PULP AND PAPER

Vietnam September 2015



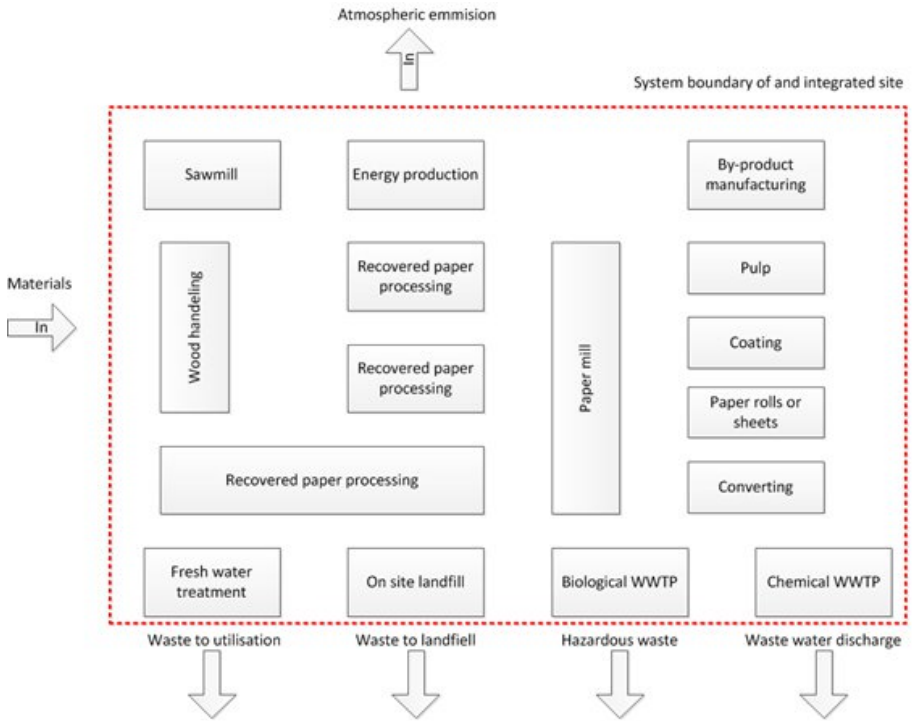
AGENDA

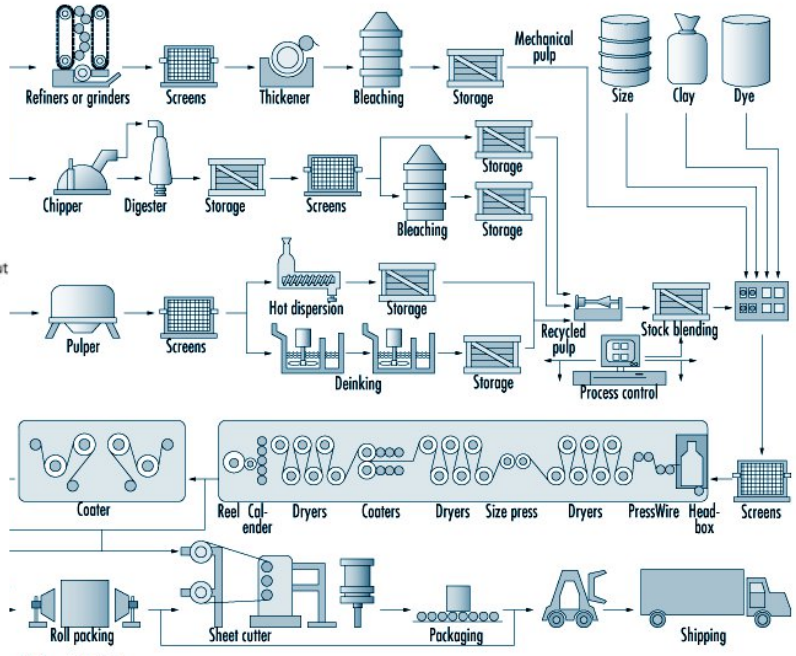
- Introduction to the handbook

- Introduction to the training program
  - Day one: Audit
  - Day two: Production
  - Day three: Utility
  - Day four: Site visit

INTRODUCTION

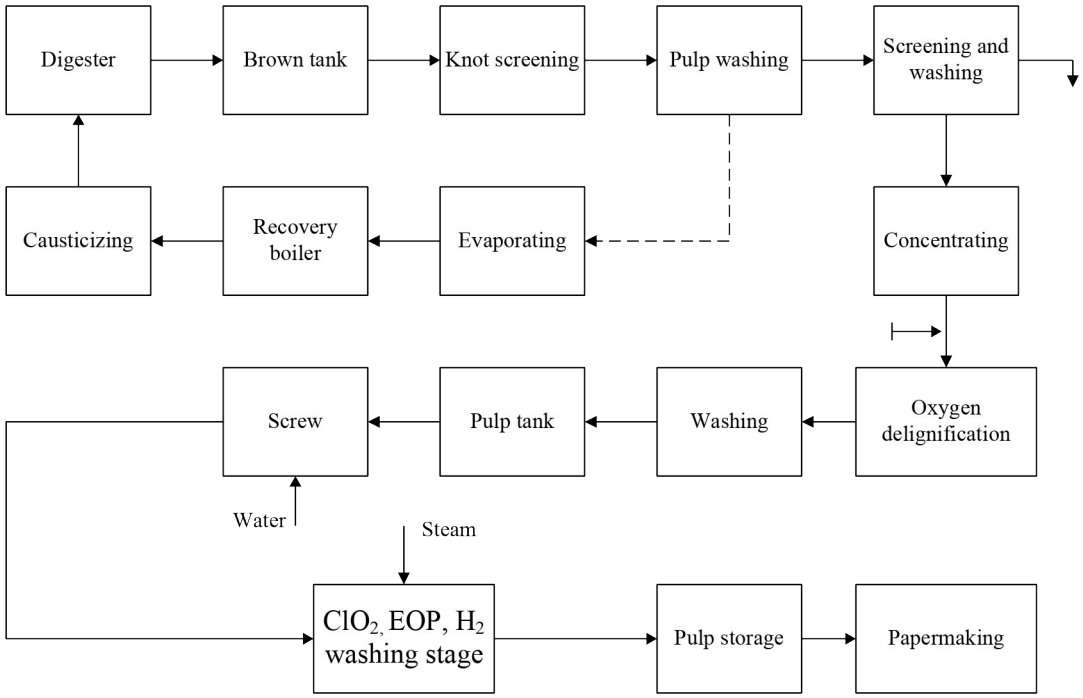
Overview – how to improve the use of energy?





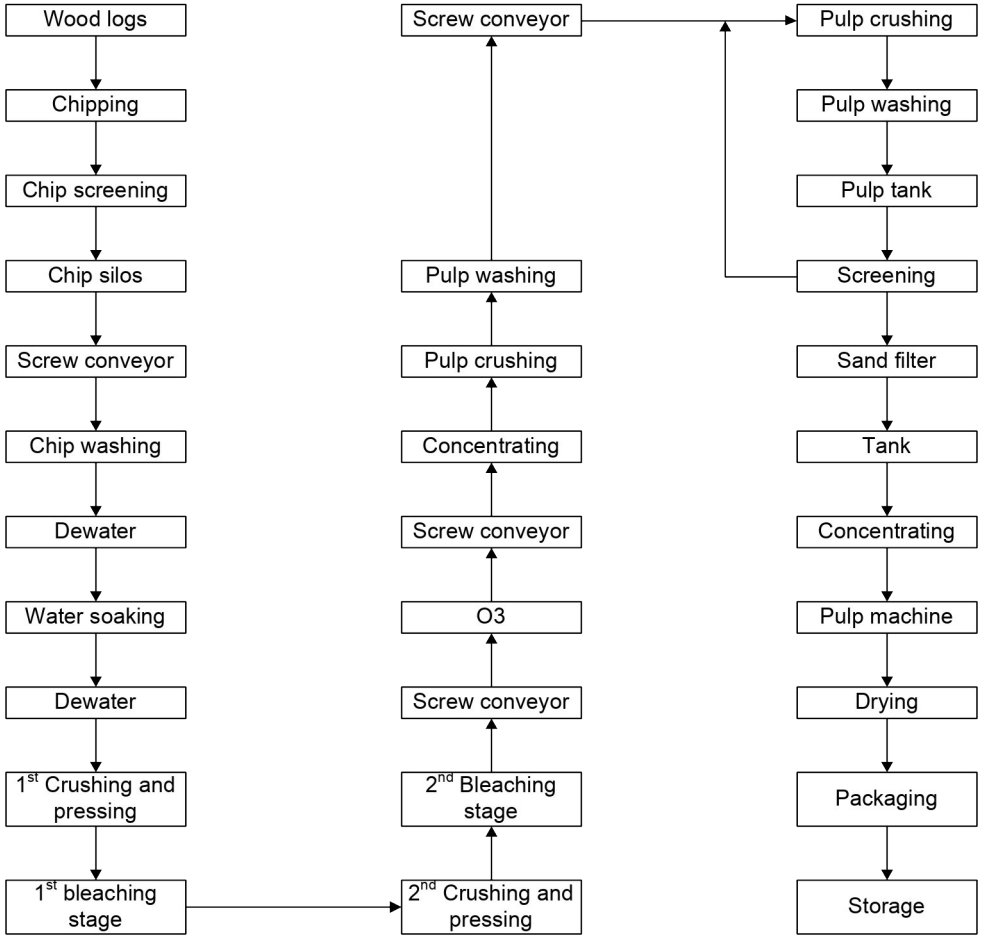
PULP PRODUCTION (I)

Production technologies for Bleached Hardwood Kraft Pulp (BHKP)



