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PRACTICES AND TECHNOLOGIES ADOPTED BY INTERNATIONAL PULP AND PAPER MILLS TO ENHANCE ENVIRONMENTAL SUSTAINABILITY

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Summary :

Many pulp and paper mills enhanced their environmental sustainability by adopting various practices and technologies. This paper attempts to collate such practices and technologies among selected international pulp and paper mills in Europe, Americas, and Asia. Sources of information for this study are the sustainability reports published by these mills in the public domain. Such practices and technologies were related to raw materials, energy, water, treated wastewater, solid waste and emissions to the air. Practices adopted in plantations forest operations are also presented as adopted by some of the mills.

INTRODUCTION :

Sustainability reporting involves the disclosure of economical, social and environmental aspects of an organisation. While economical and social aspects of the organisation are also equally important, it is the environmental aspects that really determine the sustainability of the future generations. This school of thought argues that sustainability is treated as the scenario in which the industry is in unison with nature as a cyclical process similar to what nature has for millions of years like carbon cycle, water cycle, etc . Today, companies across many industrial sectors in many countries publish sustainability reports. There is a growing body of knowledge and experience publically available on improving sustainability performance. Many companies have developed economically feasible and environmentally sustainable solutions to enhance sustainability performance. Innovation helps us to challenge the status quo, to re-think the way we do things, and to find ways of being effective in an efficient way. Driving sustainable innovation help organisations pave the way for the next generations.

This paper discusses such solutions for enhancing environmental sustainability by the following world's leading pulp and paper companies, as published by these companies in their respective sustainability reports.

- APRIL- Indonesia
- APP - China,
- APP- Indonesia,
- CLEAR WATER- USA
- FIBREA – Brazil
- INTERNATIONAL PAPER – USA
- METSA GROUP – Finland
- MONDI GROUP – Europe
- NIPPON PAPER – Japan
- SAPPI – Europe

The practices and technologies that are adopted in the above mentioned pulp and mills are listed below. Due to restriction on number of pages some of the details such as the quantum of benefits, location of mills, etc where these are implemented are not provided in this paper and can be found in the sustainability reports mentioned in the references.

APRIL INDONESIA [1]

- Adopts Sustainable Forest Management Policy (SFMP) with High Conservation Value (HCV) commitment and safeguarding the environment. APRIL Group manages its conservation areas and plantations based on a landscape approach

- APRIL Group, in partnership with Fauna & Flora International (FFI) and local social development non-governmental organization BIDARA, manages more than 40,000 hectares of ecologically important peat forest as a biodiverse forest reserve area on the Kampar Peninsula and at Pulau Padang. This multi-year ecosystem restoration

program employs an integrated scientific approach with permanent resources and expert capabilities.

- Responsible Peatland Management - APRIL Group protects high value conservation areas from the threats posed by wildfire and illegal encroachment as part of a total landscape management approach.

- Land and Forest Fire Management - The program aims to foster collaboration with nearby communities as well as to draw lessons for a more comprehensive community-based fire prevention program. Under the program, APRIL Group acknowledges the efforts of villages that successfully prevent land and forest fire for three consecutive months. Assistance packages are awarded to villages that prevent fire successfully. Established rigorous fire detection and early warning system rapid response and aggressive suppression

- The integrated pulp and paper mills are equipped with the best available technology and benchmarked against the world's best

- Uses 29.5 gj/adt of total energy which is fuel based and with more than 82 percent of total energy produced comes from bio-fuels such as bark, sludge, palm husk and palm shell.

- Electricity consumption is 1.1 mwhr/adt (BAT is 1.5 to 1.2)

- Water consumption is 29.6 m3/ adt (BAT is 50 to 30). counter current washing system in pulp washing stage, where condensates from an evaporator are used in washing pulp.

- Established technology to capture significant methanol from weak black liquor through a process of evaporation and distillation resulting in cleaner gasses and condensate generation. This valuable bio-fuel is reused in the recovery boilers and lime kilns, replacing the use of fossil fuel

- PCC plant combines calcium hydroxide with waste CO2 that is captured from lime kilns leading to significant reduction in GHG emission

- Exploring the possibilities of using boiler ash material in road making and brick production.

