

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

**By Arumugam Arivalagan
Head – Project Planning,
Indo Karya Bangun Bersama, Kerinci, Indonesia.**

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Over view

- List of Pulp & Paper Mills studied
- Forestry related
- Raw materials related practices
- GHG emission related practices
- Bio-Energy related practices
- Energy related practices
- Air emission related practices
- Solid waste related practice
- Water & Waste water related practices

List of Pulp & Paper Mills studied

- **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**
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FORESTRY

- **Silviculture** to improve yields from the commercial forest areas
- Operation of **Large scale Nurseries** producing quality seedlings that contribute to the development of plantations with high yield potential.
- **Planting clones** that are similar in performance, but genetically distinct – reducing the risk of loss arising from pests, diseases and climate change. Facilitating planting of seedlings by external growers.
- **Intensive breeding** programme in plantations based on a wide genetic base to produce stronger, more robust species
- **Protecting and nurturing endangered** 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

FORESTRY

- **Protection of “high value conservation areas”, High Carbon Stock (HCS) forests, native ecosystems** including biodiversity, Natural Heritage Reserve, protecting endangered tree species, natural habitats of wild animals and plants in the plantation forest, etc
- **Eliminating illegal logging** and promoting environmentally and socially responsible forest management
- **Forest Fire Management**, Communities-based fire prevention program, Rigorous fire detection and early warning system for rapid response and aggressive suppression
- **Integrated Fire Management Strategy**, providing an aircraft equipped with water tanks and use of professional fire fighters to provide expertise and additional resources on the ground.
- **Forest Restoration** - 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. Restoring wetland landscape.

FORESTRY

- **Scientific methods for plantation operations** (such as coppice regeneration, higher efficiency soil fertilization, the use of compact machinery in operational processes)
- Integrated **Fertilization Recommendation** System - 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
- An inverting method developed for **soil preparation** for easier planting rapid growth of the saplings with less brushwood than usual
- **Fiber source certified** to Forest Stewardship Council (FSC), chain-of-custody (COC), Sustainable Forestry Initiative (SFI), Programme for the Endorsement of Forest Certification (PEFC)

GHG emission reduction

- Use of CO₂ from lime kilns for making PCC
- Use of CO₂ from boiler to produce light calcium carbonate
- Reduction of use of imported pulp leading to meaningful decrease in indirect transport-related CO₂ emissions.
- The installation of new weighing scales and new gateway to the wood yard had reduced the time spent by delivery trucks in the mill from 60-90 minutes to 30 minutes
- 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 and save environmental emission
- Flash dryer installed for chemi-mechanical pulp production to achieve an 88% rate of dryness which reduces the transportation energy requirements as related emissions

GHG emission reduction

- Rotary drier was installed next to belt press in ETP to utilise sludge as fuel after mixing with coal
- Finished goods transportation by increased use of rail and marine transportation compared to truck.
- By utilizing the Railway cargo stations as temporary holding facilities, the need for inventory storage is eliminated at point of consumption
- Developed a new process to make lightweight nano-cellulose fibres from wood pulp by reducing energy & expensive chemicals.
- Cellulose fibres 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.

Water & Waste Water

- 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
- Installed new wash press in paper machines, reducing chemical use and improving the quality of waste water.
- A new wastewater system capture more water for reuse, enabling to cut water consumption by 30 percent
- Installed wastewater equipment for capturing and reusing processed chemicals
- 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.
- 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.

Bio energy

- Generating most of energy requirements from Renewable biomass,
- Use of bio-fuels such as bark, sludge, palm husk and palm shell
- Use of bio fuels such as plant stalks, sugar cane bagasse, and solar energy
- Incineration wood chip waste, sludge, waste residues for power generation.
- Burning off sludge and saw dust in boilers.
- Generating green power using woody biomass
- Running the lime kiln with gaseous fuel derived from bark using thermal gasification with secondary fuel such as bio-based tall oil pitch and methanol, both generated as side streams of the mill's processes
- Use of bio-fuels such as recycled and sorted wood from the local construction industry and fibre clay, a waste from deinking plant in boilers
- Biogas is generated in the anaerobic waste water treatment plants
- 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

Bio energy

- Supply of biomass fuels, which consist of branches and top refuse of harvested trees as well as bark and dust from production to other companies
- Use of biogas generated from waste water to generate electricity
- Branches, crowns and stumps that cannot be used for pulp production are used as bio-energy
- Biomass and refuse including construction wood waste, used tires and refuse paper and plastic fuels in boilers
- Sandy bark generated during the storage and debarking of wood is used as a fuel when screened, as a cover layer for extensive areas, such as ski slopes and motor-racing tracks
- Residues from waste paper processing are used for green energy generation