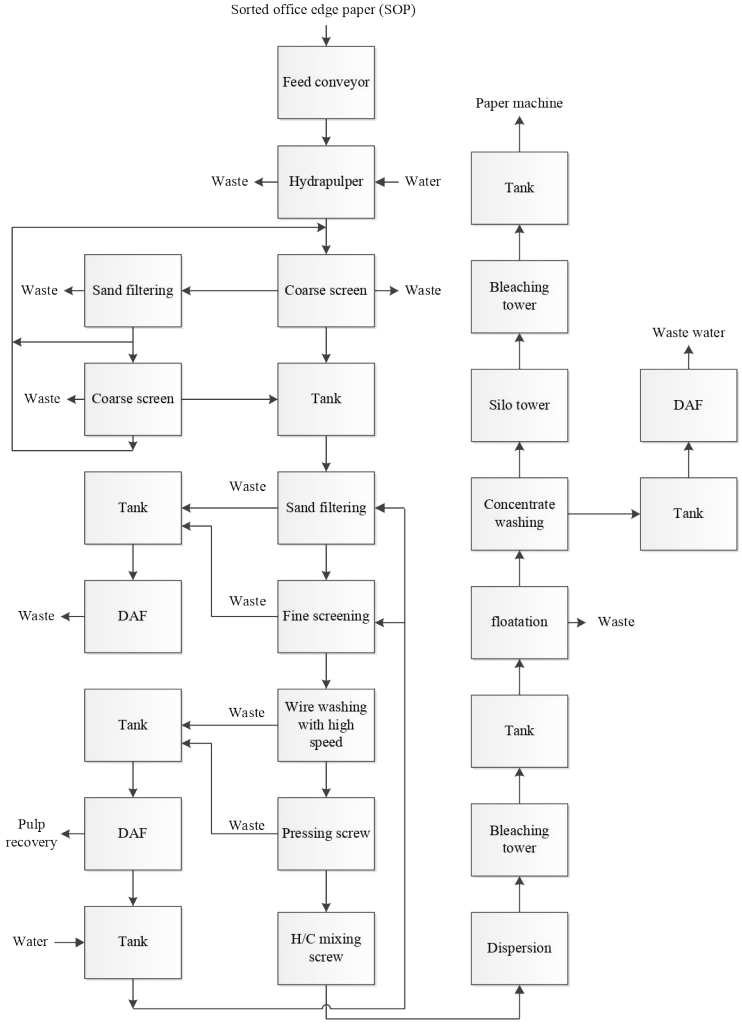
PULP PRODUCTION (II)

Chemi-*thermomechanical pulp production technology (CTMP, PRC-APMP)*



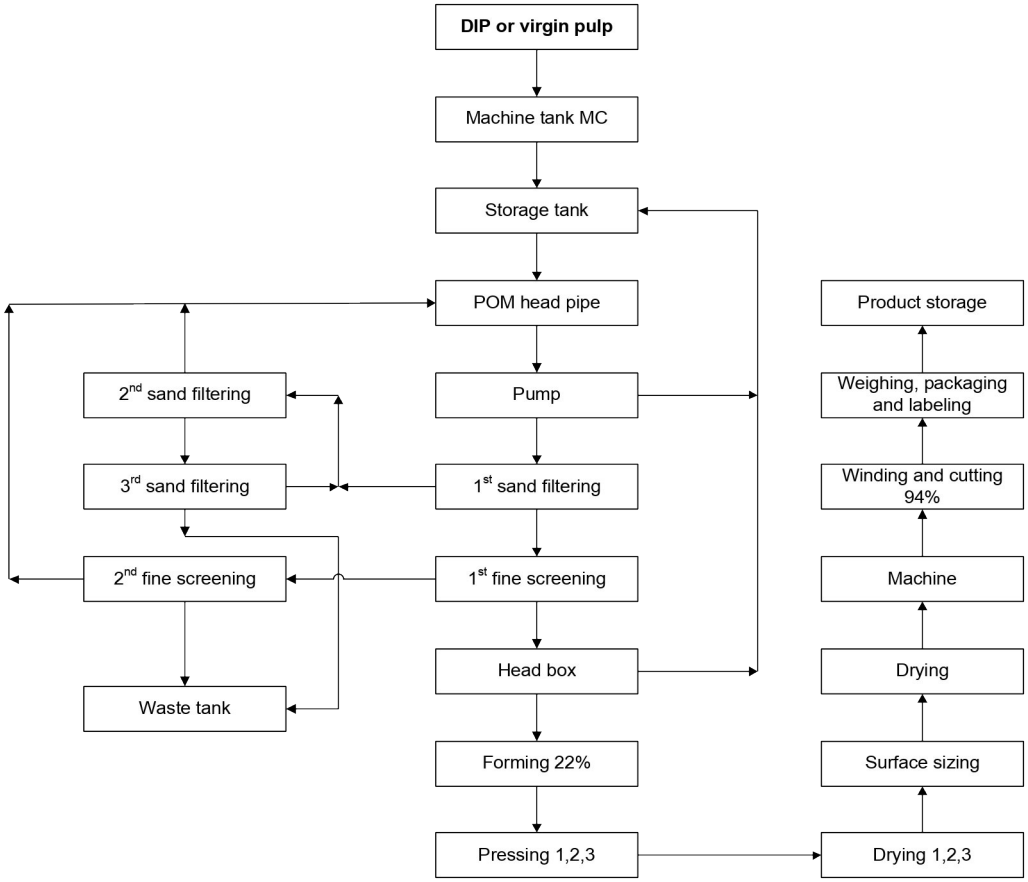
PULP PRODUCTION (III)

Production technology for recycling by the deinked method (DIP)



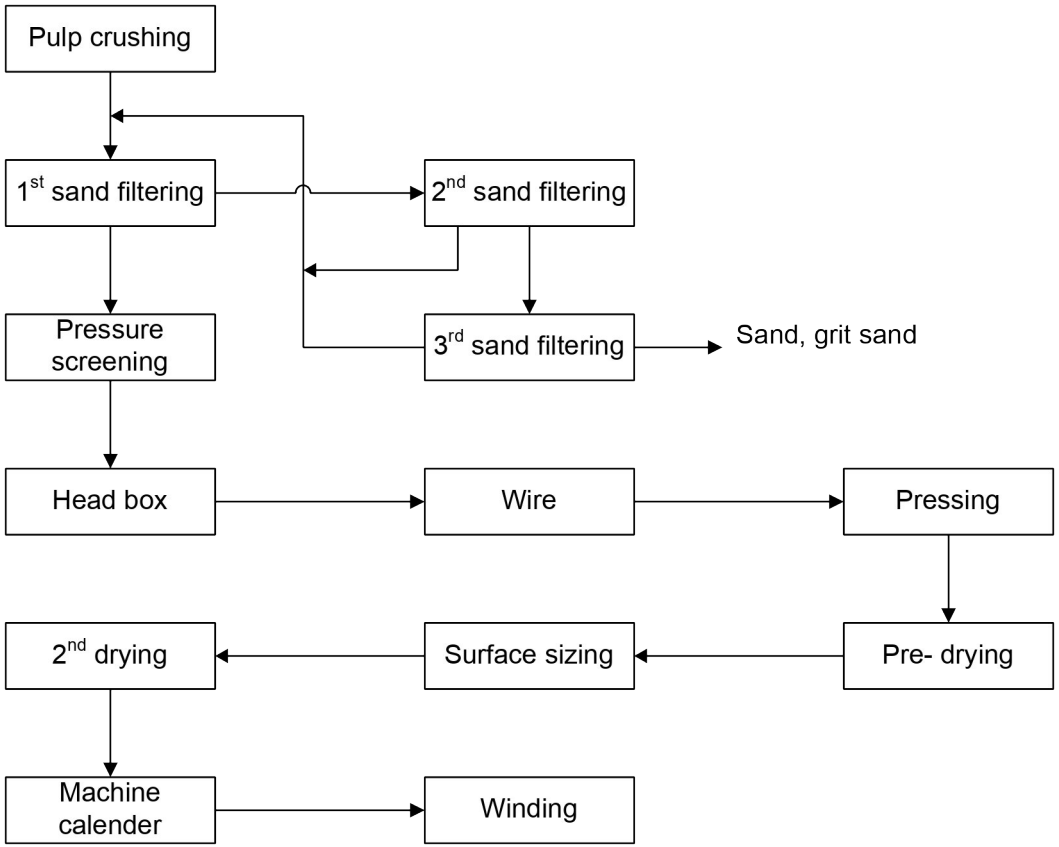
PAPER PRODUCTION (I)

Newsprint production technology



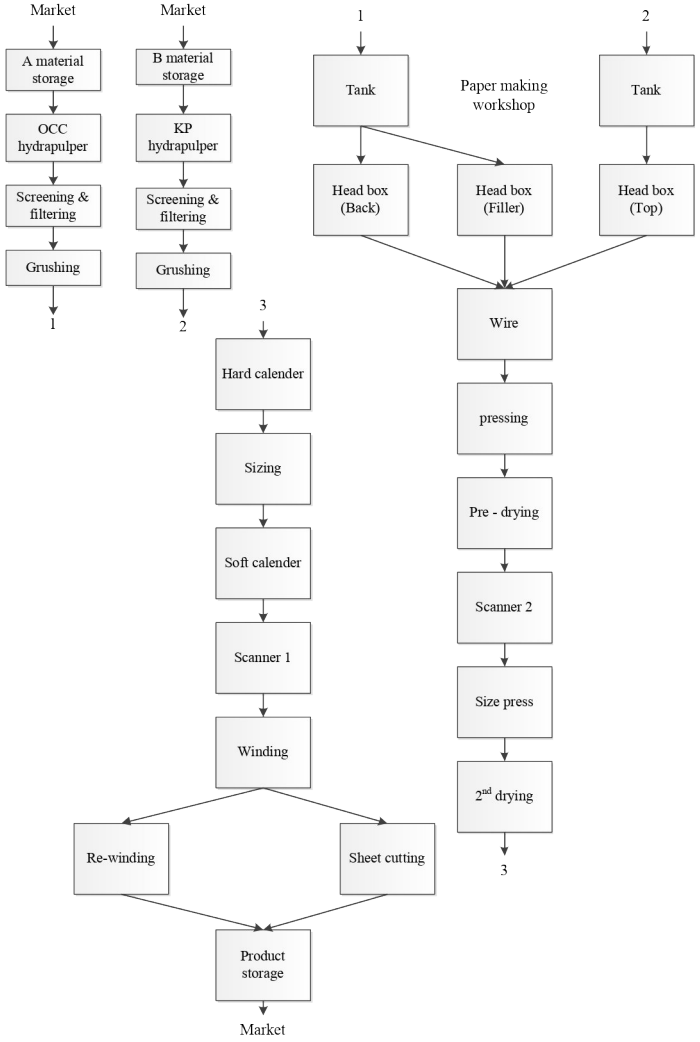
PAPER PRODUCTION (II)

