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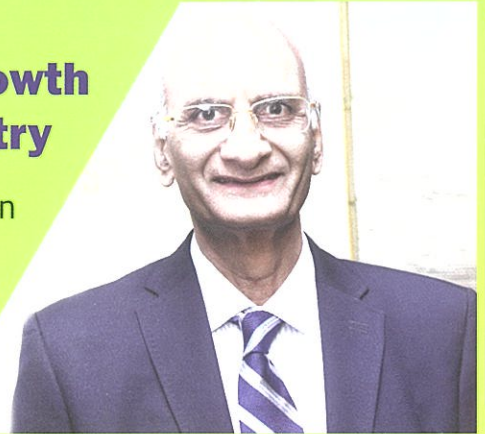
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Challenges Confronting the Growth of the Indian Paper Industry

- K.S. Kasi Viswanathan



Paperex ISSUE

Industry Captains on Sustainability of Paper Industry.....12



Bindlas Duplex a trend setter in Eco-friendly Paper Manufacturing

- Pankaj Agarwal.....53



Parason setting milestones in technology development

- Shekhar Desarda.....56



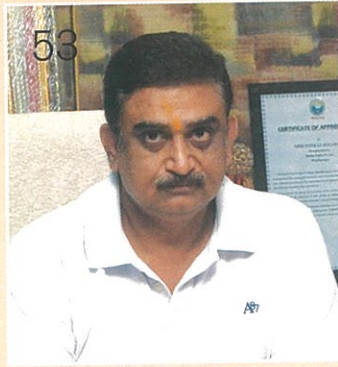
UNIDO-Partner in Inclusive & Sustainable Development of Indian Industries

- René Van Berkel.....63

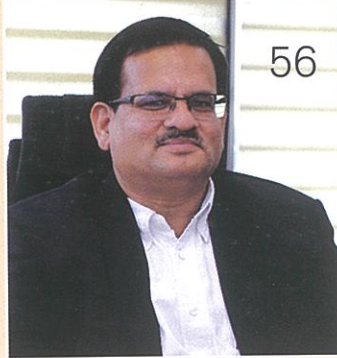


MLM Striding towards value addition

- Vinay Jain.....66



Bindlas Duplux a trend setter in Eco-friendly Paper Manufacturing
– Pankaj Agarwal



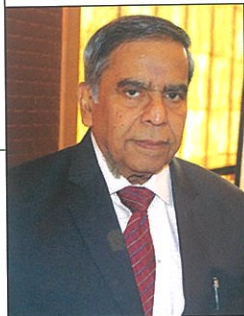
Parason setting milestones in technology development
– Shekhar Desarda



UNIDO–Partner in Inclusive & Sustainable Development of Indian Industries
– René Van Berkel



MLM Striding towards value addition
– Vinay Jain



MILL PROFILE

68 - 70

Seshasayee Paper and Board - Marching to New Images
– N. Gopalratnam



PEER REVIEWED

71 - 77

Membrane Technology as an Option for enhancing Wastewater Recycling in Agro Based Pulp & Paper Mills

- Abhishek Tyagi, Scientist, Nitin Endlay, Scientist, S. Mishra, Scientist, M. K. Gupta, Director and B.P. Thapliyal, Ex-Director, Central Pulp & Paper Research Institute (CPPRI), Saharanpur-247001, Uttar Pradesh, India.

ENERGY EFFICIENCY

78 - 81

Sustainability through Energy Efficiency and GHG reduction

- Dr. B.P. Thapliyal, Secretary General, IARPMA, and Former Director, CPPRI, India



TECH WATCH

82 - 92

Indian Paper Industry – Innovative and Efficient Solutions

- K. Rajkumar B.E., CEO, Tectehtron India, Chennai, India and Former Group Advisor & Vice President, Sripathi Papers & Boards Pvt. Ltd.

BTG Solutions help mills offset their increasing energy costs

- Suresh Balasubramaniam, Country Manager, BTG Instruments, A Voith Company, Begumpet, Hyderabad, India

A Status Review of Utilization of Proven Advance Process Control Technology in Kraft Process

- Adam Melton, Global Sales Director, Process Solutions, BTG Group, USA and Akhlesh Mathur, ASPAC Fiber Segment & SEA Sales Director, BTG Group, Singapore.



INNOVATIVE TECHNOLOGY

93 - 95

Building competitiveness of the Indian Paper Industry through Productivity and Innovation

- Dr. Rakesh Kumar Jain, Shradha Srikant, United Nations Industrial Development Organization (UNIDO), New Delhi, India. and Farrukh Alimdjano, United Nations Industrial Development Organization (UNIDO), Vienna, Austria.