- Reduction of around 12000 tpy imported Bleached Soft Wood Kraft (BSWK) used to strengthen paper during paper making process leading to meaningful decrease in indirect transport-related CO2 emissions.

- Fine wood particles are captured and converted to pulp by installing pin chip digester and chip classification screens for resources maximization and waste prevention.

APP, CHINA [2]

- About 17% of the reclaimed wastewater is reused in the cultivation of green plants, equipment washing, reverse osmosis (RO) and backwashing.

- Flash dryer installed for chemi-mechanical pulp production to achieve an 88% rate of dryness which reduces the transportation energy requirements .

- Plantation forestry management is certified and established monitoring programs aimed at safeguarding ecosystems, including biodiversity, watershed water quality, topsoil displacement

- Adopted scientific methods for its plantation operations (such as coppice regeneration, higher efficiency soil fertilization, the use of smaller compact machinery in operational processes) to minimize negative impact on the environment and to ensure sustainable land tenure.

- Energy conservation and emission reduction measures such as motor inverter rebuilding, recycling steam at after dryer section, feed water pump efficiency improvement, and lighting improvements

- Incineration wood chip waste, sludge, waste residues for power generation.

- fly ash, dregs and grit sold to companies that qualify for raw material production.

- functional testing and improvement of boilers, compressors, and circulating water system of steam turbines,

- Protect and preserve threatened and endangered tree species, natural habitants of wild animals and plants in the plantation forest.

- Green Procurement - the purchasing standard for coal ash has been reduced from 25% to 15%; Sulfur from 0.8% to 0.6%.

- Transformed treatment facilities of the boiler gas to the external desulfurization and denitrification systems. The desulfurization process employs a limestone gypsum method with white mud as the desulfurizing agent, with the CaCO3 as an effective supplement. The desulfurization rate was greater than 96.5% and the utilization rate of the device satisfies the needs of the generator unit. The denitrification process employs Selective Catalytic Reduction (SCR) which was placed in between the boiler economizer and air-preheater without a bypass. The catalyst is the cellular form and the deoxidizer is liquid ammonia. The denitrification rate is more than 72%.

- Increased the use of alternative bio fuels such as plant stalks, sugar cane bagasse, and solar energy to reduce carbon emission from its production operations

- Uses furnaces to burn off wastes such as sludge and saw dust.

- Recycle waste by producing concrete out of coal ash and furnace slag.

- Mix the mud from waste water processing into coal to burn in the furnace to dispose mud and reduce the use of

limestone, and in turn reduce the energy consumption.

- Utilize CO2 from boiler to produce light calcium carbonate which is used as filler in paper production

- Establish desulfurization and denitrification systems to utilize SO2 from flue gas of boiler to produce fertilizer ammonium sulfate without discharging any waste water, waste liquid or other form of waste

- Utilize the calcium carbonate mud and fiber in the waste water to produce sludge cover plates and mould resistant lining paper to reduce the overall cost structure

- Sell the waste wet pulp in the waste water to be recycled for reuse

- Design multiple white water collecting pools in the whole production process, and build an effective and efficient white water processing system. The isolated white water is collected and batch processed as much as possible. The white water is processed to recycle microfibers in the water. The water can be totally recycled in the production process. For instance, processed white water is used to dilute starch to reduce the use for clean water and effluent.

- Construct reclaimed water system to recycle discharged water, and reuse the reclaimed water for cooling tower, landscaping, road cleaning, fire fighting and bathroom flushing for reducing the use of clean water

APP, INDONESIA [3]

- Introduced the Integrated Forest and Farming System Programme (IFFS), advancement in best practice peatland management program, and completion of the Integrated Sustainable Forest Management Plans (ISFMPs), which consolidated the various assessments undertaken under the management commitment .

- Work with partners to develop and refine the Best Practice Peatland Management Plan (PBPMP), and have commissioned the mapping of peatland in Sumatra and Kalimantan using LiDAR (Light Detection and Ranging) technology, which has resulted in the mapping of approximately 4.5 million hectares of peatland as a long term effective measure to protect peatland and prevent forest fires.

