Controlling Odour Problem in Kraft Paper Industry (Innovative Wastewater Treatment and Monitoring Solutions)

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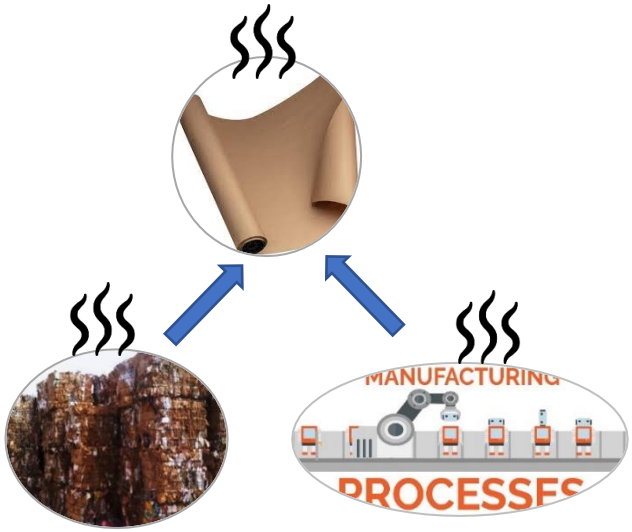
Odour Problem in Kraft Paper

- Kraft paper is commonly used as packaging material for food, chemicals, and other consumer goods due to its durability and eco-friendly nature.
- Kraft papers often have obnoxious odours which can have severe consequences
  - Problems in safe transport of packaged materials to long distances and storage
  - Alteration in taste, flavour and other quality of packaged materials
  - Consumer dissatisfaction
  - Financial losses
- Many Kraft paper mills need solutions for odour control, to produce good quality Kraft paper.

Causes of Odour



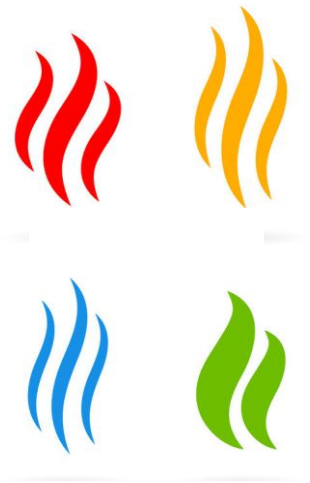
Odour can be due to the raw materials and/or due to the process

- Unbleached recycled wastepaper as raw material
  - Glues
  - Inks and colors
  - Chemicals
  - Food waste etc.
- Closed circuit water system
  - Use of wastewater for pulping and paper manufacture
  - Lack of adequate wastewater treatment process
  - Anaerobic conditions and Microbial decomposition
  - H_2S, Ammonia, lactic acid, volatile acids, alcohols etc.
  - Increased organic load due to prolonged recirculation of untreated wastewater encourages excessive growth of odour causing bacteria

Solutions for Odour Control

- **Effective wastewater treatment systems to treat and recycle the wastewater**
  - **Minimum COD/BOD in the treated water**
  - **Low growth rate of bacteria in the treated water**
  - **Low odour level in the water used for paper making**
- **Use of antimicrobials and chemicals**
  - **To control the growth of microbes in wastewater**
  - **To control the accumulation of odourous compounds**
  - **Low odour level in the water used for paper making**

Odour Monitoring



- Lack of simple and easy-to-use assessment methods for odour measurement
- Sense of smell by human nose is limited by many factors
  - Confusion - Same human nose confuses between different levels or types of odours
  - Subjectiveness - Same odour level gets different responses by different human noses
  - Acquaintance - Human nose gets acquainted to the smell very quickly
  - Errors - Incorrect determination of the true odour intensity
  - Disagreement - Different odour intensity reported by mill quality control and the consumers

Electronic (Artificial) Nose for Odour Monitoring

Innovative technology that mimics human olfaction system

- Precise and Accurate determination of odour intensity
- Uses chemical sensor array and pattern recognition modules to generate signal patterns
- Odour intensity is reported in terms of a numerical value and perceived as a global finger-print
- Values are reported accordance with ASTM E544 -99 12-point intensity scale
- Can be used to measure the odour intensity in wastewater, air and paper samples

In this study we used an Artificial Nose, specifically designed for monitoring odour intensity in pulp and paper mills

Treatment site

- The study was conducted in a twin-wire Kraft Paper mill based in South India.
- Manufactures Kraft paper using recycled wastepaper, with an overall capacity of more than 75,000 TPA.
- The mill operates throughout the year using recirculated wastewater
- High odour in the final product as well in the surroundings.
- The wastewater (back water) from the top and bottom layers is collected in the 'Back Water Tank' which is treated using a 'Clarifier' and the treated water is stored in a 'Treated Water Tank'
- The treated water is recirculated for pulping and pulp dilution for paper manufacture.