SPECIAL REPORT

96 - 97

Year in Review: Chinese Tissue Paper Industry in 2021

- China National Household Paper Industry Association (CNHPIA)

INDUSTRY WATCH

98 - 99

Technological Challenges & Opportunities in Indian Corrugation Industry

- Raghavendra Hebbar, Head of Technology & Development, and Ashish Chourasia, Project Engineer, JK Paper Ltd., India.

NEW TECHNOLOGY

100 - 102

New Trends in Corrugation & Requirements of Container Grades in view of Growing E-commerce

- Dr. Shivamurthy Modgi, Domtar-Packaging Mill, Kingsport, Tennessee, USA.

A Step towards Sustainability: Aqueous Barrier Coatings

- Raghavendra Hebbar, Head of Technology & Development, and Ashish Chourasia, Project Engineer, JK Paper Ltd., India.

COUNTRY NEWS

108 - 110

- ABB completes remote commissioning of new actuator....
- Valmet to supply new Intellijet V hydraulic headbox....
- Evernew Papers Started commercial production at its....
- Gloris Papers commenced Absorbent Kraft Paper....
- JK Paper looks to export 20% from new packaging....
- ANDRITZ successfully starts up a new HERB recovery....

AROUND THE GLOBE

111 - 113

- Voith's new QualiFlex QView press sleeve reduces....
- Paper One Show 2022 achieved its goals
- Andritz paper technology sets new standards in....
- Metsä Fibre and Veolia conclude long-term partner....
- AFT supplying POMix stock processors for new Pratt....
- BTG to supply Industry 4.0 solutions package to....

UPCOMING EVENTS

115

UNIDO – Partner in Inclusive & Sustainable Development of Indian Industries

The United Nations Industrial Development Organization is a specialized agency of the United Nations that assists countries in economic and industrial development. In an exclusive interview to **Inpaper International**, **Dr. René Van Berkel**, **UNIDO Representative and Head, Regional Office in India**, unveils UNIDO activities in Indian Paper Industry.



Dr. René Van Berkel, *UNIDO Representative and Head, Regional Office in India.*

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It is important to note that UNIDO’s interventions for the Indian paper industry are based on a detailed diagnostic assessment of shopfloor operations, conducted during 2015-2016. This has been found that Indian paper mills have succeeded to steadily increase capacity and adopt incremental technology modifications to meet regulatory requirements.
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The United Nations Industrial Development Organization (UNIDO) works with the Government of India, industry and other stakeholders to promote inclusive and sustainable industrial development (ISID) for Indian Industries. Paper industry is one of the major segments where UNIDO is undertaking developmental activities in collaboration with Industry Associations. Can you please elucidate the major activities undertaken by the UNIDO in Indian Paper Industry?

UNIDO has been working with the Indian pulp and paper sector since 2015 through technical cooperation projects being implemented with the support of the Department for Promotion of Industry and Internal Trade (DPIIT), Government of India. Between 2015 and 2018, UNIDO implemented a project titled ‘Development and adoption

of appropriate technologies for enhancing productivity in the Indian pulp and paper sector’, which focused on strengthening the meso-level infrastructure of the Indian paper industry, i.e., the nodal technical institute – the Central Pulp and Paper Research Institute (CPPRI) and four national level industry associations, to support them in providing technical and management support to paper mills in line with industry best practices. This project included a diagnostic assessment of the Indian paper industry, bench-level demonstrations for 3 innovative technologies (membrane filtration, black liquor heat treatment and ozone bleaching) as well as capacity building for these aforementioned institutions.

Building on the achievements of this first project, UNIDO is currently implementing a project titled ‘Firm-level demonstration of technologies and

productivity enhancement for the pulp and paper industry' since 2019, which is also financially supported by the DPIIT. This project comprises various mill-level interventions that are implemented in close cooperation with CPPRI and industry associations. This project demonstrates process improvement interventions as well as the applicability of two innovative technologies (membrane filtration and liquor heat treatment) in Indian paper mills located in major industry clusters 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, leading to increased productivity and competitiveness and reduced environmental impacts and energy use.