- Designed a comprehensive Integrated Fire Management Strategy, provided an aircraft equipped with water tanks and hired professional fire fighters to provide expertise and additional resources on the ground.

- Maintaining High Conservation Value (HCV), High Carbon Stock (HCS) forests, understanding the hydrology of peat forests, implementing Free Prior & Informed Consent (FPIC) and social conflict resolution to mitigating the risk of fires.

- Improved boiler efficiency through equipment modification and installed a multi-cyclone system to flue gas system.

- Redesign of the vacuum systems on paper machines and improvement of refiners

- Utilise the methane gas from waste water treatment plant for producing renewable energy

- Installed a new steam condenser to improve the quality of condensate resulted in saving of heat energy and freshwater

- Reuse of white water from their pulp fibre lines to save fiber and water

- Installed additional wash presses on the pulp fibre lines and reduced water use

- Optimise the wood chipping process and reduced power consumption while at the same time increasing capacity and chip quality

- Community project was established to plant bamboo on river banks, reducing soil erosion and preventing floods during periods of high rainfall.

- Installed new wash press in paper machines, reducing chemical use and improving the quality of waste water.

- Installed a flue gas heat recovery system in boilers and reduced steam requirements

- Rotary drier was installed next to belt press in order to enable the mill to utilise sludge as an alternative fuel after mixing with coal

- Utilisation of coal ash waste to make bricks

CLEAR WATER, USA [4]

- A new wastewater system capture more water for reuse, enabling to cut water consumption 1 by approximately 30 percent

- Through “steam leveling” eliminated spikes and valleys in the steam use and saving between 20,000 and 30,000 pounds of steam per hour as a result

- Installed a system that captures and stores the turpentine that is a by-product of the pulping process

- Installed wastewater equipment for capturing and reusing processed chemicals,

- Generating 50 MW of green power using woody (waste) biomass

- Saved energy by using wastewater to heat chlorine dioxide prior to contact with pulp, reducing steam demand in the bleach plant

- Mill operates its own hydroelectric power dam on the river, which generate as much as a quarter of the mill’s electricity.

- Further to mitigate the effects of the dam, building a plunge pool at the dam that will enhance migrating fish habitat

- Generate about 10 percent of its steam by heating water with recovered exhaust gases and recovered heat from mill processes

- When the water is removed from the organic matter, the resulting by-product (short fiber with calcium), has a neutralizing capacity that is about 40 to 50 percent of that of agricultural lime, making it an excellent soil enhancer. Dewatered wastewater treatment solids are supplied to nearby farmers who use it to keep the local sandy soil moist, increase its naturally low pH and help make it more resistant to erosion. The result is win-win: area farmers get a no-cost boost for their corn, beans and alfalfa and mill save on landfill costs of US $ 1 million/year.

- To improve air quality, reduce landfill costs and provide a dramatically cleaner working environment the mill is using hoods over rewinding machines, along with a baghouse air filtration system in bailer/shredder room, to collect the dust, or "fiber lint," created as part of manufacturing process. Once collected, the dust is put through a screw press and turned into cueball-hard briquettes for use as lining material in corrugated boxes or even as a replacement for clay pigeons in skeet shooting

- Recycling ash back into a power boiler to reuse unburned material and reduce waste. Using air rather than steam to reinject the ash, lower steam consumption (and energy and water use) by approximately 7,000 pounds per hour.

- A longtime leader in the use of certified fiber Forest Stewardship Council™ (FSC®) chain-of-custody certification and certified to Sustainable Forestry Initiative (SFI)

- The facility's pump seal water was changed from clean water to reclaimed water from the facility cooling water systems.

- Pump packing design was changed to allow significantly less water use.