Materials and Methods

A combination of enzymatic antimicrobials and H_2S removal chemicals was used to control the odour

Bactosafe P and Enzytreat Pro

- Developed by testing various combinations of antimicrobial enzymes against the microbial flora (bacteria and fungi) isolated from Kraft paper mill wastewater

SulfoTreat P and SulfoTreat R

- SulfoTreat R (based on oxidizing agents) was used to remove the sulphides from the wastewater, while SulfoTreat P (based on SRB inhibitors) was used to prevent H_2S formation by sulphur reducing bacteria.

Dosing points

- **Treated water tank and Back water tank**

  Bactosafe P / Enzytreat Pro – 10 ppm

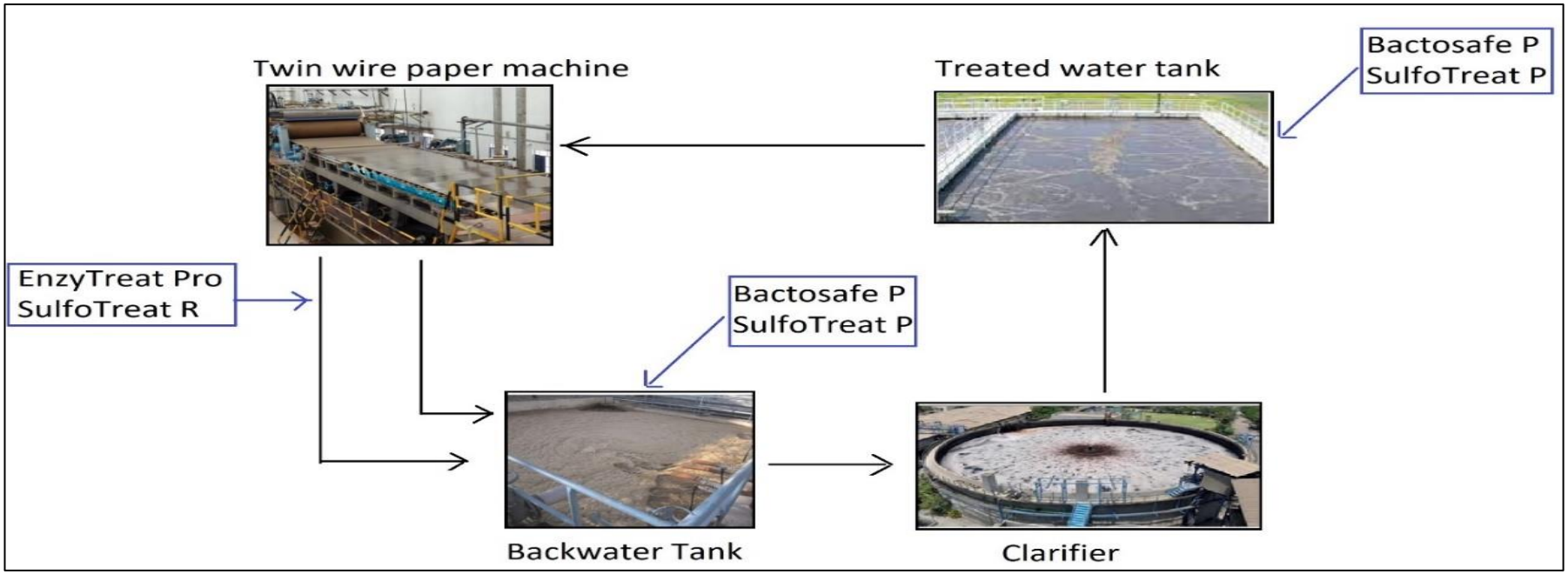
  (Either of the product runs for fortnight)