In addition, UNIDO is also implementing a project funded by the Global Environment Facility (GEF) titled 'Promoting Energy Efficiency and Renewable Energy in Selected MSME Clusters in India'. This project is being implemented along with Ministry of MSME and Energy Efficiency Services Limited (EESL). This project aims to standardize replicable energy efficiency technologies by cluster, bulk procure these and implement these through energy service contracting. The paper cluster in Muzaffarnagar is included with focus on energy efficiency vacuum pumps and agitators.

These interventions are aimed at supporting firms, especially MSMEs, to adopt technologies and production processes that improve economic competitiveness of firms, improve resource efficiency and reduce pollution loads, in line with the tenets of inclusive and sustainable industrial development (ISID). These efforts are further supported by the DPIIT-UNIDO Facility for International Cooperation for Inclusive and Sustainable Industrial Development (FIC-ISID) to further amplify the reach and impact of project interventions and foster partnerships for widespread replication of proven interventions.

Indian Paper Industry is categorized in three segments on the basis of the usage of raw materials such as Agro residues, Waste Paper and Wood for producing various grades of paper and paper board. Since UNIDO is presently undertaking various projects with an aim to promote the Indian paper industry by facilitating exposure to best global practices and

best technologies, we understand that you must have interacted closely with the industry. Can you please narrate the merits and demerits of Indian Paper Industry?

Indeed, UNIDO's ongoing project, that focuses on firm-level demonstration of technologies and productivity enhancement measures aims to work with a wide cross-section of paper mills. The demonstrations are planned to be carried out in mills using all types of raw material (agro residues, recycled fibre and wood), of different sizes and located in different parts of the country (in the major paper industry clusters in the North, South, East and West). Doing so allows the demonstration of innovative technologies and best practices in varying operational conditions, raw material mixes and paper products.

It is important to note that UNIDO's interventions for the Indian paper industry are based on a detailed diagnostic assessment of shopfloor operations, conducted during 2015-2016. This has been found that Indian paper mills have succeeded to steadily increase capacity and adopt incremental technology modifications to meet regulatory requirements. However, from an operational perspective, it was observed that there was significant scope for improvement by adopting best practices in areas such as raw material handling and its storage (need for sheltered storage with hard flooring, sorting of raw materials, transportation in compact bails); improved efficiency/yield in pulping and bleaching (through extended modified cooking, efficient drum pulpers and phasing out of elemental chlorine with the use of ECF bleaching sequences); improved internal process water handling (through fibre and filler recovery, treatment of white water, use of kidney technology); and measures for effective effluent treatment (through technologies such as membrane filtration to reduce pollution loads (at source and end-of-pipe treatment for increased water recycling and reduced freshwater consumption). All of these measures can significantly improve product quality and reduce production costs and environmental impacts.

Major issues confronting India's pulp and paper industry are high cost of production caused by inadequate availability and high cost of raw materials and chemicals, increasing power cost, uneconomical plant size, technological obsolescence, etc. What

are UNIDO's suggestions to overcome all these growth obstacles and how Indian Paper Industry can achieve maximum resource efficiency?

India is among the world's fastest growing pulp and paper markets. 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 chemicals and energy, traditional technology, among others.

Therefore, it is critical for Indian paper mills to adopt innovative, energy and resource efficient technologies and implement productivity enhancement measures that enable mills to minimise production costs, reduce waste generation, maximise value-added output for the inputs used (i.e., increased resource efficiency) and reduce pollution intensity (and therefore environmental impact).

UNIDO's 'Resource Efficient and Cleaner Production' (RECP) approach provides a useful framework towards achieving this. RECP seeks to maximize efficiency of use of materials, energy and water, and thereby reduce discharges of effluents, waste and emissions, whilst also improving the working environment – conducive to productive operations with motivated workforce. RECP is typically possible at a profit or is otherwise beneficial to companies, as money is saved in two ways: firstly, by converting valuable resources into useful products and services, and, secondly, by reducing the costs of clean-up, remediation, transport, treatment and disposal associated with wastes and emissions. Furthermore, RECP saves valuable natural resources, thus providing benefits for society and the environment.

The demonstrations under UNIDO's paper project are supportive to this RECP approach. For instance, the pilot level demonstration of membrane filtration technology will increase recycling of internal process water and treat paper mill effluents to reduce colour, total dissolved solids (TDS), chemical oxygen demand (COD) and other pollutants as per prescribed regulatory norms. This further maximises the recycling of the treated waste water to reduce freshwater consumption as well as reduce pollution loads on effluent treatment plants and associated operational costs. Similarly, the demonstration of black liquor heat treatment technology will increase energy efficiency in the chemical recovery system in agro-based

pulp and paper mills. The demonstration of productivity enhancement measures will increase resource efficiency and contribute to lower costs and higher margins.