- Energy conservation measures - Installation of a sawdust liquor heat exchanger, Installation of a fabric seal in the power boiler to improve the operating efficiency, Installation of a lime kiln cooling control system to reduce water and natural gas use and Lower temperature set points for the facility white water system

- Solid waste reduction - installed a flash dryer on its lime kiln to re-calcine lime resulting in significantly reducing the amount of lime mud sent to landfill

FIBREA, BRAZIL [5]

- The company's has forest area of 856,0001 hectares, of which 285,000 are intended for conservation of native ecosystems. In addition to its own plantations, the company has 1,980 contracts with wood suppliers, which adds up to 78,000 hectares of eucalyptus

- Forest Stewardship CouncilR (FSCR), Cerflor/ Programme for the Endorsement of Forest Certification (PEFC)

- Fibria's nurseries produce quality seedlings that contribute to the development of plantations with high yield potential. Fibria initiated planting with clonal compounds – clones that are similar in performance, but genetically distinct – reducing the risk of loss arising from pests, diseases and climate change.

- Established an Integrated Fertilization Recommendation System (SIRA) capable of indicating the type of fertilizer and the amount to be applied according to the characteristics of the soil, the nutrient requirements for each clone during the different stages of crop growth

- Currently records a positive balance of nearly 7.3 million tons of CO2 equivalent between emissions and removals of greenhouse gases per year.

- In the last five years, the company restored 16,000 hectares of land improving the vegetation cover that helps maintain the quality and availability of water, which in turn benefits the entire ecosystem and expanding the reproduction and feeding grounds of regional wildlife.

- Dealing with waste - biological sludge and primary sludge are burned in the biomass boiler) and agricultural inputs (inorganic inputs transformed into soil acidity correctives, eplacing lime).

INTERNATIONAL PAPER, USA [6]

- Promoted the value of working forests and to conserve and restore more than 200,000 acres of forestland in USA

- Established a Private Natural Heritage Reserve to protect and conserve biodiversity and conduct biodiversity research on 2,000 acres of high-conservation value forest owned by International Paper in Brazil

- Eliminating illegal logging and promoting environmentally and socially responsible forest management worldwide

- Fiber Sourcing – 56% of fiber are SFI certified, 28% non-US FSC, 10% US SFC and 4% PEFC and 2% American Tree Farm System

- International Paper owns and manages nearly 253,000 acres of Brazilian forestland, 75 percent of which is composed of eucalyptus plantations.

- Farm forestry is the cultivation of sourced plantations, usually on former agricultural land. International Paper APPM, distributed more than 1 billion seedlings allowing the planting of over 390,000 acres.

- On average 70 percent of the energy is self-generated using renewable wood-based biomass.

- Installed a ground-mounted solar system with single-axis tracking technology that will produce 1 MW of electricity, providing a significant amount of the plant's electricity needs.

The system, which uses over 3,700 solar panels, is estimated to offset 1,765 tons of GHG emissions annually

- Paper machine heat recovery - takes hot exhaust gas from the paper drying process and uses it for heating water, thus decreasing the need for steam

- Installed a new biomass boiler for burning biomass

- AIR EMISSIONS - Fuel-switching, particularly away from coal and oil, 25 percent reduction in SO2 and a 10 percent reduction in NOx

- Eucalyptus plantations grown near the mill use composted pulp and paper mill residual waste materials returns organic matter and nutrients to the very land that produces the mill's primary raw material.

METSA GROUP FINLAND [7]

- METSA is currently building a new unique bio-economy ecosystem of companies using wood as raw material. This ecosystem mill will produce 1.3 million tonnes of high-quality pulp per annum, new bio-products (tall oil, turpentine, lignin products, wood fuel, producer gas, sulphuric acid, textile fibres, biocomposites, fertilizers and biogas) and generate bio-electricity which is 2.4 times the amount it consumes. The excess bio-energy will be supplied to society. The new technology will utilise the valuable resources such as wood, energy and water to a significantly higher level compared to mills of previous generations. Fresh water needs will be halved. The emissions to water will also decrease due to a new three-stage (mechanical, biological and chemical) purification process. COD and BOD emissions per ton will be 70% lower than at the current site.

- The ecosystem mill has been planned to run the lime kiln with gaseous fuel derived from bark using thermal gasification. As secondary fuels, important especially in ramp-ups and shut-downs, bio-based tall oil pitch and methanol, both generated as side streams of the mill's processes, will also be used.

