

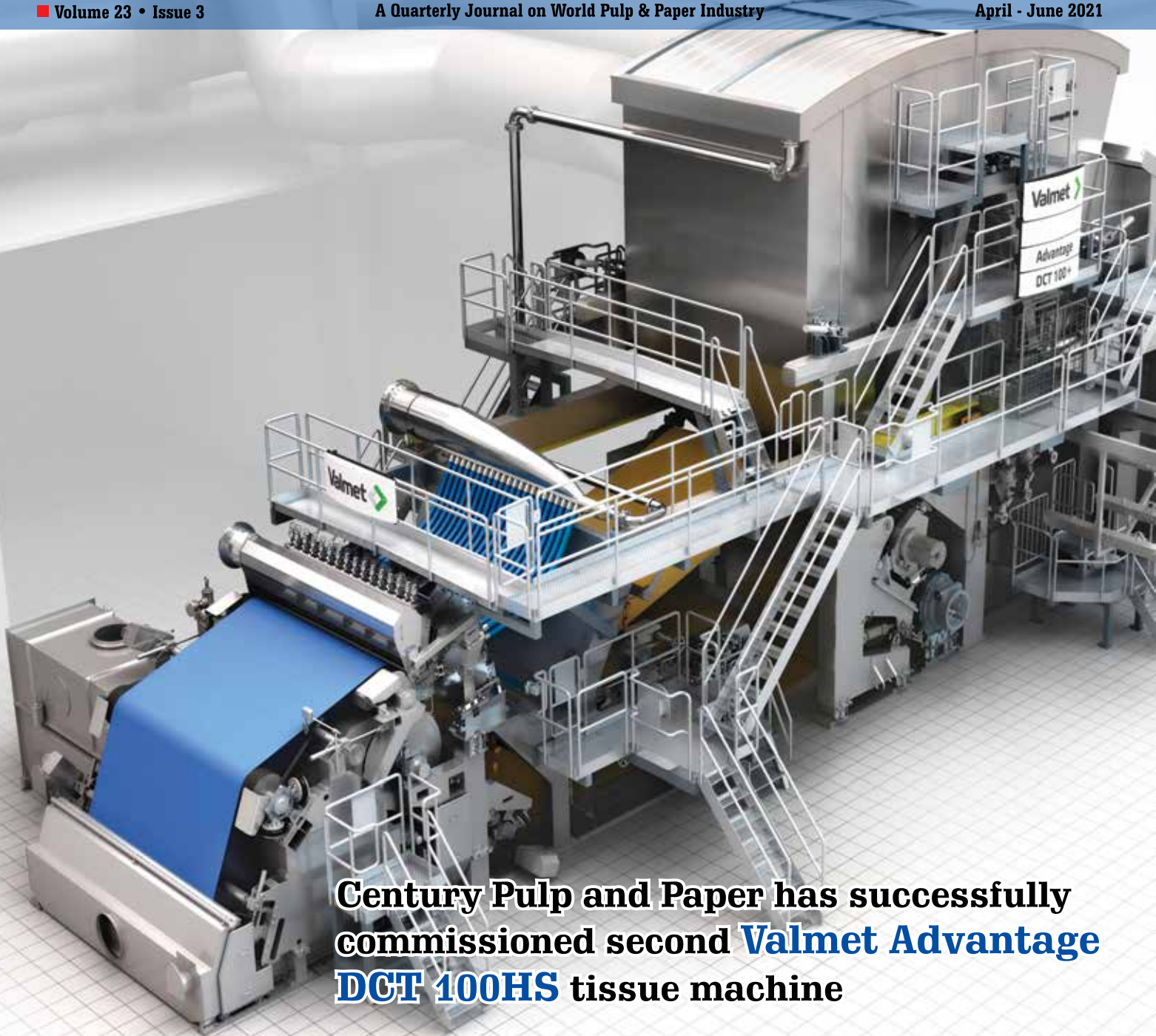
IN PAPER

I N T E R N A T I O N A L

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Enhancing competitiveness in the Indian pulp and paper industry through productivity and innovation: UNIDO's approach



