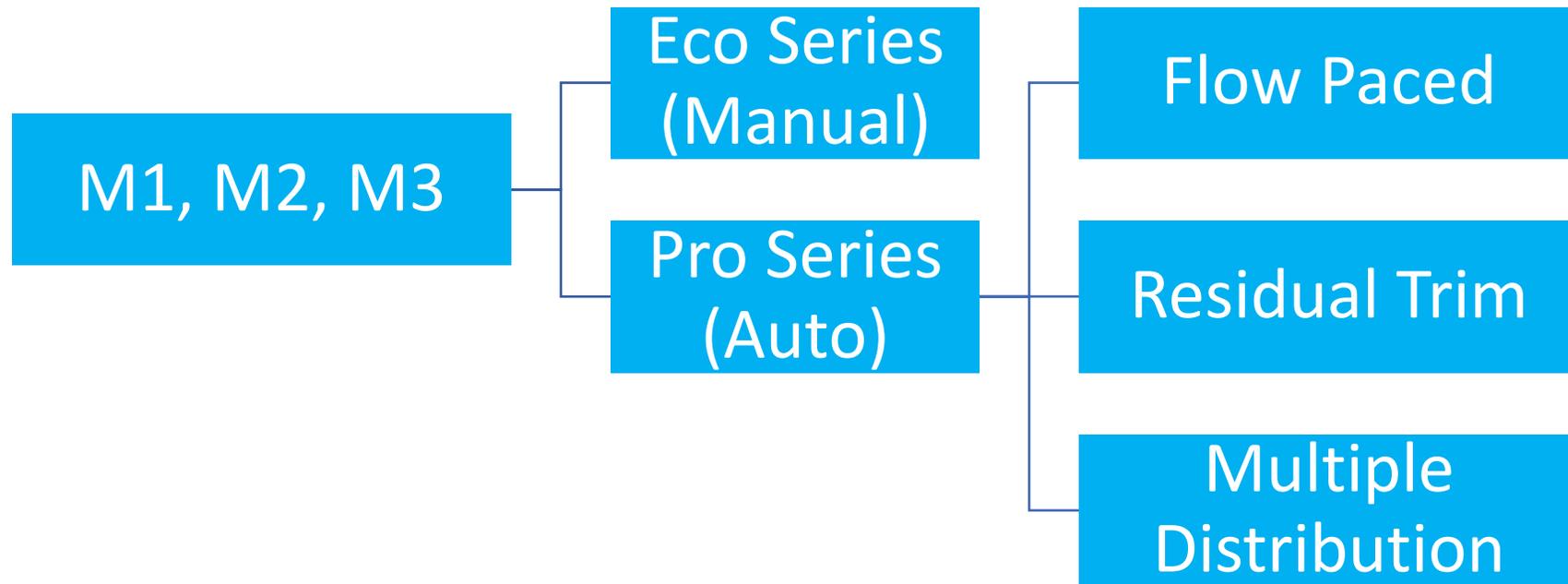
INDION CHLOGEN SYSTEM

Indion Chlogen



- Available in one pump, two pump and three pump method
- High Generator efficiency design
- Auto/Manual options available
- Designed for unattended sites
- Safest ClO₂ generator design: Available in flooded reactor technology & in underwater design
- Also available with remote monitoring & Control