Wood based “Bio-Product Pulp Mill”

- METSA FIBER is setting up a bio-product pulp mill to 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,
 - bio-composites,
 - fertilizers and
 - Biogas
 - Bio-electricity which is 2.4 times the amount it consumes
- Resources utilisation to a significantly higher level.
- Fresh water needs will be halved.
- Emissions will also decrease by 70%

Energy

- VFD for air compressors in biological aerobic reactors
- Energy Efficient vacuum system
- Eliminating a cooling hood in coating machine
- Recovering the heat in waste water using heat exchangers to produce hot water.
- Motor inverter rebuilding, recycling steam at after dryer section, feed water pump efficiency improvement, and lighting improvements
- Efficiency improvement in boilers, compressors, and circulating water system of steam turbines,
- Recycling ash back into a power boiler to reuse unburned material
- Energy conservation measures - Installation of a sawdust liquor heat exchanger, fabric seal in the power boiler to improve the operating efficiency, lime kiln cooling control system to reduce water and natural gas use and Lower temperature set points for the facility white water system
- Paper machine heat recovery for heating water, thus decreasing the steam use

Energy

- Improved boiler efficiency through equipment modification and installed a multi-cyclone system to flue gas system.
- Improvement of refiners
- Installed a new steam condenser to improve the quality of condensate resulted in saving of heat energy and freshwater
- Optimise the wood chipping to reduce power, increasing capacity and improve chip quality
- Flue gas heat recovery system in boilers
- “Steam levelling” eliminated spikes and valleys in the steam use and saving
- Using hot wastewater to heat chlorine dioxide prior to contact with pulp, reducing steam use
- Generate steam by heating water with recovered exhaust gases and recovered heat from mill processes

Air Emissions

- Collection and combustion of sulphurous off-gases / non-condensable gases in boilers
- Capture of methanol from WBL & firing in the recovery boilers / lime kilns
- Boiler gas desulfurization
- Capture and convert the malodorous gases (rich in sulphur compounds) into sulphuric acid which is reused in process
- Denitrification systems or De-Nox for boiler flue gas
- Super Low-NOx combustion system in the gas-fired power plant
- Captures and stores the turpentine that is a by-product of the pulping process.

Solid waste

- Ash from the combustion of wood based side streams and lime from pulp production are used as forest fertilisers and agricultural lime.
- Using boiler ash material in road making and brick production.
- Fine wood particles are captured and converted to pulp by installing pin chip digester and chip classification screens for resources maximization and waste prevention.
- Recollecting from customers and reusing stronger pallets that shipping paper to one of the printing customer
- Fly ash, dregs and grit sold to companies that use as raw material for production
- Producing concrete out of coal ash and furnace slag.
- Mix the mud from waste water processing into coal and burn in the furnace to dispose mud and reduce the use of limestone, and in turn reduce the energy consumption.
- 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 for reuse

Solid waste

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

Solid waste

- 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.
- 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.
- Sodium carbonate, contained in green liquor dregs is filtered in modern green liquor filters to separate dregs before disposal thereby reducing chemical losses and has also improved process and energy efficiency by reducing gas consumption by 10%.
- Sludge from waste water treatment is burnt in incineration facilities recover energy
- 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
- 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

Water & Waste Water

- Use of condensates from the evaporator in washing pulp
- Coating colour kitchen 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 adjustment of the pipes resulted in huge reduction in wasted coating colour and reduction in load to effluent treatment plant
- Reuse of pigments of coating colour kitchen waste by separating the streams containing coating from the coating machine
- Use of reclaimed wastewater for the cultivation of green plants, equipment washing, reverse osmosis (RO) and backwashing.
- Processed white water is used (recirculation) 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

Conclusion

- This paper has collated the practices and technologies among selected international pulp and paper mills published in their sustainability reports
- Some of the practices are already well known in the industry, some are innovative.
- The focus in general is
 - Protection of natural rain forest
 - Restoration of degraded forest land
 - Promoting and sustaining the forestry plantation
 - Raw material source is certified as renewable
 - Increase green energy generation , improving the resource efficiency use
 - Decrease in emissions to air and water bodies and decrease in solid wastes to land
- Emergence of the ecosystem of companies
- Bio-economy and Circular economy are extremely important for the sustainability of pulp and paper industry.