  SulfoTreat P - 10 ppm

- **Top Layer and Bottom Layer tray water**

  SulphoTreat R - 25 ppm

The dosing was done based on total volume of water present in the system



Monitoring and Analysis

- **The dosing was done continuously for a period of 3 months**
- **Chemical and microbial analysis of wastewater samples were caried out using standard microbiological, chemical and Gas Chromatography methods.**
  - Total Bacterial Count
  - Total Lactic Acid Bacteria Counts
  - COD, H_2S, Ammonia
  - Volatile acids, Lactic acid, Alcohols, Aldehydes, Acetates etc.
- **Odour analysis of wastewater, paper and air samples was done using the Electronic-Nose instrument**
- **The analysis was done in triplicates and the values reported in this paper are the average values.**

Effect on Microbial Load

- Before treatment, TBC and TLBC microbial counts were in the order of 10^7-10^8 CFU/mL.
- After 15 days of treatment, the counts were drastically reduced by more than 95%
- In the next 60-70 days, the bacterial counts were further reduced to 10^3-10^4 CFU/mL.
- The treatment resulted in very good reduction in bacterial growth.

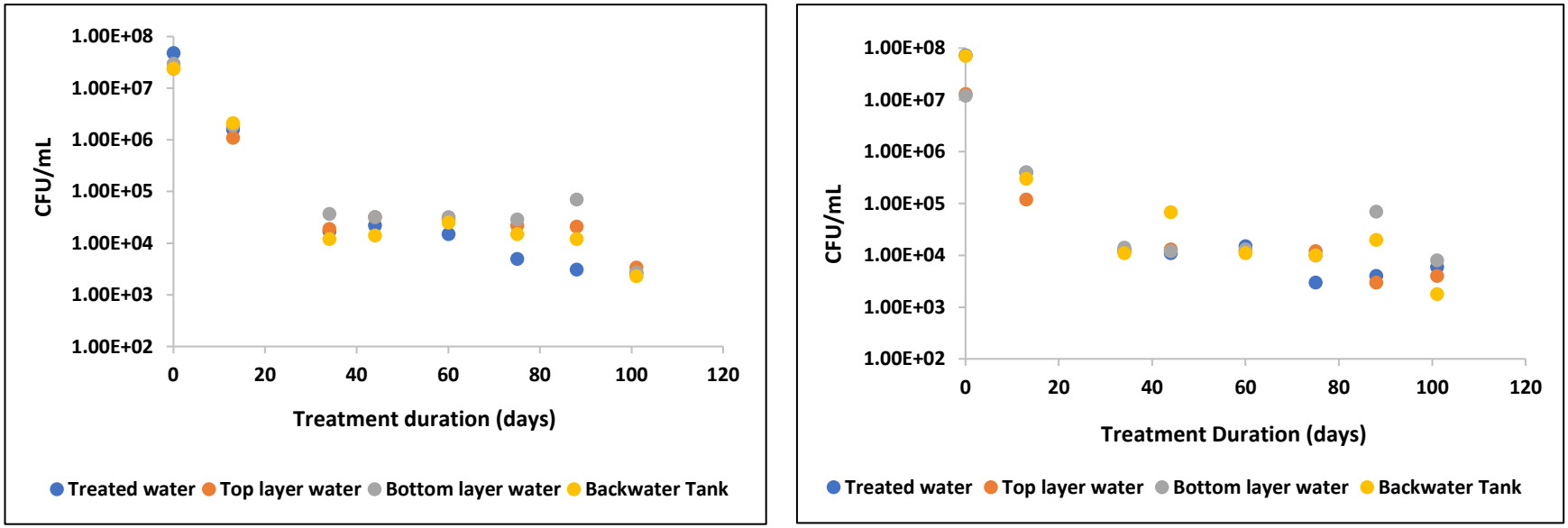
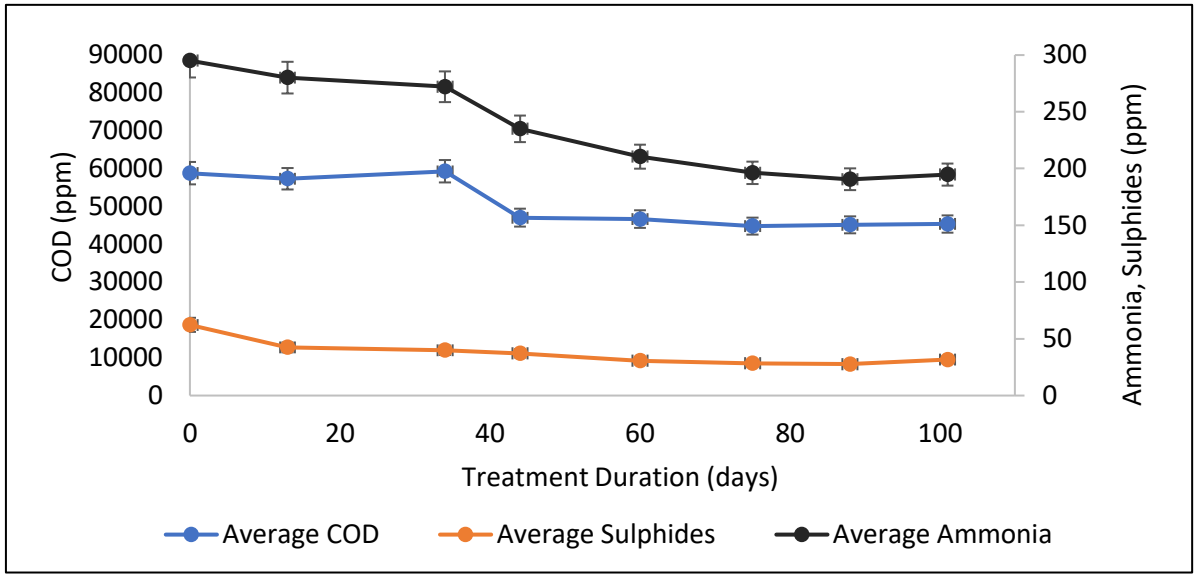