Water resources are depleting day by day and various government agencies are enforcing stringent norms for the usage of water by various industries. As paper industry is one of the major fresh water consuming industries, water conservation is necessary for the industry to ensure sustained growth and development. What are your suggestions to achieve maximum water conservation for the industry? How can UNIDO support the industry to reduce its fresh water consumption substantially?

The management of fresh water and process water is indeed a key focus area for the pulp and paper industry. Efforts to reduce fresh water consumption have resulted in mills attempting to close backwater systems and recycle process water to the extent possible. However, this closure causes a build-up of organic and inorganic substances (combined with stickies and slimes) in white water which cause paper breakages, frequent shutdowns for cleaning and issues related to the odour generated in the product (in a majority of recycled waste paper-based mills). This also adversely affects product quality, productivity and overall process efficiency.

A solution to this is the adoption of technologies that allow for the treatment of process/waste water, thereby facilitating its reuse in the process and reducing freshwater consumption. These technologies should be applied with purpose to supply 'fit for purpose' water for each process step – it is not necessary to clean to near potable quality for most water applications. Efforts can then be directed towards determining process water characteristics that meet the re-usage requirement without compromising quality of the product or process. This approach will also allow paper mills to meet regulatory requirements such as the National Charter for water consumption and wastewater discharge for paper mills in the Ganga River Basin in a cost competitive manner.

In line with this approach, UNIDO is demonstrating membrane filtration technology to reduce colour, total dissolved solids (TDS), chemical oxygen demand (COD) and other pollutants in process water. A suitable combination of subsystems (prefiltration, ultrafiltration and nanofiltration) allows for the treatment

of different streams (paper machine backwater, bleach plant alkaline extraction-stage stream and partial overflow from the primary/secondary clarifier of the ETP). Thereby process water can be treated at-source within the production process, which increases the potential for recycling and reuse of treated waste water. This contributes towards optimizing the closure of the water loops in paper mills, reduced treatment load on effluent treatment plants, reduced freshwater consumption and reduced wastewater discharge by mills.

Paper industry is considered as one of the major polluting industries in the country. What are UNIDO's views on Environmental Upgradation and Green Technologies in pulp and paper industry? How UNIDO can cooperate with Indian Paper Industry in adaption and implementation of green technologies in the industry?

As previously discussed, UNIDO has been working to identify key challenges corresponding to key production processes and unit operations, as well as mapping best available technologies that would help overcome these challenges.

The selection of the two technologies being demonstrated under the UNIDO paper project – membrane filtration and black liquor heat treatment, has also been done with a view to their potential for contributing to improved environmental performance of pulp and paper mills. In context of process water treatment, membrane filtration technology would allow for increased recycling of process water and reduced waste water discharge. Black liquor heat treatment improves the energy efficiency performance of paper mills. Thus, UNIDO's focus with reference to improved sustainability of the pulp and paper industry has been to identify, demonstrate and support the adoption of technologies that would help in increasing resource efficiency and reducing pollution intensity of mills.

Out of total paper production in India, around 85% production is contributed by small and medium paper mills using agro residues and recycled fibre. Please illustrate the possibilities of productivity enhancement, while maintaining quality of products in these mills. How UNIDO is going to address the challenges faced by small and medium sized mills in India?

An important focus area of UNIDO's interventions for the pulp and paper industry is the optimization of production

processes, which are especially relevant for (M)SMEs. Since paper mills need to constantly adapt to changing market requirements, adhere to quality requirements and reduce costs, there is a need to make production processes more efficient, effective and mature.

UNIDO's ongoing paper project includes the demonstration of 'productivity enhancement measures' (PEMs) pertaining to both, the technical aspects of paper production, combined with manufacturing excellence tools. The approach is to assess the performance of selected paper mills (spread across four regional clusters, and using different raw materials) on aspects such as the efficiency of various sub-processes and factors contributing to quality, and identify measures which can be implemented in a relatively short time frame with minimal investments. These recommendations will comprise adjustments to the technical process as well as the adoption of suitable manufacturing excellence tools such as 5S, Kaizen, quality circles, among others.