Printing and writing paper production technology



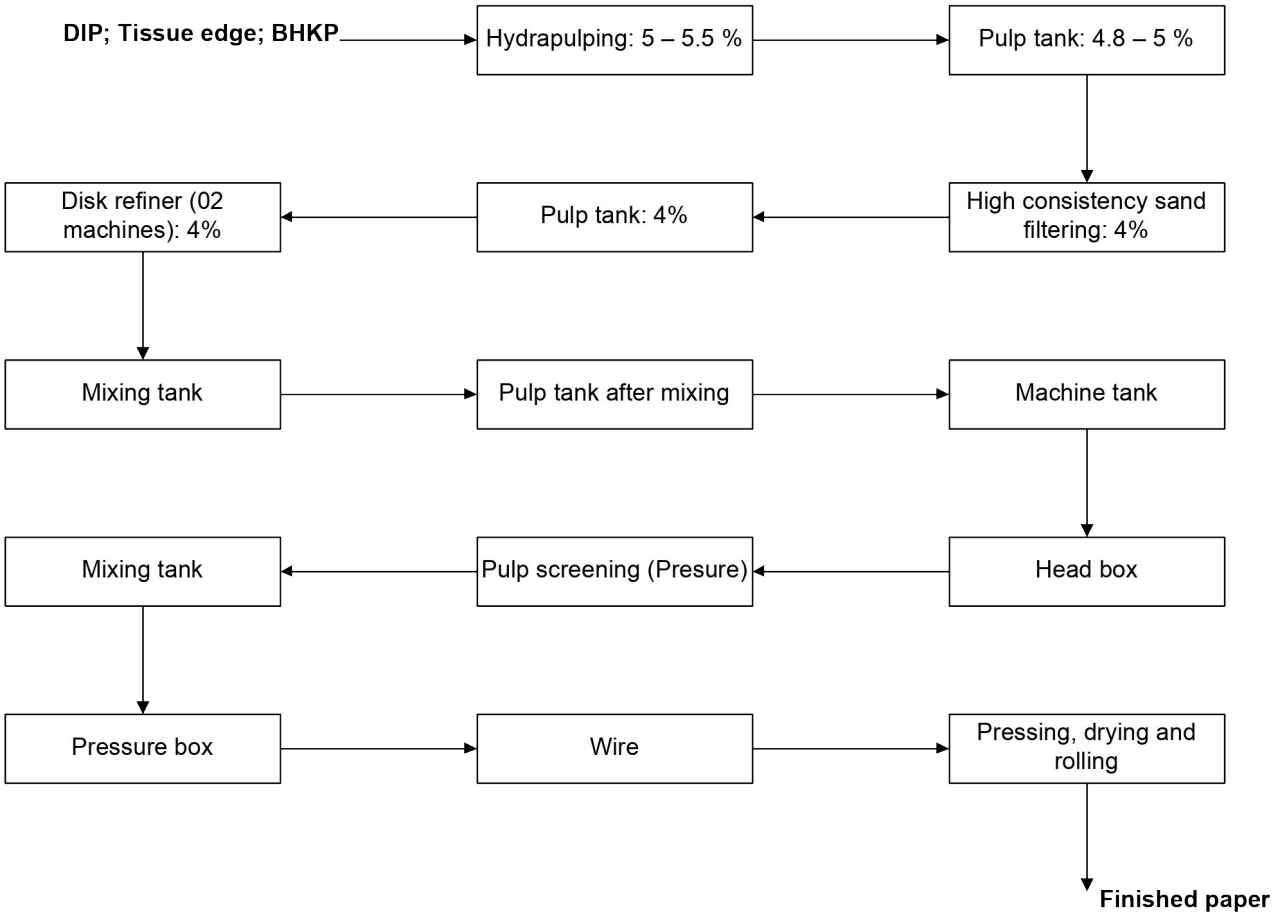
PAPER PRODUCTION (III)

Packaging paper production technology



PAPER PRODUCTION (IV)

- **Tissue paper production technology**



What is crucial ?

What is the energy service?

Where are the losses?

How can losses be identified?

How can losses be reduces?

What can cause losses?

In which form can losses ocure?

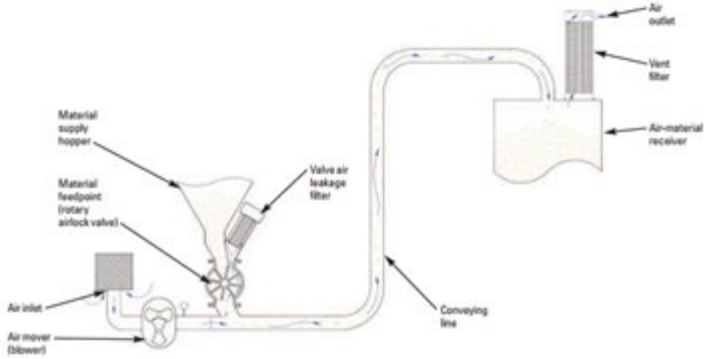
- **Material**
- **Water**
- **Energy**

Energy efficiency measures in Pre-treatment

Ex. - Replace pneumatic chip conveyors with belt conveyors:

Pneumatic chip conveyor:

- Motor efficiency
- Gear efficiency
- Air transport efficiency
- Losses of products



Belt conveyor:

- Motor
- Gear efficiency



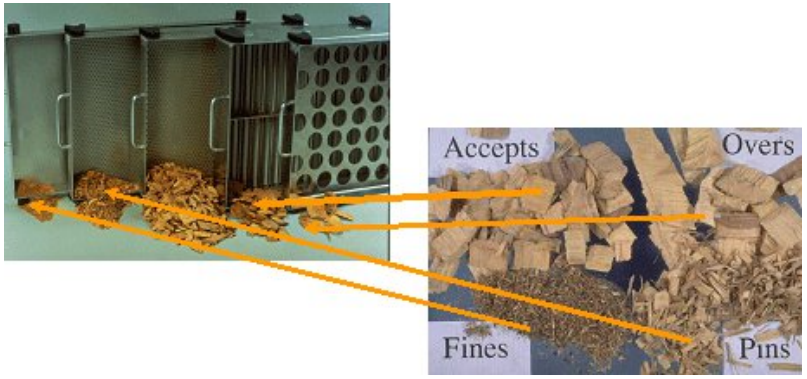
Energy Savings 80-95 %, fines 1-2 %

Maintenance costs can be significant higher

Energy efficiency measures in Pre-treatment

Ex. - Automatic chip handling and thickness screening:

- Screening:
  - **Thickness screening**
  - Jet Screen
  - OPTI
  - **Gyratory screening**
  - CS gyratory chip screen (four sizes)
  - SCL gyratory chip screen (three sizes)
  - **Processing oversize/overthick**
  - HQ-sizer (oversize and overthick)
  - Chip optimizer (oversize and overthick)
  - Rechipper (oversize only**)**
  - **Other**
  - Disc screen
- Outcome
  - Reduced cooking energy
  - Higher pulp yield
  - Higher by-product yields
  - Less chip damage



Energy efficiency measures in Pre-treatment

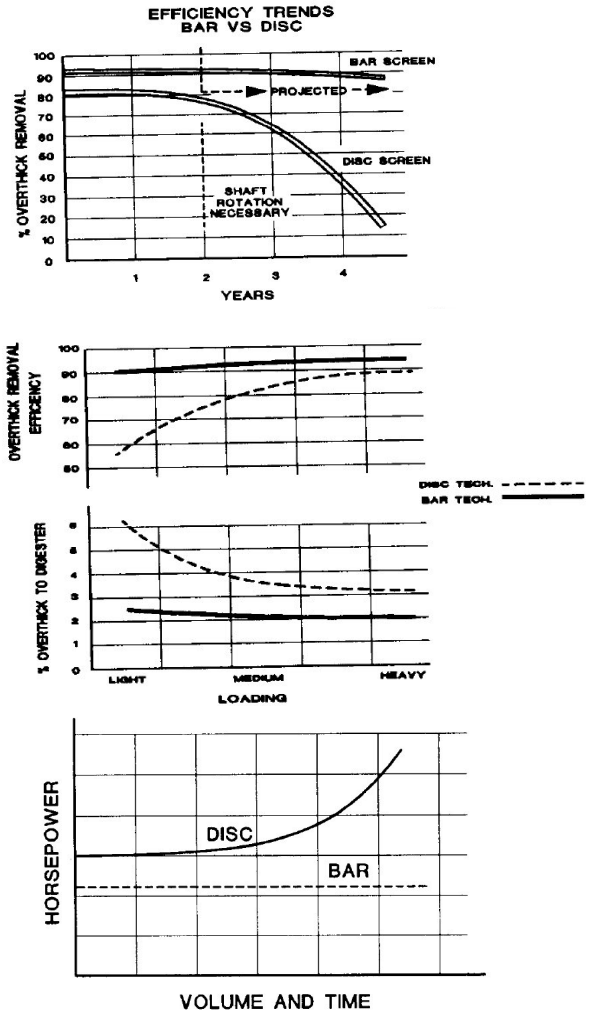
Bar-type chip screens

Benefits:

- Long lifetime
- Low maintenance costs
- Low energy consumption
- Increased yield in the pulping

What is important?

- Low level of overthick carryover
- Maintenance performance with variations in rate and size
- Consistence performance over time
- No damages of chips
- Minimum wear on screens surface



Tom E. Vala, P.E. Rader Companies, Portland, OR

Energy efficiency measures in Pre-treatment

Chip conditioning - Overthick woodchips?

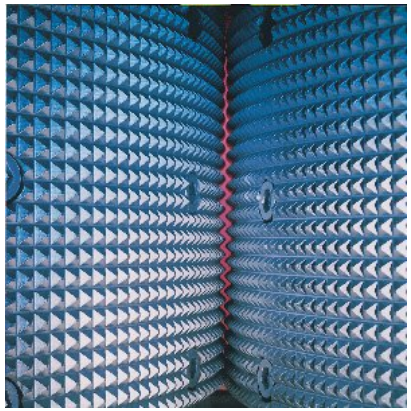
Historically:

- Slicers and rechippers where used. These machines had a negative side - the generation of pins and fines.
- A typical chip slicer may produce up to 15% pins along with 2%-8% fines depending on knife condition, moisture content, and machine loading. Rechipper type machines typically produce even higher percentages of pins and fines.

