

# PROCEEDINGS

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# UNIDO's Initiatives for Productivity Enhancement, Energy Efficiency, Odour Control and Waste Water Management in Indian Pulp & Paper Industry



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## **About the Authors**

Dr. Rakesh Kumar Jain has over 35 years of R&D and industrial experience and currently working as Technical Expert with United Nations Industrial Development Organisation (UNIDO) New Delhi. Prior to his joining with UNIDO, he served as senior scientist and superannuated as Director, Central Pulp and Paper Research Institute after serving the Institute for more than 28 years. As a researcher and scientist he was engaged in the diversified areas such as chemical recovery, energy efficiency, environment including the water and waste water management, biotechnological applications, bioproducts and bio energy.

He holds a Master of Science, Ph.D in Chemistry with specialization in pulp and paper and credited with more than 150 research papers in reputed International and National Journals and presentations at international conferences, more than 100 technical reports, patents and 2 books. Also guided and supervised many students for the award of Ph.D., M.Tech and M.Sc students.

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### **Abstract:**

Achieving optimal operational efficiency is considered to be essential for the Indian paper industry as variances in production may raise the overhead costs and in turn, make it more difficult to stay competitive both in domestic and global markets. In order to achieve operational efficiency and to provide technical support to the Indian paper industry, the United Nations Industrial Development Organization (UNIDO) is currently implementing a project "Firm level demonstration of technologies and productivity enhancement for the pulp and paper industry" in cooperation with the Central Pulp and Paper Research Institute (CPPRI) as well as paper industry associations supported by the Department for Promotion of Industry and Internal Trade (DPIIT), Ministry of Commerce and Industry, Government of India.

The ongoing project aims to demonstrate the process improvement interventions through implementation of productivity enhancement measures (PEMs) adopting the manufacturing excellence tools and technical aspect of paper production processes as well as the pilot demonstration and applicability of the innovative identified technologies such as membrane filtration and  $\text{ClO}_2$  treatment based odour technology for waste water management and Black Liquor Heat Treatment for enhanced energy efficiency of chemical recovery system in agro based pulp and paper mills.

### **Productivity enhancement measures and Firm level demonstration of technologies for the Indian pulp and paper industry:**

The overall objective of the project is to enhance the productivity and competitiveness of the Indian pulp and paper industry. To achieve this objective, the project aims to demonstrate process improvement interventions as well as the applicability of the identified innovative technologies (membrane filtration, odour control and liquor heat treatment technologies) in Indian paper mills spread across the country and using different types of raw materials (i.e., wood, agro-residues and recycled fibre). This is expected to facilitate technology uptake and firm-level innovation, with high potential for productivity enhancement and replication among other players in the sector leading to increased productivity and competitiveness.

### **Process optimization and productivity enhancement measures (PEMs):**

The Indian paper industry is under tremendous pressure with a focus on cost reduction, quality improvement, value addition and customer satisfaction which are essential for enhancing the competitiveness of the sector. Cognizant points out that for an operation to be successful, it is necessary to understand how process optimizations, equipments and technologies could help in improving the existing operations.

The activities under the project involved assessment of performance of the identified paper mill located at across the country. This enabled the identification and implementation of measures under short term and medium term category being implemented in relatively short time framework and not requiring much capital investment

#### **1) Adoption of appropriate manufacturing excellence tools (such as Kaizen, 5S, TQM, etc.)**

The implementation of the productivity enhancement measures activity is being implemented in close coordination with National productivity Council (NPC) to work together to promote

manufacturing excellence tools for productivity enhancement in pulp and paper mills in India.

The activities involved conducting audit of selected paper mills to identify areas of improvement, followed by the implementation of the recommended measures, focusing on the implementation of appropriate manufacturing excellence approaches such as Kaizen, 5S, TQM which resulted in increased productivity and efficiency of production., etc. The activities had been carried out in 3 identified paper mills (Gujarat, Uttar Pradesh and Odisha) and significant benefits have been accrued post intervention in terms of process efficiency, productivity and energy efficiency besides work place improvement.

## **2) Optimization of process parameters pertaining to technical aspects of paper production - Development of Audit tool:**

An audit tool template has been prepared for the assessment of selected paper mills. Efforts have been made to finalize the tool/ template to ensure that the audit tool cover key aspects of the paper production in Indian paper mills and KPIs focuses on the key efficiency and productivity-related parameters and in line with the international best practice. The digitalization of the audit tool is also being worked upon for ease-of-use across Indian paper mills.

