Environmentally Sound Technologies & Clean Technologies

Best Available Technologies to the Pulp & Paper Industrial Segment
Bleached Kraft Process

Celso Foelkel

Best Available Process Technologies
WOOD HANDLING
Dry debarking of logs
Low energy conveyors
Composting or other utilization of the wasted biomass from wood yard
Biomass fuel to save NRF (No Renewable Fuels)
Bark dryers or presses to improve biomass fuel quality
PULPING LINE
Cooking modifications to reduce bleaching chemicals and to improve pulp yield (extended cooking, compact cooking, lo-solids, super-batch, etc)
Additive utilization to speed up delignification (surfactant, antraquinone, etc)
Oxygen delignification (two stages)
Adoption of low kappa factor to reduce utilization of chlorine dioxide
Utilization of evaporation plant condensates for washing brown pulp
Highly efficient closed cycle brown stock washing and screening
Maximization of knots, dirt and shives removal
Washing presses to better remove carry-over of chemicals
BLEACHING LINE
Enzyme bleaching
Hexenuronic acids destruction stage (Acid stage or Dhot in pre-bleaching)
Highly efficient washing presses along bleaching line
ECF (Elemental Chlorine Free), ECF-Light, or TCF (Totally Chlorine Free) bleaching

Bleaching with ultra low AOX generation
Partial recovery of bleaching stage filtrates
Cooling system for bleaching filtrates
Ultra-filtration for bleaching filtrate recycling
Closed water cycle and low effluent flow generation in the bleaching line (less than 15 m3/adt)
Filters to recover fibers and solids from bleaching effluents
RECOVERY OF LIQUOR; BOILERS, ENERGY & STEAM
Definition of fuel sourcing, specifications and monitoring, both fossil and biomass fuels
Firing of high solids black liquor in the recovery boiler
Appropriate control of combustion temperature profile, excess of air and combustion reactor design
Low odor or odor less recovery boiler technology
Common chimney for boilers, lime kiln, smelt vent tank. The stack height should be based on optimum dispersion of fumes, and to prevent problems with weather thermal inversion layers.
Extra capacity in the recovery boiler and evaporation plant to cope with extra demands such spills, extra charges, etc.
Efficient multiple effect evaporators. Totally indirect heating evaporators, with no direct contact.
Reuse of the major part of evaporation condensates, including in the preparation of white liquor
Continuous monitoring of TRS, SOx, NO2 and particulate matter
Collecting and burning odor gases in lime kiln, captive incinerator or boilers
Management of concentrated and dilute NCG
Burning or absorbing vent gases in captive burner or scrubber
Monitoring of greenhouse gases (methane, CO2, CO, etc)
Monitoring the gases able to damage the ozone layer
Black liquor oxidation
Methanol recovery
Fluidized bed power boilers
Flash dryers to lime kiln
Highly washed and high solids lime mud to feed lime kiln
Highly efficient washing of the green liquor dregs and causticising grits to minimize leaching of caustic chemicals

Chloride and potassium removal from recovery system in a clean procedure, avoiding the not so elegant method to purge recovery boiler ashes to the effluent.
Tall oil and turpentine recovery
Condensate stripping and gas management: reuse of foul condensates
Process conditions for minimum SO2 generation or emissions from boilers and lime kiln
NOx reduction by optimum design and operation of combustion. Also, fuel monitoring is essential.
High performance electrostatic precipitators for dust abatement, in recovery boiler, power boiler and lime kiln. Particles should be maximum 100 mg/Nm³, although legislated limits may be stricter in some conditions.
Design of appropriate combustion boiler (high turbulence, high residual oxygen, temperature over 900ºC) to prevent dioxins and furans presence in the flue gases
Total electricity consumption (less than 0,7 kWh per air dry ton of pulp)
Total steam consumption (less than 7 ton steam per air dry ton of pulp)
PULP & PAPER SHEET MANUFACTURING
Closure of water systems
Recovery of fibers instead of losing them to wastewater
Minimum broke generation
Improve collecting, sorting and logistics for recycled papers
Maximum reutilization of chemicals, fines and fibers present in the white waters
Education of consumers of paper to better recycle paper (under the Corporate Citizenship targets)
CHEMICAL PLANT
Closed cycle chemical manufacturing
Membrane cells to caustic soda making
Elemental chlorine free manufacturing of chlorine dioxide
EFFLUENT TREATMENT
Utilization of indirect heat exchangers to reduce effluent temperature
Effluent treatment plant Secondary activated sludge
Effluent treatment plant

Tertiary flocculation / flotation / clarification
SOLID WASTE TREATMENT
Sludge presses or centrifuges
Reverse osmosis
Anaerobic digestion
Minimize generation of solid wastes
Separate collection and storage of solid wastes allowing further work with them when technology becomes available or possible to the plant
Recycling of solid residues (bark, ashes, etc)
Alternative incineration of non-hazardous organic materials (bark, wood wastes, effluent sludge) in a designed power boiler. Not all boilers are suited for.
Hazard wastes management and disposal
Landfill design and operation
Evaluation of dioxins and furans in all solid wastes from combustion sources to be used in land or soil applications
External utilization of solid wastes as fertilizers or soil pH correctors in forests and agricultural crops
GENERAL CLEAN TECHNOLOGIES & OPERATIONAL FACILITIES
Adequate automation and process control for environmental parameters
Recovery, recycle and reuses as much as possible, after sound and appropriate evaluations
Utilization of DBD & DBF free defoamers
Extensive and mill-wide spills recovery system (basins, tanks, lagoons, etc)
Emergency spill lagoon (extra capacity and always available)
Maximum closures in the water system. Effluent specific flow to modern bleached kraft pulp mills should be below 25 m^3/adt.
Utilization of kidney equipment for cleaning contaminated filtrates, liquids, etc.
Minimize fiber losses in the effluents
Separation and recycling of cooling & sealing waters
Direct the water from rain to the Water Intake Plant
Gas collection from tank vents, scrubbing and/or incineration