Figure (a) Total Bacterial Count (b) Total Lactic Acid Bacteria Count in different water samples during treatment

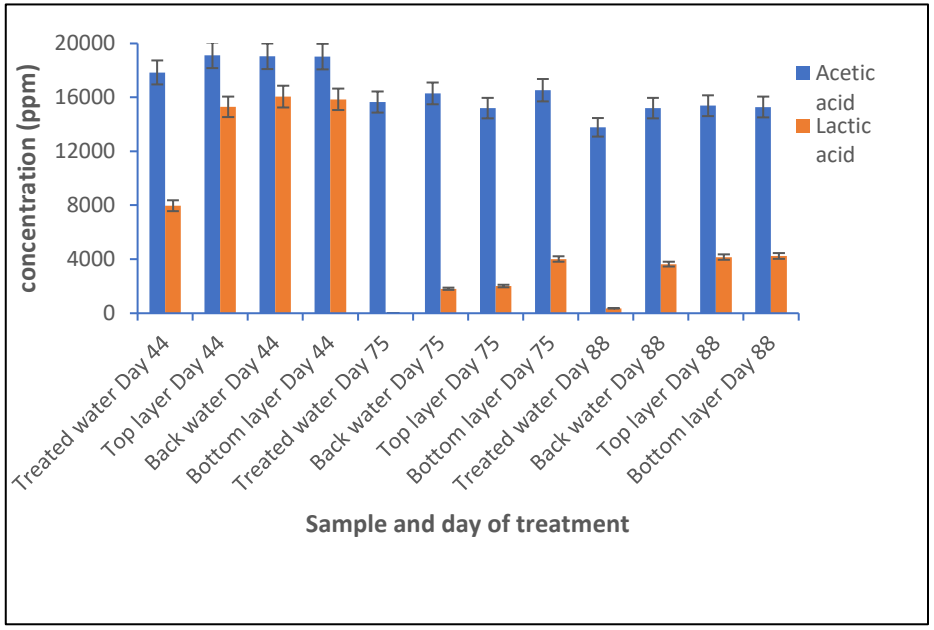
Effect on H2S, Ammonia and COD Levels

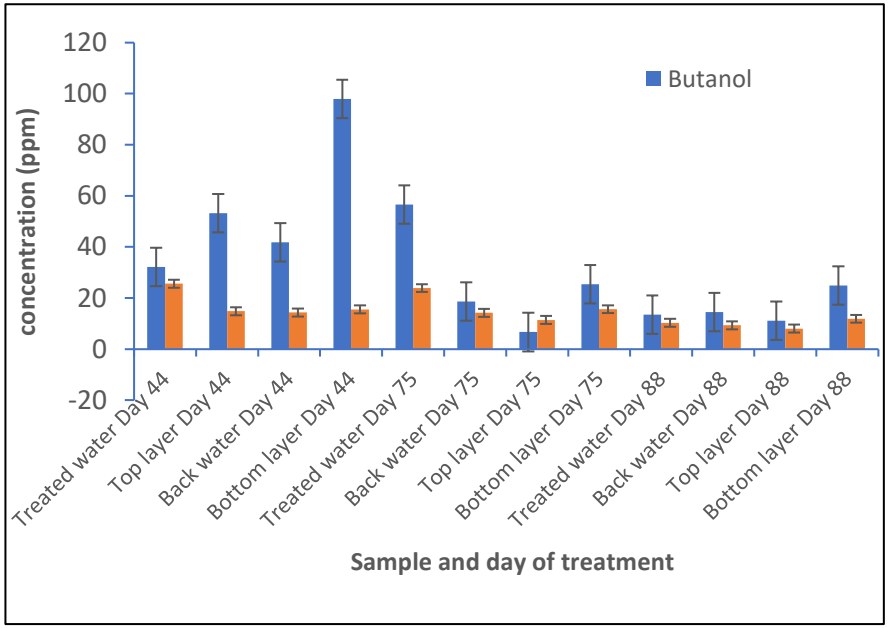


- **Substantial reduction in COD (20%), ammonia (20.3%) and sulphide (40.16%) within 30-40 days.**
- **After a period of 40-45 days, slow reduction in the sulphide and COD, while good reduction in ammonia continued for the next 60-70 days.