## **Pilot demonstration of Advanced technologies for waste water treatment and management: UNIDO's Innovative approach.**

In light of the stricter legislations being imposed by the regulatory authorities, and attempts to reduce consumption of fresh water and waste water discharge, Indian paper industry faced various issues and challenges such as build up of detrimental substances in process water having adverse impact on the productivity, quality and overall process efficiency of paper mills.

In order to address the above said challenges, membrane filtration technologies and  $\text{ClO}_2$  treatment technology for odour control have been identified as potential best available technology (BAT) options relevant in Indian context.

### **Membrane filtration technologies in pulp and paper industry :**

Membrane Filtration process has been identified to be an emerging option for the treatment of waste water in Indian paper industry facilitating possibilities to reduce consumption of fresh water and waste water discharge maximising the possibilities for recycling and reused of treated process water with benefit of high level contaminants removal (TDS, TSS, COD and colour etc).

The pilot plant consisting of an appropriate configuration of membranes ( Hollow UF submerged membranes in combination of NF of appropriate pore size) has been designed based on pre-pilot plant experimentation carried out in close coordination with CPPRI and consultation with international experts. The basic approach being adopted in the current pilot demonstration involves at-source reduction of pollutants and their recovery as value added by-products followed by end-of-pipe treatment of the identified waste water streams ( Paper machine back water, final discharge effluent and alkali extraction bleach effluent stream, wherever applicable) facilitating the techno-economic feasibility of the process.

The results of the preliminary experiments conducted on smaller size pilot and pre-pilot plant with identified membrane configuration have been quite encouraging in respect of reduction of SS (100%), TDS ( 70-75%) , COD ( 85-90%) and colour (85-90%).

The demonstration of the technology with customised membrane configuration in identified paper units across country would help in establishing the techno economic feasibility of the membrane filtration process besides confidence building among the paper mill across country for adaptation and replication of the membrane filtration technology at large.

### **Odour Control Technology:**

Tighter limitations being placed on fresh water use and trends towards zero liquid discharge, the RCF based paper mills are faced with several challenges related to odour coupled with increased slime causing serious concerns related to foul smell in the finished paper product as well as of paper breaks due to the formation of excessive slime in the paper machine. Bacterial colonies both aerobic and anaerobic (in dead spots of the system) grow at any point in the paper machine white water loop (Head box, wire part, broke chest and fiber recovery system) causing odour and slime formation.

Microbial colonies after break off attach to the paper sheet, appears as a holes, specks, spots and weaken the paper sheet causing frequent paper breaks, thus productivity losses. The odorous substances adversely affect the product quality resulting in quality complaints and reduced revenue

Conventional biocides or its cocktails being practiced in Indian paper industry are found to have limited efficacies to address the serious issues related to foul odour and its associated challenges. Under the ongoing project, an innovative approach has been adopted which involves the application of Chlorine dioxide ( $\text{ClO}_2$ ), a broad-spectrum and ecologically compatible biocide, which has proved to be an potential treatment option to address the issue of odour in paper produced in the paper mills using recycled waste paper as a major raw material. The application of this technology has been successfully demonstrated and implemented at one of the paper mill in south in cooperation with an international technology supplier and the analysis support from expert R&D Institution. The effectiveness of  $\text{ClO}_2$  treatment in controlling the microbial growth was evidenced by the reduction in microbial counts (both anaerobes and aerobes) which were reduced from a population range of  $10^7$  to less than  $10^3$  (more than 99.9%) with significant reduction in VFA in process water and finished paper.

Successful demonstration and implementation of the  $\text{ClO}_2$  treatment technology indicated the current option as a techno economically viable odour-control solutions with positive impacts on product quality and overall productivity. The technology has been replicated and implemented in other paper mills. Due to the effectiveness of the technology combined with its fiscal feasibility, the technology has received an impressive response for adoption by the mills across India. The technology adoption would help these paper mill to improve quality, productivity, environmental health and export potential while helping to enhance sustainability and competitiveness of the Indian paper industry.

The project interventions which basically involves demonstration of process improvement interventions through productivity enhancement measures as well as the applicability of the aforementioned technologies are expected to support the Indian paper industry in improving product quality, productivity and process and resource efficiency; increased water recycling and reduced freshwater consumption and wastewater discharge and ability to meet stringent discharge norms prescribed by regulatory authorities. These interventions are expected to facilitate technology uptake and firm-level innovation, leading to increased productivity and competitiveness of the industry.

The technical paper cover and share the findings of the project interventions through presentation during the conference based on the activities undertaken in the area of productivity improvement,

membrane filtration and odour control technology being implemented in the Indian paper mills located in major paper clusters across country.

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