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Abstract

The United Nations Industrial Development Organization (UNIDO) works with the Government of India to promote inclusive and sustainable industrial development (ISID). This is aimed at making factories forward looking and addressing the challenges of the 21st century head on, by quality goods and services that are sought after by consumers and valued in the market, meeting – and where possible exceeding – environment, energy and climate challenges, and providing decent employment and being a good neighbour to communities. Most recently, the Department for Promotion of Industry and Internal Trade (DPIIT), under Ministry of Commerce and Industry, agreed on Facility for International Cooperation on Inclusive and Sustainable Industrial Development to promote best practices and techniques and facilitate partnerships for their implementation. Pulp and paper industry is among the current target sectors for support. UNIDO's project for the Indian paper industry focuses on facilitating the demonstration of process improvement interventions as well as the applicability of two innovative technologies (membrane filtration and liquor heat treatment), with the objective of facilitating technology and firm-level innovation, leading to increased productivity and competitiveness, conservation of fibre, water and energy and reduction of effluents and waste.

Introduction

Industry scenario

India is the 4th largest producer of pulp and paper and accounts for around 4% of global production. There are more than 500 operational paper units producing around 20 million tonnes per annum of paper, paper board and newsprints against an installed capacity of around 27 million tonnes per annum, using recycled waste paper, agro-residues and wood, including small quantities of imported wood pulp, as raw materials. India is also the fastest growing pulp and paper market in the world, with an average growth rate of around 6% per annum. The industry creates around 6 lakhs jobs directly and 15 lakhs jobs indirectly, contributes 1.1% to total manufacturing value, 1.8% of manufacturing jobs and 0.6% of manufactured exports. The sector is significant to the national economy.

While the demand for paper is growing

considerably, there are several supply-related challenges to be overcome by the industry. These include, inter alia, limited availability of good quality raw materials, high cost of basic inputs, use of traditional technology, limited resource efficiency and the need for efficient internal water handling, solid waste disposal and effluent treatment. For what is considered to be a resource-intensive and polluting industry, the paper industry requires support towards increased production and operational efficiency, adoption of cleaner production processes and sustainable environmental management, to remain competitive and become sustainable.

UNIDO's Interventions and technical support for the Indian paper industry

UNIDO has been supporting the Indian pulp and paper industry by facilitating exposure to, and adoption of, global best practices and best available technologies.

The overall objective is to strengthen the productivity and sustainability of the industry, and therefore, its competitive position in domestic and international market.

UNIDO has adopted a “meso-to-micro” approach in supporting the industry. UNIDO has previously completed a project titled ‘Development, transfer and adoption of appropriate technologies for enhancing productivity in the paper and pulp industry’ (2015-2018) aimed at strengthening the capacity and capabilities of the nodal technical institution for the Indian pulp and paper industry, the Central Pulp and Paper Research Institute (CPPRI), and industry associations to provide better technical and management support to paper mills. Based on a detailed diagnostic assessment of the industry, the project facilitated the bench-

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level demonstration of three technologies pertinent to the industry: membrane filtration, black liquor heat treatment and ozone bleaching. This was further supported by knowledge dissemination workshops, study tours, fellowship training programmes and twinning with international organizations for the beneficiary institutions. The technology transfer initiatives of the project were able to establish and optimize some technical process parameters as a foundation towards the subsequent adoption of the aforementioned technologies for mill level demonstration and commercialization. The project's capacity building activities provided the beneficiary institutions with exposure to the latest technological developments from across the globe, including the concept of bio refinery and the application of nano and micro fibrillated cellulose and lignin based value-added by-products for diversified industrial applications. These interventions significantly increased the knowledge base and innovative R&D activities, institutional linkages, and ability to meet the needs of the industry.

Building on this strengthened meso-level capacity, UNIDO is currently implementing a project titled 'Firm-level demonstration of technologies and productivity enhancement for the pulp and paper industry'. This current project, supported by DPIIT, comprises various mill-level interventions, to be implemented in close cooperation with CPPRI and paper industry associations at national as well as regional levels.

Firm level demonstration of technologies and productivity enhancement for the Indian pulp and paper industry - Project Highlights:

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 two innovative technologies (membrane filtration and liquor heat treatment, as identified in the predecessor project) 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 and firm-level innovation, leading to increased

productivity and competitiveness, conservation of fibre, water and energy and reduction of effluents and waste.