Indion Chlogen Generators – Family Tree



0-6 gram / hr

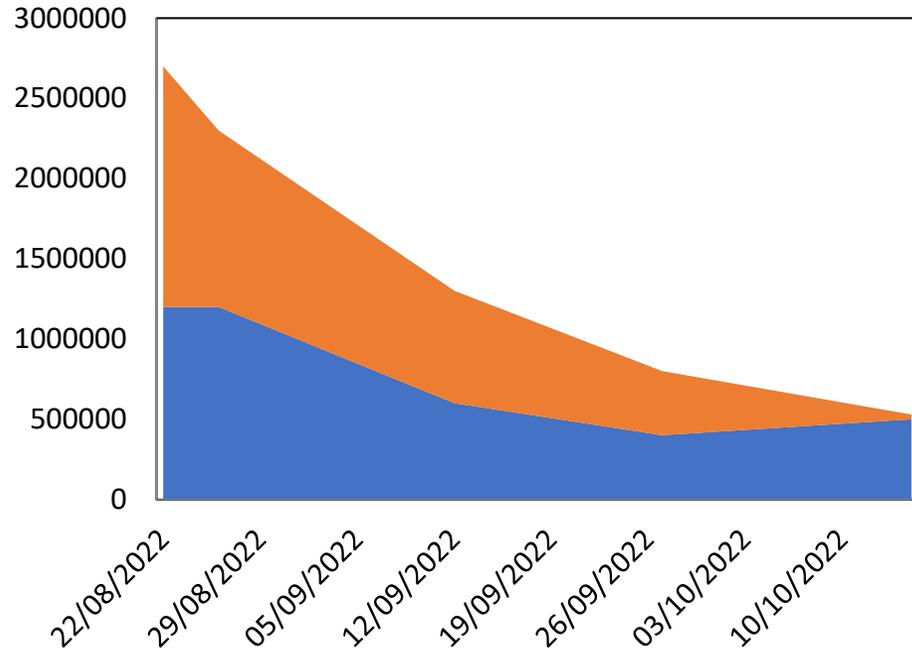
15-210 gram / hr

80 gram – 2 Kg/hr

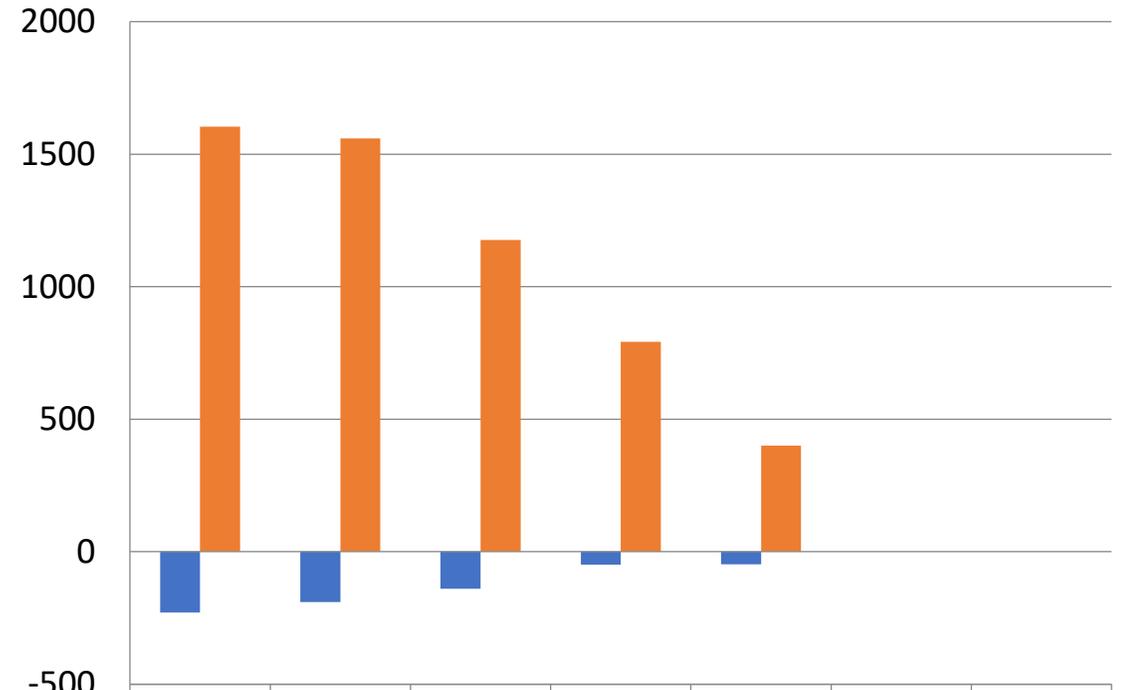
1-100 kg/hr

CLO2 Results- Mill 1- Brown Paper, Test Liner, 400 TPD

Microbial count monitoring



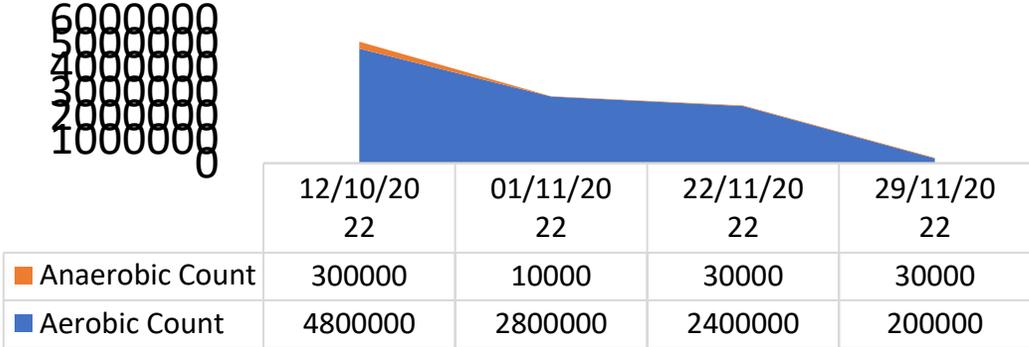
	22/08/2022	26/08/2022	12/09/2022	27/09/2022	15/10/2022
Anaerobic in out after	1500000	1100000	700000	400000	30000
Aerobic in out before	1200000	1200000	600000	400000	500000



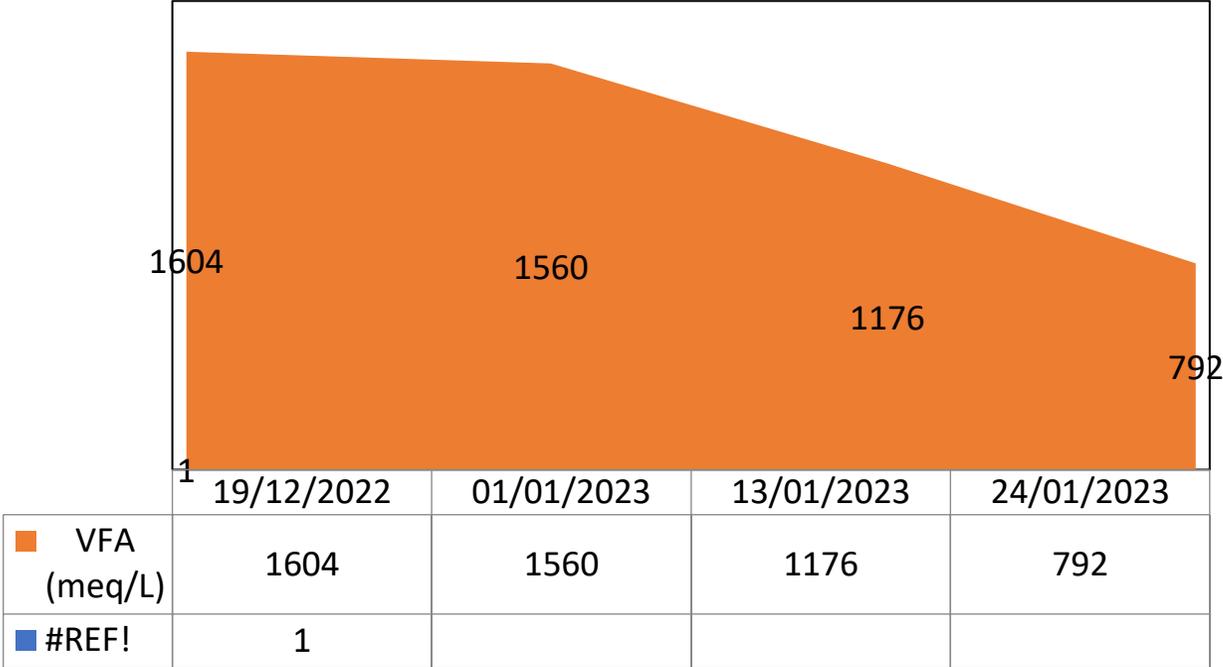
	22-08-2022	26-08-2022	12-09-2022	27-09-2022	15-10-2022	18-09-2021.	30-09-2021.
ORP	-230	-190	-140	-49	-47		
VFA (meq/L)	1604	1560	1176	792	400		

CLO2 Results- Mill 2- Kraft Paper, Test liner, 350 TPD

Microbial count monitoring



VFA Monitoring in Paper Sample



Conclusion

- **ClO₂** treatment technology with its optimized mild doses in the process water has emerged as an UNIDO innovative approach for control of odour and slime in Indian paper industry
- The indigenous equipment manufactures like Ion Exchange India Ltd has being able to successfully demonstrate the technology, commercialized and replicated technology which is in operation in numbers of paper mill across country
- The technology absorption such as helped the industry enhancing the productivity of quality of paper specially in the Indian paper mills adopting close water loops and zero liquid discharge while improving the sustainability and competitiveness at domestic and global level

Thank You