It is also important to emphasize the role of the pilot-level demonstrations being undertaken under the project. These demonstrations would allow MSMEs to observe the performance of the identified technologies – membrane filtration and black liquor heat treatment (and productivity enhancement measures) in an operational environment, and assess the techno-economic feasibility of the proposed solutions. Such experimental or exploratory initiatives cannot be undertaken by individual small units, and thus it is envisaged that firm-level demonstrations (and subsequent regional dissemination) under the ongoing project will facilitate the uptake of technologies at a wider scale, especially among the smaller units. UNIDO has also introduced the demonstration of an additional technology – the application of chlorine dioxide to improve internal process water quality and thereby control of odour in Indian paper mills, specifically in the small and medium sized recycled waste paper-based mills producing unbleached variety of packaging grades of paper. This would allow mills to improve product quality.

Overall, the interventions are expected to facilitate technology uptake and firm-level innovation, leading to increased productivity and competitiveness and reduced usage of water and energy and generation of effluents and waste.



Building competitiveness of the Indian Paper Industry through Productivity and Innovation



Dr. Rakesh Kumar Jain*



Farrukh Alimdjnov**



Shraddha Srikant*

Indian paper Industry scenario

The pulp and paper industry is an important industry in the Indian economy. India accounts for around 4% of global production and is the 5th largest producer of pulp and paper¹. In India the paper industry contributes 1.4% to Manufacturing Value Added, 1.9% to manufacturing jobs and 0.6% of exports of manufactured goods².

India is also among the fastest growing markets for paper in the world. The reasons for such growth include the prominence and growth of the education sector, combined with need for packaging in the retail sector, especially with the advent of e-commerce. It is also important to acknowledge that given the recent pandemic-related slowdown of commercial activities, the demand for paper from sectors such as education, offices and such has understandably declined, while packaging has been in focus, to support the pharmaceutical sector, FMCG products and e-commerce-based distributions. The Indian pulp and paper industry must leverage several

strategies to be cost competitive, enhance product quality and cater to niche product segments. To do so, manufacturers must adopt strategies to address supply-side challenges and constraints such as, but not limited to, limited availability of good quality raw materials, high cost of basic inputs, traditional technology, limited resource and energy efficiency and need for effective environmental management (handling of internal process water, solid waste disposal and effluent treatment).

In such a context, 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 global competitive position. Adopting a meso-to-micro approach, UNIDO first implemented a project titled "Development, transfer and adoption of appropriate technologies for enhancing productivity in the paper and pulp industry" between 2015 and 2018, focusing on transferring key technologies and expertise to the nodal technical institution for the Indian pulp and paper industry, the

Central Pulp and Paper Research Institute (CPPRI), and paper industry associations, such that they are equipped to, in turn, better support and guide manufacturers.

Building on this strengthened institutional capacity, UNIDO is now facilitating firm-level interventions, aimed at demonstrating process improvement measures as well as two innovative technologies in Indian paper mills, of different sizes, using different raw materials and located across the four main paper industry clusters across the country. The ongoing project, titled, 'Firm-level demonstration of technologies and productivity enhancement for the pulp and paper industry', is supported by the Department for Promotion of Industry and Trade (DPIIT), Government of India and is being implemented in close cooperation with CPPRI and national and regional paper industry associations.

Productivity Enhancement Measures

The first set of interventions focus on enhancing productivity in paper mills. This entails optimization of process

¹<https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwifsfyr-ILzAhUGxGdGHdp2CKIQFnoECAoQAQ&url=https%3A%2F%2Fwww.scribd.com%2Fdocument%2F457532091%2FShort-Treatise-of-Indian-Paper-Industry&usq=AOvVaw1rKaMA1Y4o2wIVfVSDBoyt>

²<https://iap.unido.org/data/explore?p=IND&s=CHN&t=142>

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parameters and operational procedures such that output per unit of input is maximised, wastages are curtailed and processes are tweaked such that quality maybe be enhanced. These productivity enhancement measures thus focus on both, technical aspects of paper production as well as the adoption of manufacturing excellence tools such as TQM and 5S. The underlying strategy of this activity is to identify improvements that can be made with minimal investments, and in short periods of time. To aid this activity, UNIDO has also developed an audit tool to gauge and monitor productivity in paper mills covering key unit operations, but focusing on the paper-making section of Indian paper mills. This tool, which is also being developed into a digital tool, is also envisaged to facilitate remote data collection and monitoring, thus furthering the adoption of digital tools in the industry.

Promotion and adoption of advanced technologies

The second focus area of the project

is the pilot-level demonstration of two innovative technologies with high adoption and replicability potential in the industry.