**
- **Treatment inhibited the bacterial growth and metabolism resulting in lower accumulation of odour causing ammonia and sulphides.**
- **Since SulphoTreat R is formulated using oxidizing agents, a considerable drop in COD was also observed during the treatment.**

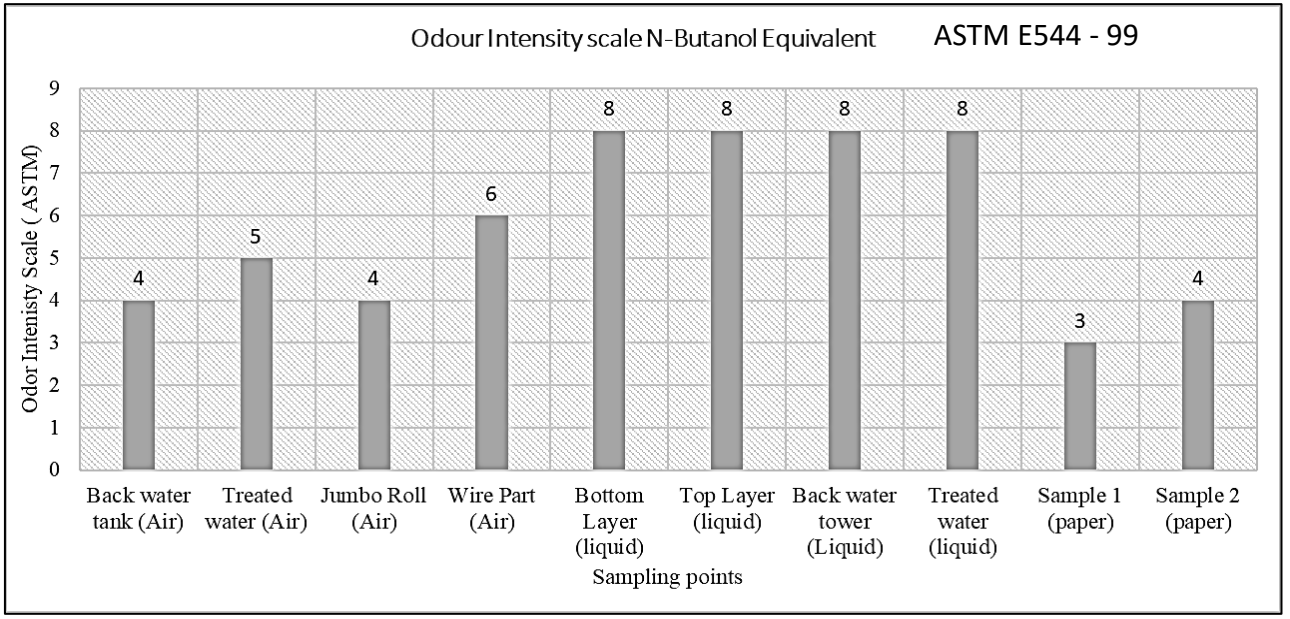
Effect on Organic Acid and Alcohol Levels