The firm-level interventions of the project are focused on two broad areas: (i) process optimization and productivity enhancement measures (PEMs) and (ii) pilot demonstration of new technologies (Membrane filtration technology and Liquor heat treatment technology) with high potential for productivity enhancement and replication among pulp and paper mills.

i. Productivity enhancement measures (PEMs):

There is immense potential for Indian paper mills, especially the micro, small and medium-sized enterprises (MSMEs) to achieve minimisation of costs, optimisation of quality and maximisation of resource efficiency as the basis of competitiveness in domestic and global markets. Given the nature and scale of operations of a majority of units, it is imperative that manufacturers make the most of limited resources and maximise output with minimal quality variances. In such a context, UNIDO aims to demonstrate 'productivity enhancement measures (PEMs)' pertaining to the technical aspects of paper production, as well as the adoption of manufacturing excellence tools (such as 5S, Kaizen and TQM approaches).

The project aims to work with 13 selected paper mills (spread across 4 paper industry clusters, and using different raw materials) towards the identification and implementation of measures under short-term and medium-term categories, which can be implemented in a relatively shorter time frame and not requiring high capital investment, if at all.

The PEMs pertaining to the technical aspects of paper production would cover optimization of various aspects of the different sub-processes in paper manufacturing such as raw material preparation and handling, pulping, bleaching, stock preparation, papermaking, and chemical recovery, among others. From the manufacturing excellence point of view, lean manufacturing tools for e.g., 5S, Kaizen, Total

Quality Management and adoption of quality circles, as relevant for productivity enhancement in Indian pulp and paper mills are being considered. These selected mills would be demonstration sites for dissemination to other paper mills for subsequent adoption.

Under the project, an audit tool covering key processes, sub-processes and key equipment/machineries of pulp and paper production has been prepared in close cooperation with a team of international experts and CPPRI. The audit tool covers key aspects of the Indian process conditions and KPIs focus on the key efficiency and productivity-related parameters and in line with international best practices.

The implementation of the productivity enhancement measures pertaining to manufacturing excellence tools is being carried out in close coordination with National Productivity Council (NPC), India. Experts from NPC have been working with three selected paper mills (in Gujarat, Uttar Pradesh and Odisha) to audit operations and identify areas of improvement that would result in increased productivity and efficiency. Quality Circles (QC) have been formed in the selected mills, to facilitate detailed data collection, problem identification and joint problem-solving in three areas, respectively workplace improvement, energy saving and productivity improvement. The experts have been conducting virtual training sessions for the nominated quality circles covering the QC approach, different tools and the process of collaborative solution-generation.

ii. Pilot demonstration of two advanced technologies:

Under the project, pilot demonstration units (PDUs) for each of the two identified technologies are being designed, developed and operationalized in paper mills (including trials, optimization of the process parameters, continuous operations under stabilized conditions and

validation of the results) to show the techno-economic feasibility of adoption in the Indian context as well as support local supply and manufacturing of customized equipment.

(a) Membrane filtration technology:

One of the major challenges faced by the Indian paper industry is the need to reduce freshwater consumption, close up the back water system and increase recycling of process water and recovery of fibre. Whilst attempting to recycle and reuse process water, paper mills are faced with issues pertaining to the build-up of detrimental substances in white water which are responsible for paper breaks and shutdowns for cleaning.

Membrane technology in the Indian paper industry has emerged as a potential option to optimise loop closure and therefore help to reduce fresh water intake and waste water treatment as well. The adoption of this technology facilitates reductions in total suspended solids (TSS), colour, total dissolved solids (TDS), chemical oxygen demand (COD) and other pollutants, thereby maximising the scope for recycling and reuse of treated waste water. Besides these, some added advantages are improved product quality because of decreased pollution loads of loop water, re-use of treated effluents in production, recovery of valuable fibre, fines and inorganic components and minimizing environmental impact because of improved quality of effluents. The technology simultaneously facilitates a high level of contaminant removal, reduced space requirements and lower energy consumption.

(b) Black liquor heat treatment technology:

Processing of agro-residue black liquor during chemical recovery operations is difficult on account of its high viscosity due to presence of extensive

lignin carbohydrate complexes generated during the pulping processes. During evaporation of agro residue black liquors, high viscosity at low solids level results in inefficient operations of recovery boiler. Black liquor heat treatment technology aims to reduce the viscosity of black liquor generated from agro-residue based paper mills (i.e., bagasse, wheat straw or a mixture), enabling black-liquor firing in recovery furnace at higher dry-solids' concentration resulting in enhanced steam generation. This would facilitate achieving greater energy and chemical recovery efficiency, as well as reduced emissions in the chemical recovery system

UNIDO's approach on Pilot Demonstrations

(a) Pilot Demonstration of Membrane Filtration process:

One of the activities under this project is to demonstrate membrane filtration technology at the pilot level in paper units (including units of different sizes and using different raw materials), located in paper clusters across the country. The basic aim is to customise the technology to the Indian context and to demonstrate the techno-economic feasibility and building industry-wide confidence in the adoption of the membrane technology. This would subsequently support the paper industry in meeting the aforementioned environmental challenges.