Pyramid chip conditioning

- Making cracks along fines
- Increasing surface
- Increasing liquid penetration
- Reducing fines





Assignment No. 1

- List other ways of improving the pre-treatment section.
- Consider how to quantify the improvements

Suggestions will be discusses in plenum

Energy efficiency measures in Chemical pulping

Kraft pulping – Use of pulping aids to increase yields

Pulping aids:

- Increase liquid penetration
- Promote more even cooking
- Reduced cooking time

Benefits:

- Increase pulping yield (reduction in rejected pulp)
- Reduce energy consumption (36 kWh per ton of wood)
- Reduced raw material input
- Improve productivity
- Less bleaching chemicals
- Reduction of sulfur emissions

Energy efficiency measures in Chemical pulping

Kraft pulping – Optimize dilution factor control

Minimizing the dilution factor of black liquor

- **Lower the averages amount of water that must be evaporated from weak black liquor.**



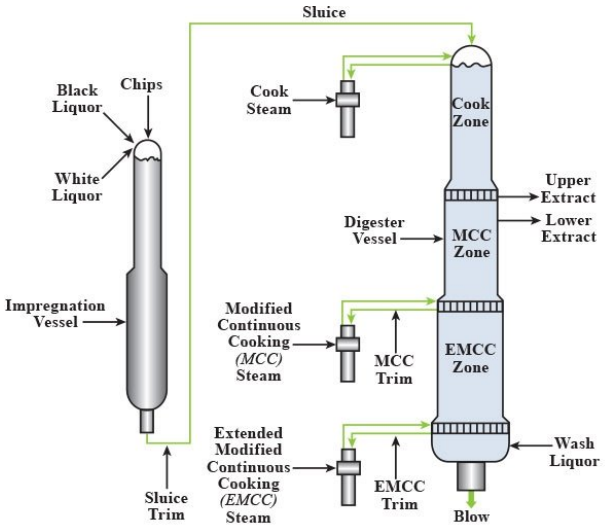
Optimizing by:

- **Controlling shower water on the large washing stage to a optimal level by:**
  - **Considering cost of steam**
  - **Costs of bleaching chemicals**
  - **Impact of effluent quality**
  - **Other process variables**

Energy efficiency measures in Chemical pulping

Kraft pulping – Continuous digester control systems

- The pulp digester is known as the bottleneck unit in the pulp mill flow sheet because it can require 5% to 50% of typical on-line operation time, making this component of the pulping process very capital intensive.
- Improving digester performance can significantly reduce production losses, operating costs, and negative environmental effects while increasing paper quantity and quality.
- Using a computer-based model and control system for continuous digesters could regulate the pulping process, thereby minimizing mill downtime caused by digester problems and fostering continuous operation and pulp production.



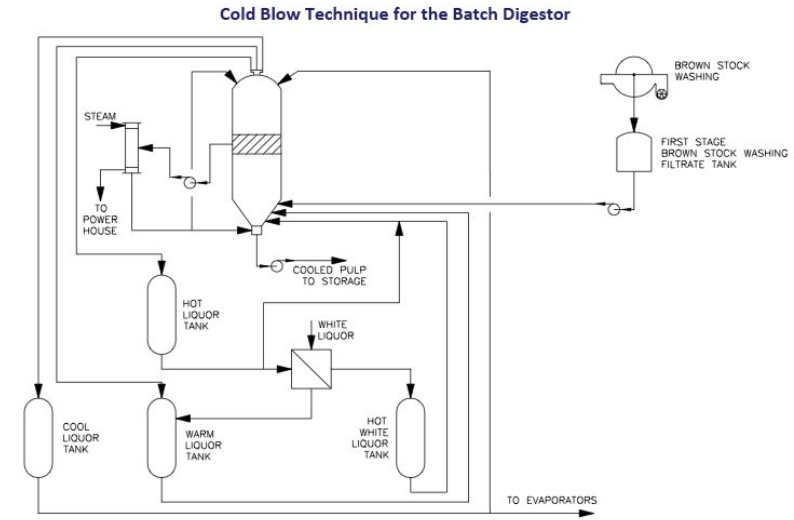
Energy efficiency measures in Chemical pulping

Kraft pulping – Batch digester modification

The batch digester good for a varaity of products.

Indirect heating and cold blow

- Using indirect steam instead of direct steam
- Heat is recovered from the liquid spend
  - **Preheating wood chips**
  - **Preheating white liquor**
  - **Preheating of precess water**



Source: NCASI, 2001.

Energy efficiency measures in Chemical pulping

Kraft pulping – Digester blow/flash heat recovery

Reduction of pressure in the digester creats steam which can be used to:

Chip-steaming – two ways:

1) flash from the first stage is used to heat chips in the steaming vessel

2) flas from the seckond stage can be used in stead of live steam in the chip bin.

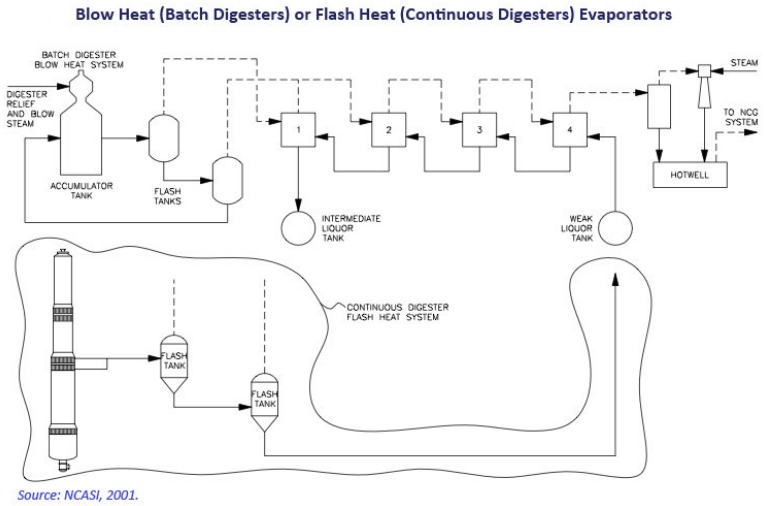
Facility water heating

Black liquor evaporation used as thermal energy in a multistage evaporator

Energy efficiency measures in Chemical pulping

Kraft pulping – Digester blow/flash heat recovery

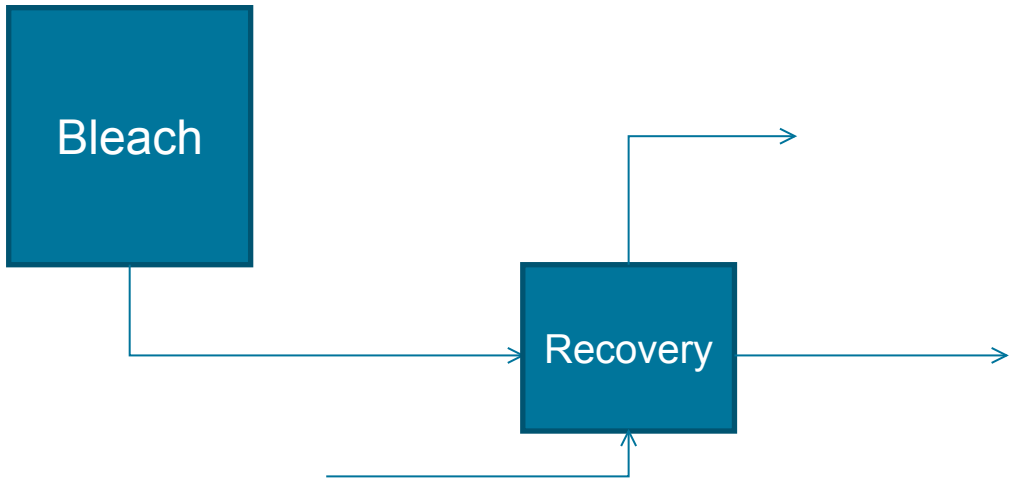
Reduction of pressure in the digester creats steam which can be used to:



Energy efficiency measures in Chemical pulping

Bleaching – heat recovery from bleach plant effluents

Bleach plant effluents can contain a large amount of heat, which will be wasted if the effluents are discharged without heat recovery. Heat exchangers can be installed to recover some of this heat for other beneficial uses around the mill, including hot water heating



Energy efficiency measures in Chemical pulping

Bleaching – Improved brownstock washing

Conventional brownstock washing technology consists of a series of three to four drum washers where a fibre mat under vacuum pressure is sprayed with water to dissolve solids.

State-of-the-art washing systems replace the vacuum pressure units with pressure diffusion or wash presses. These systems remove solids more efficiently;

- require less electric power and/or steam
- less bleaching chemicals.

In particular, wash presses have demonstrated improved efficiency and their adoption is becoming widespread in the industry.

Energy efficiency measures in Chemical pulping

Bleaching – Chlorine dioxide heat exchange

Solutions of ClO2 are normally chilled to maximize ClO2 concentration prior to use in the bleach plant.

However, preheating of ClO2 before it enters the mixer will reduce steam demand in the bleach plant, and is therefore an important energy conservation measure.

Pre-heating can be accomplished using secondary heat sources by installing heat exchangers in the ClO2 feed circuit.