- One of the new process concepts is to capture and convert the malodorous gases (rich in sulphur compounds) generated in production into sulfuric acid and then re-use the sulfuric acid as a process chemical in the main process cutting the sulphate emissions as well as other external chemicals needed otherwise.

- Metsa Group purchases wood from sustainably managed forests. It supply 30 million m3 of wood with 100% traceability. An inverting method developed for soil preparation makes not only planting easier but the saplings grow rapidly and with less brushwood than usual, and the costs of tending young stands are reduced. In addition, nutrient runoff into waterways is reduced, the roots of forest plants remain better intact and moving about the stand is easy. Inverting is expected to help in controlling the vigorous spread of aspen.

- Presently 86% is wood-based bioenergy - Branches, crowns and stumps that cannot be used for pulp production are used as bioenergy to meet the heating and electrical energy needs of both the forest industry and communities

- A new boiler only uses bio-fuels such as recycled and sorted wood from the local construction industry and fibre clay, a waste from deinking plant

- Company supplies biomass fuels, which consist of branches and top refuse of harvested trees as well as by-products such as bark and dust from production

- Utilizes nearly 100% of its wood-based production side streams, of which some 50% are used to produce electricity or steam for energy on-site. Around 40% are used as forest or field fertilisers, in landscaping, as industrial raw materials, in geotechnical construction and landfill construction.

- Ash from the combustion of wood based side streams and lime from pulp production are used as forest fertilisers and agricultural lime. Fly ash from wood based energy production is particularly suitable for fertilising peat soils and forest soils where growth is hindered because of deficiencies in phosphorus and potassium. In this way, nutrients are returned to the natural cycle where they have a great effect on wood growth of 3–6 cubic metres per hectare.

- The pulp production processes generate surplus lime which has been stored temporarily at the mills or sent to landfill sites. However, lime has been proven to be a good liming material and local partners sell and deliver the lime surplus generated by the mills to farmers. The use of lime as a field fertiliser has already produced good results.

- The storage and debarking of wood generate around 14,000 tonnes of sandy bark, which be used for various purposes. It is used as mulch or as a fuel when screened and has been used as a cover layer for extensive areas, such as ski slopes and motor-racing tracks, as well as for landscaping in landfill sites.

- De-inking sludge from the mill have been used as a raw material in the production of bricks and tiles. This has enabled them to minimize its consumption of other, diminishing natural resources such as natural clay and sawdust.

- Ash has been used to build durable, load-bearing roads, mainly in industrial and storage areas. Also developing a new solution where the surfaces of forest roads are layered with a mixture of ash and crushed rock employing a traditional method. Once hardened, the ash serves as a binding component in the surface layer.

- A new back-up boiler for the treatment of malodorous gases from the pulping process was installed and also has a positive effect on local air quality.

- Achieved major improvements in controlling emissions with a new Super Low-NOx combustion system in the gas-fired power plant with over 20% lower NOx emissions.

MONDI GROUP – SOUTH AFRICA & EUROPE [8]

- Forest certification is 100% PFC and PEFC certified. About 25% of owned and leased land, amounting to 524,000 hectares have been identified as HCV land

- Ecosystem management including eco-sensitive harvesting plans, in all forestry operations where rivers, wetlands, other key biotopes and HCV areas are identified and protected

- Forest management - Intensive breeding programme in the South African plantations is based on a wide genetic base and aims to produce stronger, more robust species.

- In Russia, within the framework of a sound landscape approach where intact forest landscape (IFLs) and HCV areas have been identified for protection, Mondi is placing increasing emphasis on sound silviculture to improve yields from the commercial forest areas

- 59% of fuel consumed is from renewable. Biogas is generated in the anaerobic waste water treatment plants. About 0.1 million GJ of biogas has been collected and used as fuel to replace natural gas, leading to around 0.01 million tonnes of CO2e being avoided.

- About 50,000 tonnes of foil waste from the recycled pulp process sent to a cement manufacturer for energy generation, about 0.06 million tonnes of CO2e were avoided.