The basic approach being adopted in the current demonstration of the process is to facilitate at-source reduction of the pollutants and their recovery as value-added products, followed by the end-of-pipe treatment of the waste streams to enhance the techno-economic feasibility and sustainability of the membrane filtration process. The main targeted waste water streams include the paper machine white water (clear filtrate), alkali extraction bleach stream and

secondary ETP overflow as per specific requirements of different mills.

Based on assessments of available membrane filtration technology options suitable for the Indian context, in discussion with CPPRI and Indian paper mills, it has been preliminarily found that improved paper machine runnability and efficiency is achievable through the use of an appropriate submerged Ultra Filtration (UF) configuration, operated on a continuous basis in agro and recycled waste paper-based mills. This approach allows for mills to produce a permeate water stream almost free of suspended substances (fibres/fines, inorganic chemicals and stickies). This UF treated water obtained as a permeate stream therefore has the potential to be used as replacement of fresh water in the showers and other applications thereby achieving major savings in water usage. Thus, the adoption of the identified configuration of ultrafiltration process in paper machine white water treatment may have several benefits for the mill, such as lower fresh water consumption, higher process temperature, increased drainage and web dryness in the press section requiring less drying energy, reduction of fresh water costs and effluent discharge costs and increased waste water treatment plant efficiency due to lower hydraulic load.

Water pollution problems in the pulp and paper industry (for wood and agro-based mills producing bleached variety of paper) originate largely from bleach plants. The two most harmful bleach plant effluent streams are the chlorination and alkali extraction stage effluents in these category of paper mills. The alkali extraction stage effluent from the pulp bleach plant is very suitable for membrane use due to low volume and higher load of high molecular weight materials including colour (more than 50% colour while only 5% volume). It



Save-all outlet from paper machine and feed to ultrafiltration (left) and filtrate (permeate) of ultra-filtration (right).



Paper machine back water fed to UF and reject to be recycled back in wet end operations.

carries over 80% of total colour, 30% of BOD and 60% of COD of the total load from a bleaching plant.

The combination of a submerged UF system with the Nanofiltration would help in the significant reductions in colour, COD and TDS.

The concentrate may then be burned in the recovery boiler since it would have very little chloride content and good calorific value, helping significant reduction of pollutants at source and reduced load on the ETP. Ultrafiltration does not retain salts and, therefore, chloride build up will restrict the reuse of water. Also, there are some residual colours which limits the reuse of water. However, a NF/RO system can be employed to further polish the permeate for water reuse.

Thus, a combination of submerged UF in combination with NF seems to be a promising option for water recycling in pulp

and paper industry, with a need to demonstrate the feasibility of this option. In addition, the issue of high TDS present in pre-treated effluents of the paper and board mills producing unbleached variety of paper (RCF-based mills) may also be addressed through the technology demonstration, since recovery rates and treatment costs are interconnected.

(b) Pilot demonstration of Black liquor heat treatment technology:

Under the project, a pilot demonstration unit with a capacity of around 15m³/day of black liquor is being designed and fabricated, which is to be installed, commissioned and run in identified paper units (including units of different sizes, predominantly using agro-residues as a raw material), located in paper clusters across India. It is expected that the customization of the technology

to the Indian context and demonstration of the techno-economic feasibility of the LHT process would build industry-wide confidence in its adoption, and subsequently support the paper industry in meeting the challenges mentioned in the previous section. UNIDO is currently working towards the fabrication of this pilot unit with an identified technology supplier and will soon initiate trials in an operational environment.

Conclusion

The various interventions under the project 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. The adoption of these technologies is aligned with various schemes of the Government of India, such as the 'Swachh Bharat Mission' (i.e., Clean India Mission) as well as the National Mission for Clean Ganga.

Acknowledgement

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Ultrafiltration + Nano Filtration of Alkali Extraction stream.