Energy efficiency measures in Chemical pulping

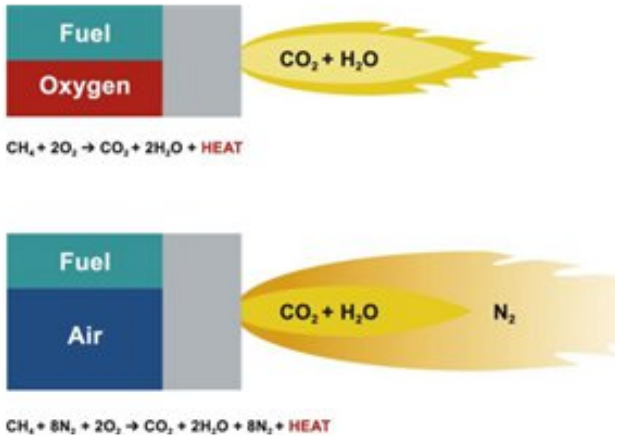
Bleaching – Other

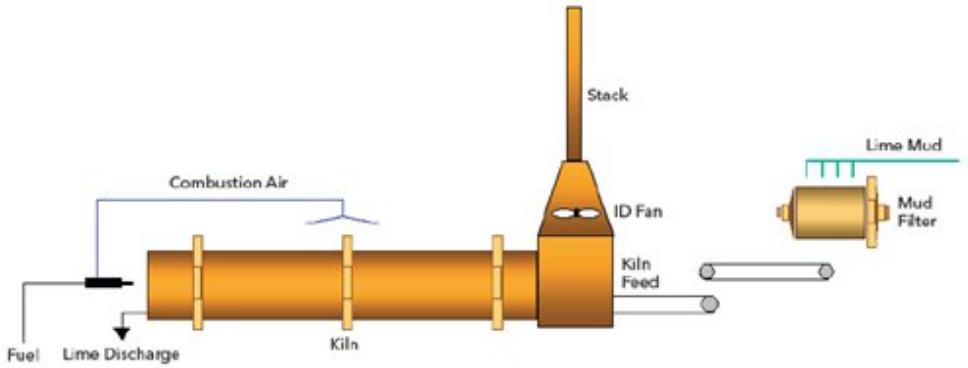
- Extended cooking
- Oxygen predelignification
- Ozone bleaching
- Oxidative extraction Direct alkali recovery system
- Biobleaching
- Washing presses

Energy efficiency measures in Chemical pulping

Chemical recovery – lime Kiln oxygen enrichment

- Oxygen enrichment is an established technology for increasing the efficiency of combustion, and has been adopted in various forms by a number of industries with high-temperature combustion processes. Oxygen enrichment of lime kilns can reduce fuel requirements by around 7-12%
- In oxygen enrichment the combustion air is substituted by oxygen (reduced by 70-80%).



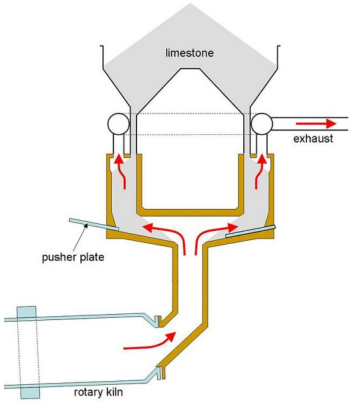


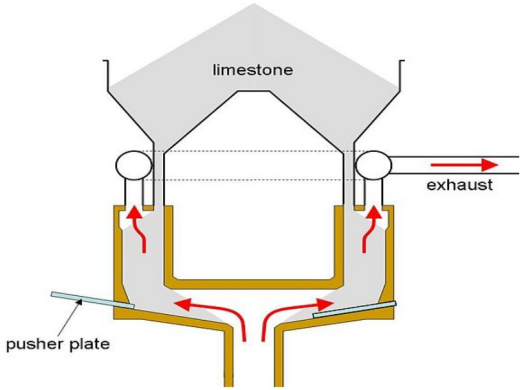
Energy efficiency measures in Chemical pulping

Chemical recovery – lime Kiln modification

Several modifications are possible to reduce energy consumption in lime kilns.

- High efficiency filters can be installed to reduce the water content of the kiln inputs, thereby reducing evaporation energy.
- Higher efficiency refractory insulation brick can be installed to decrease radiation heat losses from the kiln.
- Heat can also be captured from the lime and from kiln exhaust gases to pre-heat incoming lime and combustion air. Energy savings achievable through the combined application of the above measures is around 138 kWh per ton of production. Furthermore, such improvements may also improve the rate of recovery of lime from green liquor, thus reducing a mill's requirement for additional purchased lime

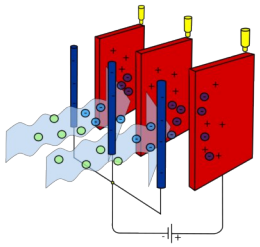


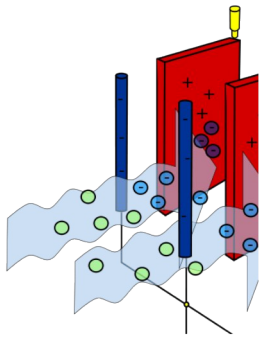


Energy efficiency measures in Chemical pulping

Chemical recovery – lime Kiln electrostatic precipitators

- Electrostatic precipitators can replace wet scrubbers on lime kilns and lead to energy and water savings. Electrostatic precipitators can collect kiln dust as a dry material, and return it directly to the kiln feed without unnecessarily loading the lime mud filter.
- In contrast, wet scrubbers require effluent recycling via the lime mud filter and are significant consumers of water.
- Analysis has shown then by increasing mud dryness from 70% to 75% would reduce fuel consumption by 117 kWh per ton of lime

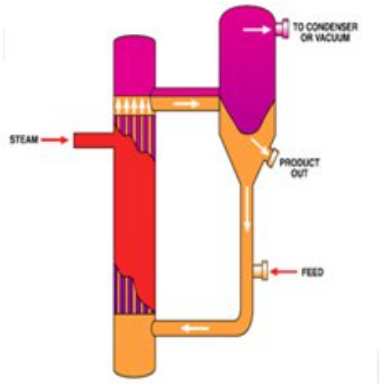


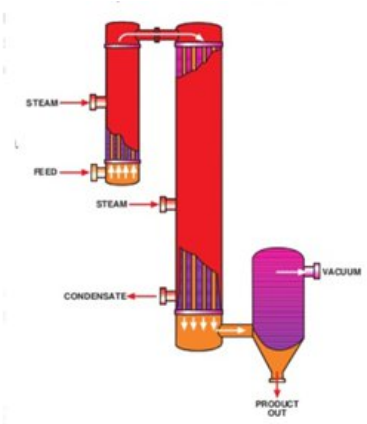


Energy efficiency measures in Chemical pulping

Chemical recovery – black liquor soids concentration

- Black liquor concentrators are designed to increase the solids content of black liquor prior to combustion in a recovery boiler.
- Increased solids content means less water must be evaporated in the recovery boiler, which can increase the efficiency of steam generation substantially.
- There are two primary types in use today: submerged tube concentrators and falling film concentrators





Energy efficiency measures in Chemical pulping

Chemical recovery – Improved composite tubes for recovery boilers

Recovery boilers consist of tubes that circulate pressurized water to permit steam generation. These tubes are normally made out of carbon steel, but severe corrosion thinning and occasional tube failure has led to the search for more advanced tube alloys.

Research has led to the development of new weld overlay and co-extruded tubing alloys. These advanced alloys make it possible to use black liquor with higher dry solids content, leading to an increase in boiler thermal efficiency, as well as to a decrease in the number of shutdowns.

Energy efficiency measures in Chemical pulping

Chemical recovery – Recovery boiler deposition monitoring

- Better control of deposits on heat transfer surfaces in recovery boilers can lead to higher operating efficiencies, reduced downtime, and more predictable shutdown schedules.
- A handheld infrared inspection system has been developed that can provide early detection of defective fixtures and slag formation, preventing impact damage and enabling cleaning before deposits harden.
- The system can reportedly provide clear images in highly particle-laden boiler interiors, and enable inspection anywhere in the combustion chamber.
- Benefits:
  - Increases thermal efficiency
  - Improves boiler productivity
  - Decreases boiler shutdowns and gaseous emissions
  - Improves boiler safety

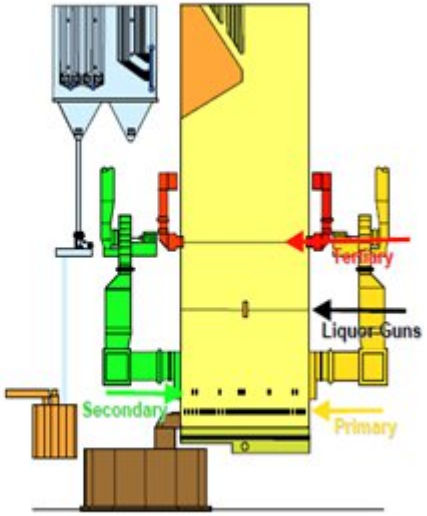
Energy efficiency measures in Chemical pulping

Chemical recovery – Quaternary air injection

Manny recovery boilers have three stages of air injection, but utilize the third stage in a limited fashion.

By fully utilizing the third stage and adding a fourth air injection port, carry over and tube fouling can be reduced.

This can reduce the frequency of recovery boiler washing, which will lead to energy savings because boiler shut downs and reheat can be reduced



Assignment No. 2

How much energy can be recovered from bleaching effluent, using the following data?

- Discharge volume: 1.000 ton
- Heat capacity: 3,8 kJ/kg K
- Discharge temperature: 75 C

Where can it be put into use?

Energy efficiency measures in Mechanical pulping

Mechanical pulping

Mechanical pulping is the oldest form of pulping. The process employs mechanical energy to weaken and separate fibres from wood and waste paper feedstock via a grinding action.

The advantage to mechanical pulping is that it produces much higher yields than chemical pulping processes (up to 95%). However, because this process does not dissolve lignin, the fiber strength and age resistance of the resulting pulp are low.

The weakness of the resulting pulp is compounded by the fact that the mechanical grinding process also produces shorter fibres. As a result, most mechanical pulp is used for lower grade papers such as newsprint, magazines, and catalogues. Mechanical pulping also requires more raw materials screening to remove contaminants such as dirt, shives, and knots than chemical pulping processes.

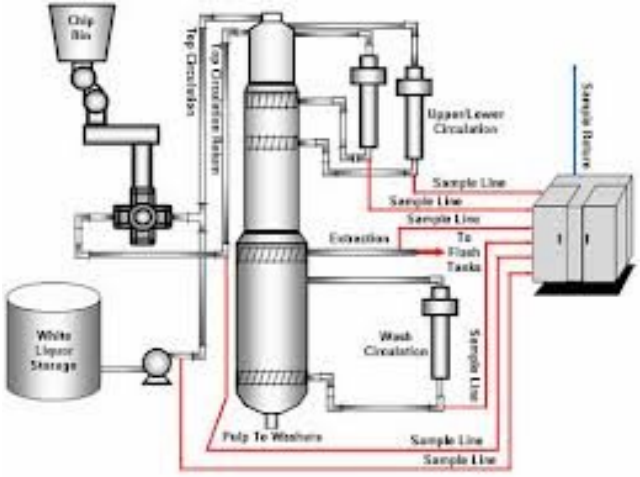
- Stone groundwood pulping
- Refiner mechanical pulping
- Thermomechanical pulping
- Chemi-thermomechanical pulping

Energy efficiency measures in Mechanical pulping

Mechanical pulping – Continuous repulping

The repulping process for purchased market pulp involves blending the dried pulp feedstock with water in a large tank to produce a fibrous slurry.