- collection and combustion of sulphurous off-gases in recovery boilers

- In boilers, introduced de-NOx systems in the purification of exhaust gases.

- Sodium carbonate, contained in green liquor dregs is filtered in modern green liquor filters to seerate drus before disposal thereby reducing chemical losses and has also improved process and energy efficiency by reducing gas consumption by 10%.

- Upgrading waste water treatment plants and optimised its treatment process to manage the balance of carbon, nitrogen and phosphorous, and increase the quality of the treated waste water. This has significantly reduced the need for chemical treatment.

- Sludge from waste water treatment is burnt in incineration facilities recover energy

- Developed a stable and safe procedure to burn concentrated non-condensable gases (CNCG) and stripper off gases (SOG) without requiring support fuel in the recovery boiler

- Mobile TRS monitoring stations to map ambient odour impacts and locate sources within the mill

- fluidised-bed boiler NOx emissions. To comply with the more stringent emission limits in the revised BAT reference document for paper and board production, the mill has invested in fuel gas re-circulation technology. This will reduce NOx emissions, increase the energy output of the boiler, reduce ash by-products, optimise temperature control and reduce lime consumption (for desulphurisation).

- Forest Plantations - 100% of owned and leased forests are FSC certified. 25% of owned and leased land is set aside for conservation, protect water, biodiversity and ecosystems.

- Restoring a wetland landscape - The plantations were reducing freshwater flows to the lake system, which was having a negative impact on the lake and its wildlife – especially during the dry season – as well as causing concerns for local stakeholders. A 120 kilometre 'eco-boundary' now divides dry plantation soils from sensitive wetland areas. Some 9,000 hectares of plantations were given over to the park. Plantation trees were removed, and the land restored to wetland and savannah. Rhino, buffalo and elephant now roam alongside the commercial plantations

- 66% of wood purchased came from Chain-of-Custody certified sources, and 59% of fuel consumed came from biomass-based renewable sources

- Cutting waste to landfill - 50,000 tonnes of foil waste is used for power at a nearby cement kiln instead of as a waste to landfill

- Reducing emissions to air - Odour, caused by total reduced sulphur (TRS) emissions from kraft pulp mills was reduced by 37%, mainly by collecting and incinerating sulphur-containing off-gases in boilers.

- Over 95% of the energy used by the mill will come from renewable biomass, and also supply sustainable heat energy to the local community.

- One of the existing recovery boiler rebuilt as a biomass boiler and will replace two coal-burning boilers

NIPPON, JAPAN [9]

- Approximately 20% of Company owned forests 90,000 hectares in Japan maintained as environmental forest areas that are permanently protected prohibiting harvesting

- Recycled paper utilization rate: paper 40%; paperboard 89%

- Non-fossil energy biomass and waste material energy accounting for 45% of energy consumed. The Nippon Paper Group installed 10 boilers in Japan that can combust such carbon neutral non-fossil fuels as biomass and refuse including construction wood waste, used tires and refuse paper and plastic fuel.

- Finished goods transportation by increased use of rail and marine transportation compared to truck. By increasing load efficiency, particularly over long distances, the environmental impact is reduced

- Nippon Paper Industries is engaging in transit-type transhipment distribution in an effort to shorten transportation distances. By utilizing the structures

within Japan Railway cargo stations as temporary holding facilities, the company is eliminating the need for inventory storage within existing warehouses at each point of consumption.

- Developed proprietary technologies for (i) protecting and nurturing endangered species (ii) protecting cherry tree species. A technology that encourages plants to root using a cultivating room characterized by an environment that promotes photosynthesis. This method allows the propagating of plants that failed to root by cutting. This method involves placing the container in a cultivating room with an elevated carbon dioxide concentration and light with suitable wavelengths to boost the plants' photosynthetic activities

- Developed proprietary technologies for restoring tidal flat environments by mixing granulated paper sludge ash (generated after combustion of paper mill sludge) with dredged marine sediments. This new material was used as a tidal flat reclamation material in verification tests for ecosystem terrace revetment

- Cinder ash is used as raw material for making cement, roads, etc

- Inorganic sludge as base material for greening, raw material for cement, etc

- Organic sludge for heat recovery fuel, energy recovery, etc

- Effectively utilizing boiler incineration ash as a construction material (right) in the paving of forest roads

- Consistently reducing emissions of NOx, SOx, soot and dust - Introduced desulfurization, denitrification, dust collection equipment to reduce these contaminants to levels substantially lower than legal requirements.