The first technology is membrane filtration technology, the application of which would facilitate recycling and reuse of treated process water, by reducing colour, total dissolved solids (TDS), chemical oxygen demand (COD) and other pollutants. Treatment using membrane filtration technology would address the challenges caused by closure of the mills' internal water circuit, which results in build-up of organic and inorganic contaminants, coupled with stickies and slimes.

The approach being adopted under the project involves determining the acceptable quality level of recycled process water for different applications within the process, so as to optimise treatment procedures – including configuration of the membranes (and costs), instead of aiming for 'potable quality' water for the entire quantity of process water, which may not be necessary

for some applications such as the showers, and may also prove very expensive. The PDU, comprising a combination of submerged ultra filtration and nano filtration modules, would aim to treat: (i) Paper machine backwater, to reduce TSS such that the permeate can be reused in high-pressure showers of the paper machine as an alternative to freshwater; (ii) Bleach plant alkaline extraction-stage stream, to achieve at-source reduction of major pollutants such as colour, TDS, COD and chloro-organics, such that the permeate, could be used for different unit operations and also reduce the overall pollution load on the effluent treatment plant (ETP); and (iii) Partial overflow from the primary/secondary clarifier of the ETP, to recycle the treated stream within the process as a replacement of freshwater, and thus reduce freshwater consumption. This would not only enable paper mills to meet environmental management norms, but would also enable them to save operational costs, enhance product quality and improve the performance of the effluent treatment plant.

The second technology being demonstrated under the project is black liquor heat treatment, which would improve the energy efficiency of the chemical recovery systems in agro-based paper mills (bagasse, wheat straw or a mixture). LHT technology involves reducing the viscosity of black liquor, such that this treated black liquor displays a higher dry-solids concentration when fired in the recovery furnace, resulting in greater steam generation. This would facilitate achieving greater energy-recovery efficiency, as well as reduced emissions in recovery boilers.

For both these technologies, pilot demonstration units are being designed and developed, such that they may be operationalized in paper mills (for optimization of the process parameters, continuous operations under stabilized conditions and validation of the results), located in major paper industry cluster in the North, South, East and West, to show the techno-economic feasibility of adoption in the Indian context.

Control of odour in recycled waste paper-based mills

The activity basically involves pilot



Pilot unit for preliminary pre-trials for demonstration of membrane filtration technology.



Pilot unit for demonstration of application of ClO₂ for improving process water quality and odour control.

demonstration of an additional technology, involving the application of Chlorine dioxide (ClO₂) to address the need to improve internal process water quality and control of odour in Indian paper mills, specifically in the small and medium sized recycled waste paper-based mills producing unbleached variety of packaging grades of paper.

Chlorine dioxide, being a strong oxidizing agent, is widely used as an odour control agent. Chlorine dioxide provides broad-spectrum kill of microorganisms. Processing equipment can be kept free of slime build-ups owing to this 'fast-killing rates' of chlorine dioxide. Developing a slime control program using chlorine dioxide improves the quality of paper products by reducing defects such as specks, spots, and holes in the sheet. This reduces sheet breaks and avoids subsequent production losses.

Under the ongoing project, pilot-level trials are currently underway to determine the efficacy of ClO₂ in reducing the microbial count in process water and paper samples (largely seen to be responsible for poor process water quality and odour). It is envisaged that the application of Chlorine dioxide would help prevention of formation of slime on surfaces by reducing the total aerobic and anaerobic count in the treated, clear filtrate. Thus, the objective of the trial is to reduce microbiological activity, thus reducing odour and slime formation. To establish a clear picture of conditions in the water systems of the paper

machine, a microbiological assessment of the total microbial count (both aerobic and anaerobic) has been performed before the initiation of and during the trials.

Preliminary testing results appear to be encouraging vis-à-vis the reduction in the microbial count (both aerobic and anaerobic), and shall be disseminated among industry stakeholders upon completion of the trial.

In conclusion, there is immense potential in the Indian paper industry to adopt productivity enhancing measures and adopt technologies that will allow for production processes to become more efficient and effective. Widespread uptake of such solutions will go a long way in boosting the competitiveness and sustainability of the industry at large.

Acknowledgement

UNIDO expresses its sincere thanks and gratitude to DPIIT, Ministry of Commerce and Industry, Govt. Of India for supporting this project for the Indian pulp and paper industry. UNIDO also acknowledges the cooperation and support of the CPPRI team and Indian paper Industry associations - IPMA, IARPMA, INMA, GPMA, South India Kraft paper Mills Association, North India Paper Mills Association, KGCCI (Paper Chapter) for their valuable inputs towards the project.



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