Typically this is done as a batch process, but converting to a continuous process can lead to energy savings due to improved process efficiency. The energy savings up to 40% are possible, in the form of reduced pulping motor power requirements



Energy efficiency measures in Mechanical pulping

Mechanical pulping – Efficient repulping rotors

Newer repulper rotor designs have been optimized for power consumption using computational fluid dynamics simulations to study the interaction of rotors with pulping slurries.

Reportedly, replacing an existing rotor with a new rotor that is optimized for efficiency can reduce rotor motor consumption by anywhere from 10% to 30%.



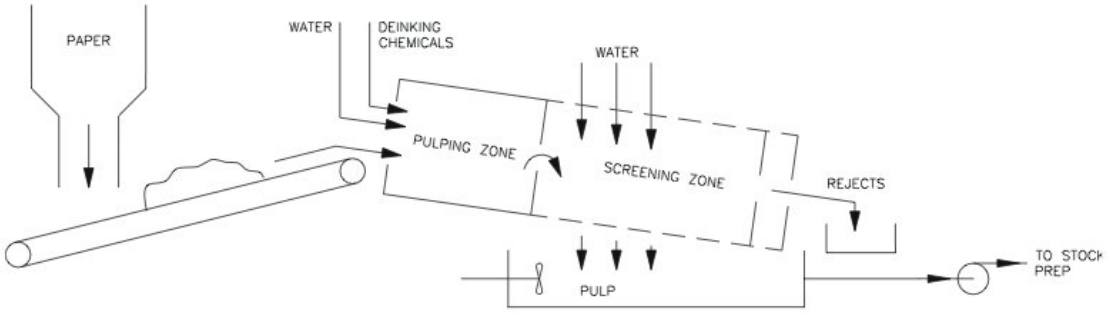


Energy efficiency measures in Mechanical pulping

Mechanical pulping – Drum pulpers

- Drum pulpers are applicable to mills that generate pulp from recovered paper and paperboard products.
- A drum pulper is essentially a rotating, inclined drum with baffles that is used to mix recovered fiber sources, water, and (in de-inking applications) deinking chemicals. The more gentle mechanical action of drum depulpers allows contaminants to remain intact while the paper is defibered.
- Drum pulpers have lower energy requirements than conventional mechanical pulpers, can use less water, and reduce fiber shortening.

Drum Pulper



Source: NCASI, 2001.

Energy efficiency measures in Mechanical pulping

Mechanical pulping – Heat recovery from de-inking effluent

- De-inking effluents are often discharged at elevated temperatures and represent a possible source of low-grade heat recovery in a typical recycled fibre pulping mill.
- The installation of heat exchangers in the effluent circuit can recover some of this heat for other beneficial uses, such as facility water heating.

- Example: A paper mill produces newsprint and specialty paper products on three paper machines, using about 60% recycled fiber from old newsprint and magazines in its furnish. The mill's combined effluent streams were at approximately 48°C with a flow rate of 170 m^3/h. A heat exchanger system would generate warm filtered shower water for the mill's paper machines, which would offset some of the mill's steam demand.

Energy efficiency measures in Mechanical pulping

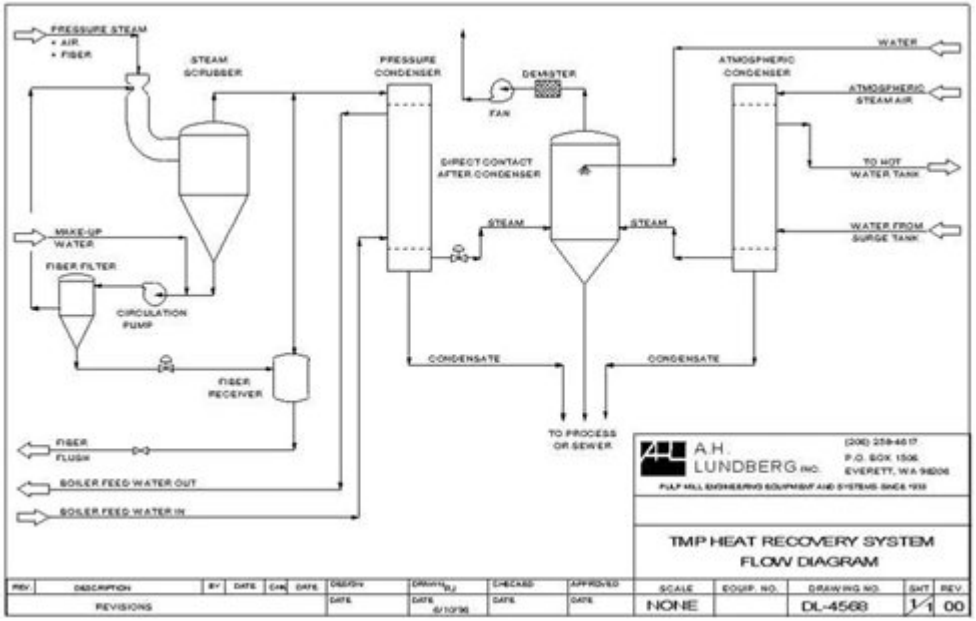
Mechanical pulping – Heat recovery inTMP

- A vast amount of steam is produced as by-product of thermos mechanical pulping. This low-pressure steam is often contaminated, but most of the energy can be reclaimed for use in other mill processes through heat recovery equipment. Heat recovery options include:
  - Mechanical vapor recompression or integrated mills, where the clean steam generated can be used in the paper machine dryer section
  - Direct contact heat exchangers for generating hot water for use in paper machines and as boiler makeup water and clean process steam
  - Reboilers for producing clean process steam
  - Other devices such as thermo vapor recompression and cyclotherm plus heat pump systems

Energy efficiency measures in Mechanical pulping

Mechanical pulping – Heat recovery inTMP

- The TMP heat recovery is applicable to any mill that uses pressurized refining and currently does not use heat recovery (which usually means older mills, because most modern TMP mills are designed with heat recovery systems).
- A typical heat recovery systems for pressurized refiners can generate 1.1 to 1.9 tons of clean steam at dryer can pressure per ton of pulp.



Energy efficiency measures in Mechanical pulping

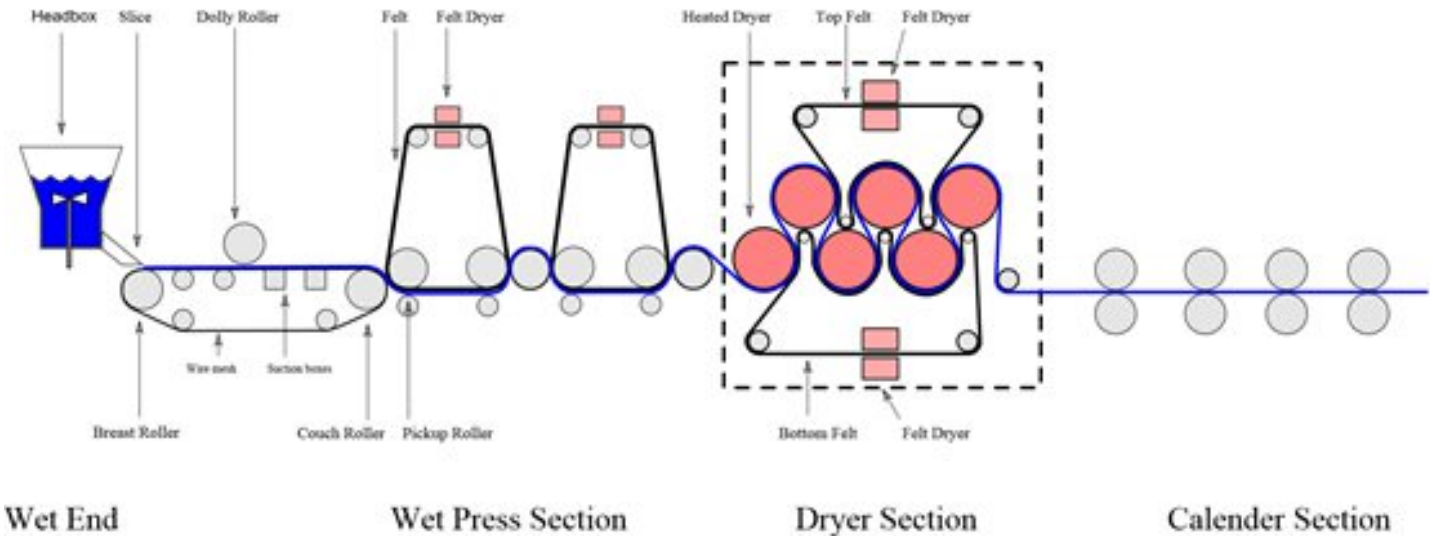
Mechanical pulping – Other measures

- Increased use of recycled pulp
- Thermopulping
- RTS pulping
- Fractionation of recycled fibre

Energy efficiency measures in paper production

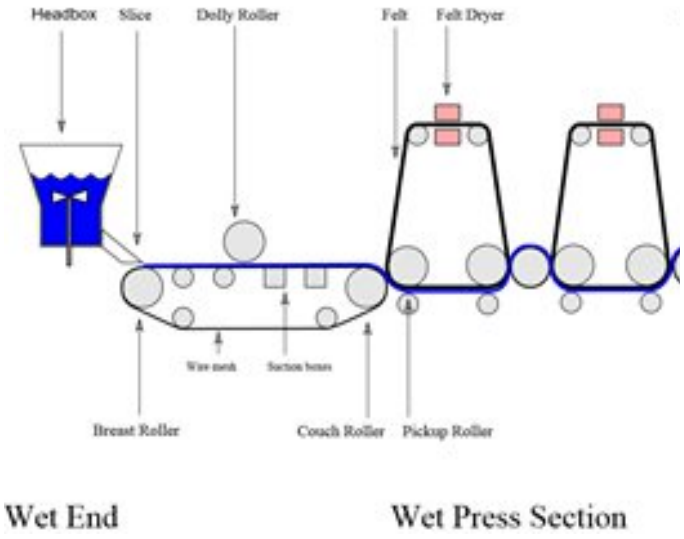
Paper production:

- A rule of thumb:
  - Four times the energy is needed in the press, compared to the forming section
  - 25 times the energy is needed in the dryer, compared to forming section



Energy efficiency measures in paper production

Wet section



Energy efficiency measures in paper production

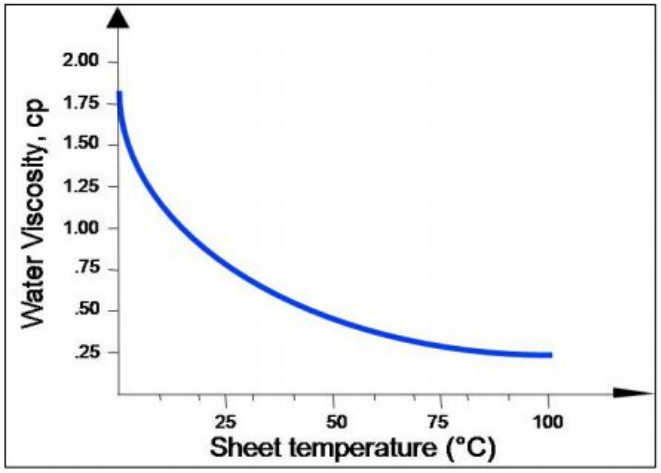
Wet section - Optimization of water removal in forming and pressing

- On older paper machines:
  - excessive quantity of high vacuum elements which add to the vacuum system operating power
  - increasing the forming fabric drag load and associated drive power
- Reducing of rewetting
  - Use of the right felt for the actual paper grade
  - Optimise the geometry of the web and felt path shuts as the two are separated as early as possible
- Press:
  - Press nip loading needs to be maximized within design limits
  - Optimising roll covering surface patterns
  - Felt design
  - Minimize temperature reduction

Energy efficiency measures in paper production

Wet section – Preheating with at steam box

- A steam box is installed to increase the temperature of the wet paper sheet, before pressing, so that the water viscosity will be reduce and it will drain/dry easier.
- This then allows the paper machine to run at a fastest speed or use less energy. The steam box will use energy in the form as steam, but the energy saving in the drying section will be much higher.
- The add steam increases the temperature and the viscosity.
- The saving is equivalent the reduced amount of water that needs to be evaporated.



Energy efficiency measures in paper production

Wet section – Press dewatering

Dewatering in the papermaking machine is achieved by increasing the nip pressure and by applying it uniformly in the cross direction.

To ensure effective use of the equipment function, repair, maintenance and adequate modifications must be provided at all times.

Care should be taken in the daily control to assure that the press blanket is elastic enough to have a sufficient suction force.

W = (Pw-Dm)/(1-Pw)

- W: is the amount of moister evaporated from 1 kg of dm% paper [kg]
- Dm: Is the wet web moisture at dryer part outlet [%]
- Pw: is the wet web moisture at press outlet [%]

The table show the moisture evaporated from Pw% of wet paper in the production of 1 kg of paper, when paper moisture at the dryer end (Dm) is 5% or 10%:

Pw %		65	64	63	62	61	60	59	58	57	56	55
W (kg)	Paper moisture: 5 % (Dm)	1,71	1.64	1.57	1.50	1.44	1.38	1.32	1.26	1.21	1.16	1.11
	Paper moisture 10% (Dm)	1.67	1.50	1.43	1.37	1.31	1.25	1.20	1.14	1.09	1.05	1.00

Assignment No. 3

Using the rule of thump then what will be the effect on the dryer if the water content in the press where reduced by 2%?

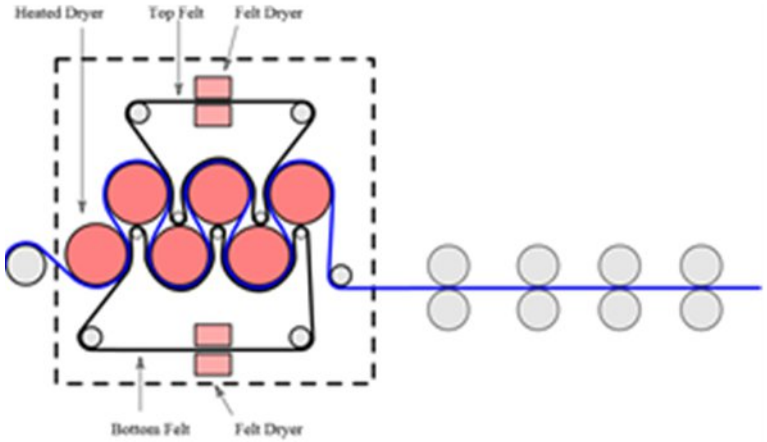
Energy efficiency measures in paper production

Dry section:

The water needs to be removed from the paper, and after the pressing section, the only way to remove water is by evaporation. Evaporation of water takes a lot of energy, but there is no other way to do this.

It is important to look at how the water is evaporated and if the equipment is working optimal.

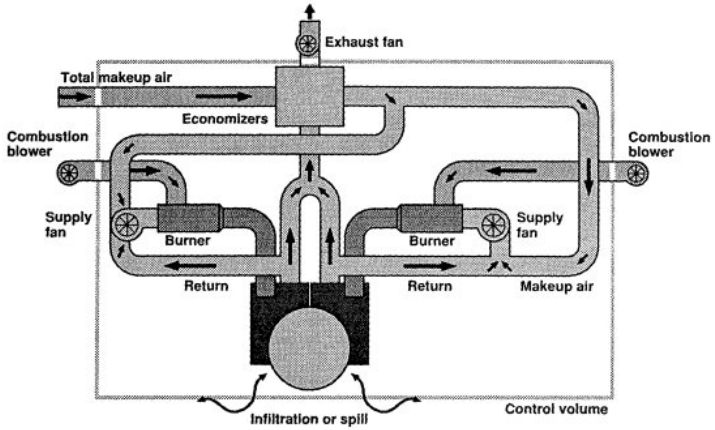
There are three major areas of the drying section when we are looking at energy consumption. This is air handling and heating, steam and water consumption, direct combustion.



Energy efficiency measures in paper production

Dry section – Reduce and reuse of moist air

- The water that evaporates from the paper lane is removed by air which it dissolves in. At some point, the air will be saturated with water and cannot carry any more water and needs to be changed with fresh air. The physical properties of air are that the solubility of water increases radically with increase temperature.
- The most important thing is that the outgoing air is heat exchanged with the ingoing air. This is normally installed in all systems and is considered as a standard. The effectivity of the heat exchangers can vary, and this is important to check.
- It is also important to use the whole drying capacity of the air before it is led to the surroundings. The drying capacity of air is dependent on the relative humidity, not the specific, which is dependent of the temperature. The general idea is to measure the relative humidity of the outgoing air, and if it is to low, recirculate it back into the drying section



Energy efficiency measures in paper production

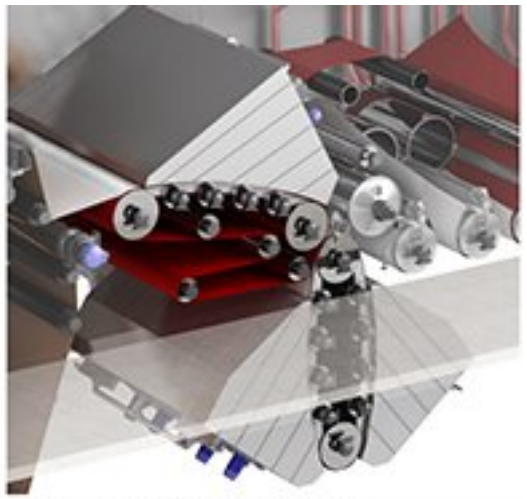
Dry section – Heat recovery from exhaust system

- On a paper mill there can be multiple different sources of hot air leaving thru the stack. This hot air contains a lot of energy that can be reused in the process leading to saving in energy or increased production. The first step in reusing energy is to see if there can be I direct heat transfer between an outgoing stream and a new ingoing. After this potential has been utilized as much as possible, the next step is to look at secondary utilisation of heat energy.
- The most common way is to install air to water heat exchangers in hot air outlets. In this way a lot of heat energy can be transferred to feed water or other kinds of low temperature water. Another utilisation is to heat up the back water an increase the general temperature on the paper machine.
- Hot air leaving the production if often very moist, and there is a lot of latent energy in all that water. If it is possible to condensate some of that water, a lot of energy can be recovered. Usually this will happen at very low temperature and it can be difficult to find a heat sink. A solution could be a heat pump to raise the temperature level, but this should need more calculations and engineering.

Energy efficiency measures in paper production

Dry section – Use of air impingement dryers

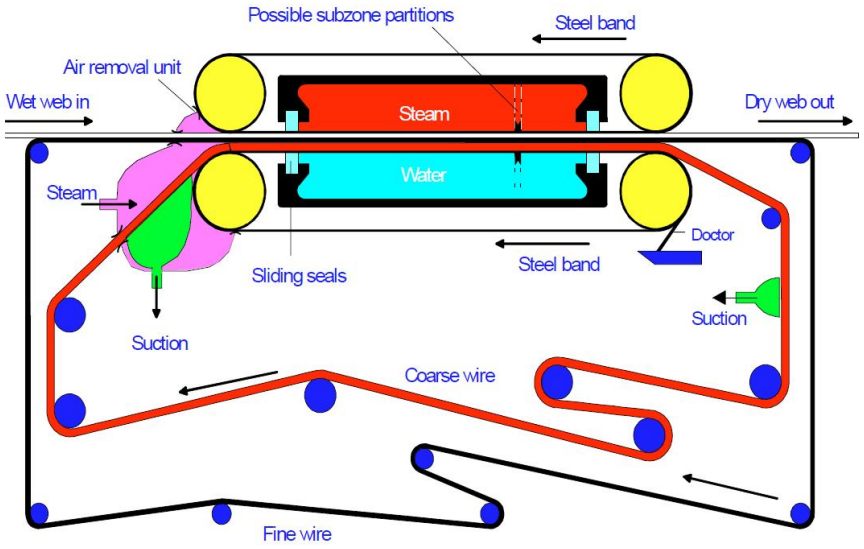
- Air impingement drying involves blowing hot air (at 300C) in gas burners at high velocity against the wet paper sheet. Air impingement drying leads to less steam use and slightly higher electricity use. This technology is mostly applicable to coating drying, but is also gaining acceptance for general paper drying in place of traditional steam cylinders.
- Given that this measure involves a trade off between thermal and electrical energy use, and the extent of this trade off may vary by installation, it is important that net energy savings is verified on a facility basis.