- Use of carbon-free fly ash (CfFA) as the concrete admixture by adopting ring technology to eliminate the problem of unburned carbon, Nippon Paper Industries produce carbon free fly ash as a resource that improves concrete. Increasing the durability and useful life of concrete make positive contributions in terms of aiding disaster recovery in areas devastated by the Great East Japan Earthquake and reducing infrastructure lifecycle costs (40-tonne breakwater tetrapod made with concrete containing CfFA)

SAPPI, EUROPE [10]

- Fiber certification - Sappi Europe uses the certification of FSC and PEFC, Chain of custody

- The installation of two new weighing scales and a new gateway to the wood yard had reduced overall traffic by 30% and lessening noise, the time spent by delivery trucks in the mill has significantly decreased from 60-90 minutes to 30 minutes knocking off 7,800 km of internal traffic on an annual basis

- Green gas from effluent – Polluted waste water was converted into biogas and used to generate electricity

- Sappi finances the planting of 12 million seedlings by external growers every year in order to cover up the wood supply needs.

- Residues from waste paper processing are used for green energy generation

- Using transport by train, sea and canal instead of trucks altogether and also empty containers are now filled with products back to the origin for other customers in the originating city, closing the loop

- Stronger pallets that were used for shipping paper to one of the printing customer. These pallets were recycled in coordination with customers supporting the environment.

- Developed a new "low-cost process" to make lightweight nanocellulose on a intensively processing wood pulp to release ultra-small, or 'nano' cellulose fibres The newly discovered process drastically reduces the amount of energy needed to power the process, as well as the need for expensive chemicals. The product can be used in a huge range of applications – including wound care, packaging, touch screen displays and car panels – a potential market that could reach 35 million tonnes per year within 10 years

- SAPPI has used cellulose fibres to produce a partly bio-based plastic that can be employed in a variety of applications e.g. loudspeaker enclosures, parts for car interiors, consumer electronics, toys. The fibres give the plastic certain characteristics; rigidity, weight reduction and a lower carbon footprint.

- In wastewater treatment plant, compressed air blown into the biological aerobic reactors. A flexible air compressor with a variable speed drive has been added to complement the two existing inflexible compressors. As a result, the varying demands for pressurised air can be met, whilst decreasing power consumption.

- Replacing paper machine vacuum system, a reduction in energy consumption of 57% was achieved in the wire and press section.

- Saving energy without a cooling hood in coating machine, as series of tests found the right settings to enable us to produce standard high quality paper without the need for a cooling hood

- Recovering the heat in waste water through additional heat exchangers to produce hot water.

- Work at the coating colour kitchen at the Kirkniemi Mill and noticed that small amounts of unused coating colour remained in the tank during the stand-stills, simply because the suction pipes didn't reach the bottom of the tank. A minor investment made to adjust the pipes resulted not only in overall cost savings, but a huge reduction in wasted coating colour, equivalent to 42 tonnes per annum, discharged to the effluent treatment plant

- Reuse of pigments of coating colur kitchen waste by separating the streams containing coating from the coating machine

- Transportation of finished paper by train instead of trucks save environmental emission as well as costs

CONCLUSIONS

A list of the practices and technologies that have been adopted by the above ten international pulp and paper mills has been provided in this paper. The readers who are interested to more know can refer to the sustainability reports of the respective companies. The technologies are slowly emerging a unique ecosystem of companies to increase resource efficiency and decrease dependence on fossil resources. The innovation is important to achieve closed loop in chemical /energy/water/production cycles. Resource efficiency, together with the circular economy and the bio-economy play a pivotal role in pulp and paper industry. Circular economy is extremely important for the sustainability of pulp and paper industry.

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