- A significant drop in acetic acid, lactic acid and alcohols like butanol and propanol
- Very high reduction (>90%) in lactic acid (from >15000 ppm before treatment)
- By 75th day, the lactic acid level in the treated water sample was almost nil, while in other samples it ranged between 1000-4000 ppm.
- The antimicrobial combinations had a very high inhibitory effect on lactic acid bacteria and other bacterial flora



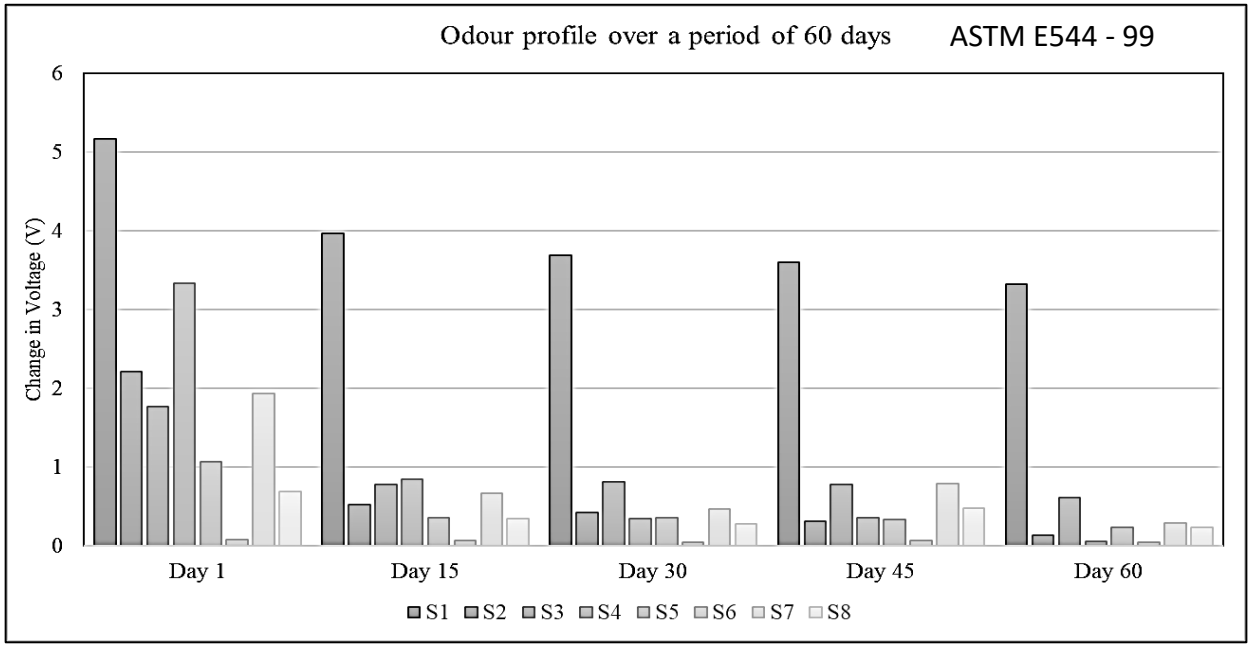


Effect on Odour Intensity



- **Based on the odour intensity of different sampling points, it was found that the treated water tank sample had maximum odour intensity**
- **High intensity of odour in treated water directly affects the obnoxious odour associated with of the paper (since the treated water was recycled back into the process).**
- **Hence, over a period of 60 days the odour profile of the treated water sampling was minutely studied with respect to its response to the treatment technique used.**

Effect on Odour Intensity



- **The electronic nose system is a sensor-based technology and S1 to S8 are various sensors employed for measurement of the odour intensity.**
- **The Y- axis represents the change in voltage, which is directly proportional the level of odourant concentrations**
- **It could be observed that there was linear fall in the overall odour intensity of the treated water, giving a positive affirmation that the remediation technique proposed was effective.**

Conclusions

- Treatment using Bactosafe P, Enzytreat Pro, and SulfoTreat effectively reduced the microbial load in the Kraft paper mill wastewater, as well as the COD, NH_3 and H_2S.
- The odour intensity measured by the electronic nose shows considerable reduction in odour levels, indicating that the treatment technique is providing satisfactory results
- However, the overall odour scenario at the industrial site was observed to be capricious
- A continuous measurement of odour intensity levels is needed to provide effective odour remediation technique
- Process fine tuning still going on to achieve complete smell free Kraft paper

Thank You

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