Energy efficiency measures in paper production

Dry section – Use of Condebelt drying

- In CondeBelt drying the paper is dried in a drying chamber by contact with a continuous hot steel band, heated by either steam or hot gas. The water from the paper is evaporated by the heat from this metal band.
- This drying technique has the potential to completely replace the drying section of a conventional paper machine, with a drying rate 5-15 times higher than conventional steam drying. However, CondeBelt drying is not suited for high basis weight papers and has seen limited application



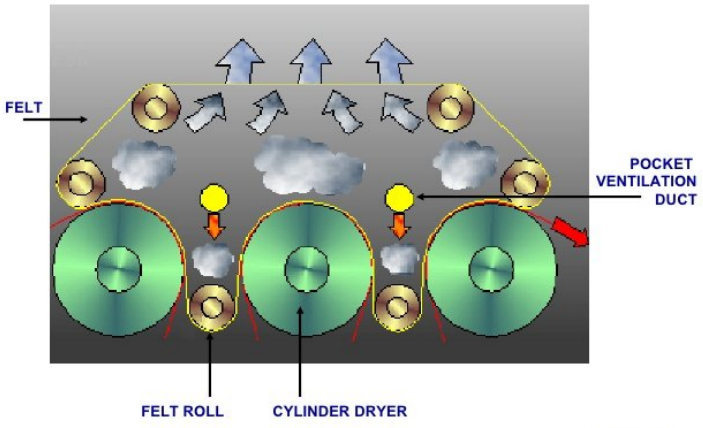
Energy efficiency measures in paper production

Dry section – Optimizing pocket ventilation temperature

For the efficient drying of paper, it is extremely important to remove the water vapour from around the web to increase the driving force for evaporation.

Increasing the cylinder surface temperature does not necessarily improve the water removal rate during paper drying process, as water evaporated from the web must be removed from the pockets by sufficiently hot and dry air. Function of the ventilation:

- capture and remove water evaporated in the dryer section
- create a controlled and favorable environment for the drying process
- improve energy utilization and energy economy in the drying process
- improve the runnability of the machine not only by means of runnability systems but also through the proper distribution and control of airflows throughout the entire dryer section
- maintain good working conditions in the machine room in terms of heat, humidity and noise
- protect the building and machinery from deterioration because of the humidity
- reduce emissions and mist to the outside of the mill.



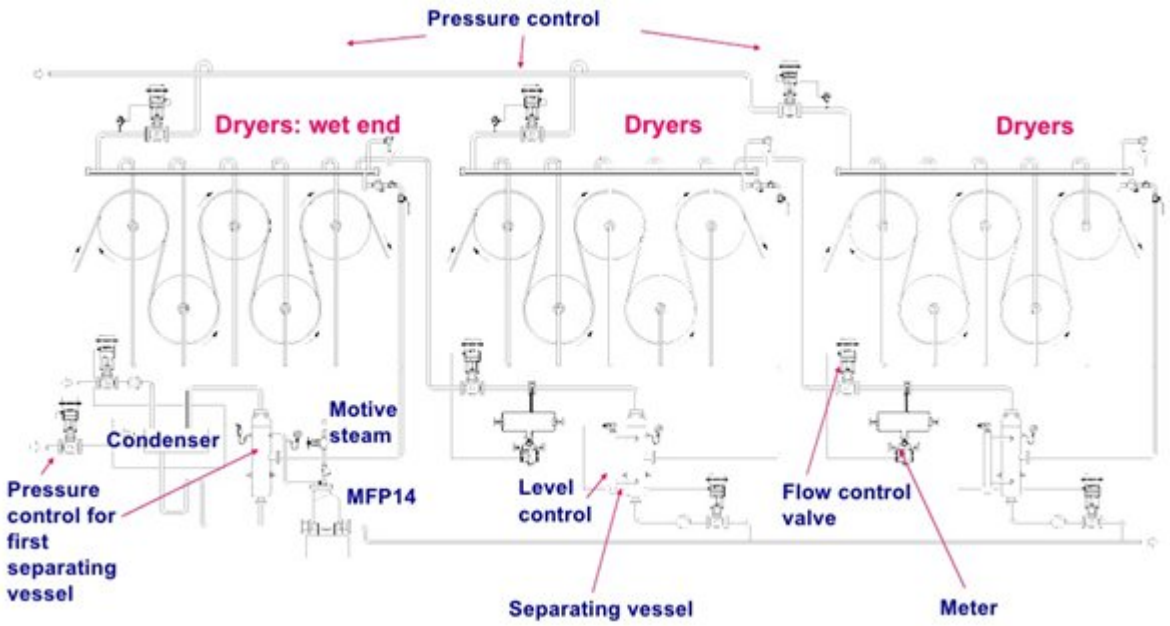
Energy efficiency measures in paper production

Dry section – Cascade system

- A cascade system can be categorised as a heat recovery system, because the flow-through and flash steam which arise at the heating of the dryer or of one drying group is used again for heating the dryers.
- The cascade system is working its way down from the dry end to the wet end by the differential pressure in the heating system
- The drying of paper starts at a low temperature in the pre-drying section where the paper is gently heated up. The drying increases because water starts to evaporate towards the dry end of the paper machine. In the dryer steam is condensate on the inside surface of the dryer. From the dryers the condensate is returned to a separating vessel.
- In order to drain the condensate, the pressure in the separating vessel must be lover then of the live steam. In the separating vessel the blow through steam is then released into the second stage drying of the cascade system.
- At the second stage the flash steam is used as a drying media. If the steam amount is not enough to cover the demand them live stem com be added by the second pressure control valve.

Energy efficiency measures in paper production

Dry section – Cascade system

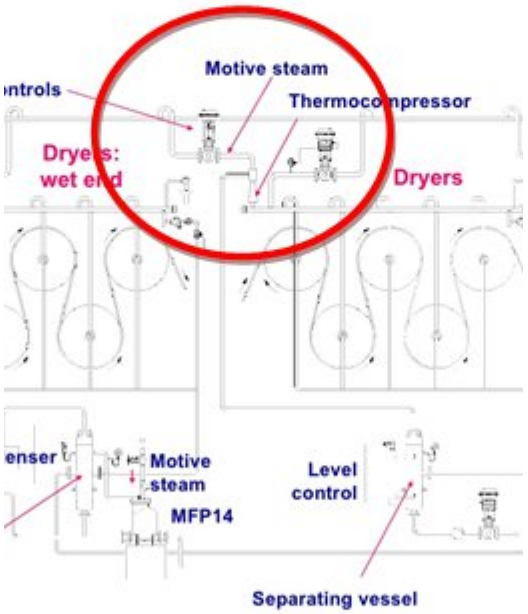


Energy efficiency measures in paper production

Dry section – Cascade system.

The use of a thermo compressor:

- The use of thermo-compressors increases the energy efficiency of the drying process because less steam has to be sent to the condenser. The thermo-compressors are used to increase the pressure of the exhaust vapours from separators.
- The exhaust vapours from the last separators in a cascaded steam and condensate system have a very low pressure level which is not directly useable for the drying process.
- With a steam thermo-compressor this exhaust vapour is boosted with high pressure steam to a pressure level which enables a recovery of the exhaust vapour to use it again for the drying process. The figure below illustrates the principals of the integration of the thermos compressor.



Energy efficiency measures in paper production

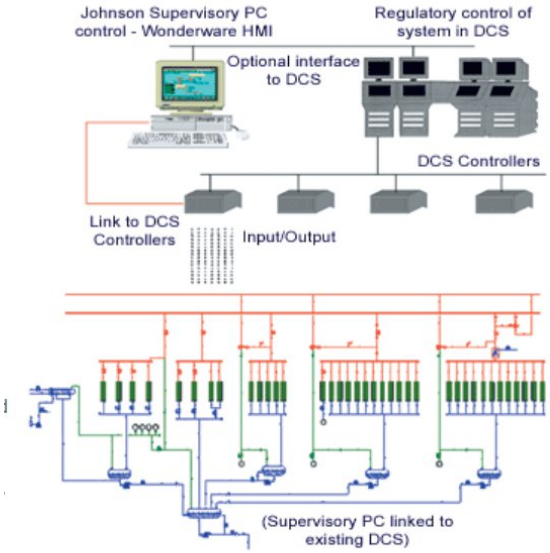
Dry section – Others

- Further reduction of air requirements
- Gap forming
- Vacuum system optimization
- Lack of cleaning the dryer surface
- Other ways of waste heat recovery

Energy efficiency measures in paper production

Control system – Advanced dryer control

- Control systems are a well-known way to optimize process variables and thereby reduce energy consumption, increase productivity, and improve the quality of industrial processes.
- One example of a control system for dryers is Dryer Management System TM control software, which reportedly offers advanced control of dryer system set points and process parameters to reduce steam use and improve productivity.



Energy efficiency measures in paper production

Control system – Control of drew point

The water vapour dew point (in the dryer hood) determines the heat exchange efficiency (exhaust temperature), but is affected by the setting of ventilation fans (recirculation).

The dew point that levels in paper drying hoods should be measured and controlled to optimize the drying process. Optimizing the operation of the dryer hood provides greater quality control, which leads to a more consistent product.

Example:

- The dewpoint instrument has helped a company control the ratio of makeup air to recirculation air for improved energy efficiency. Secondary results include improved economizer performance and better quality assurance due to reduced dripping in the hood.
- The company had been using manual controls, but direct operator attention often proved inadequate for performing timely adjustments to the recirculation/makeup air ratio that changing conditions (such as weather movements) required. Because one machine's throughput had been increased to the point that its hood system was often pushed to its capacity limits, rising dewpoint and subsequent condensation in the hood was a common occurrence.
- Drops of condensation falling onto a newsprint web running at 3,800 fpm around hot steam cans can cause havoc--weak spots, holes, breaks, and costly downtime. Before the installation of the dewpoint transmitter, the mill maintained a high flow of makeup air into the ventilator pockets to eliminate condensation, a method that used excessive energy.

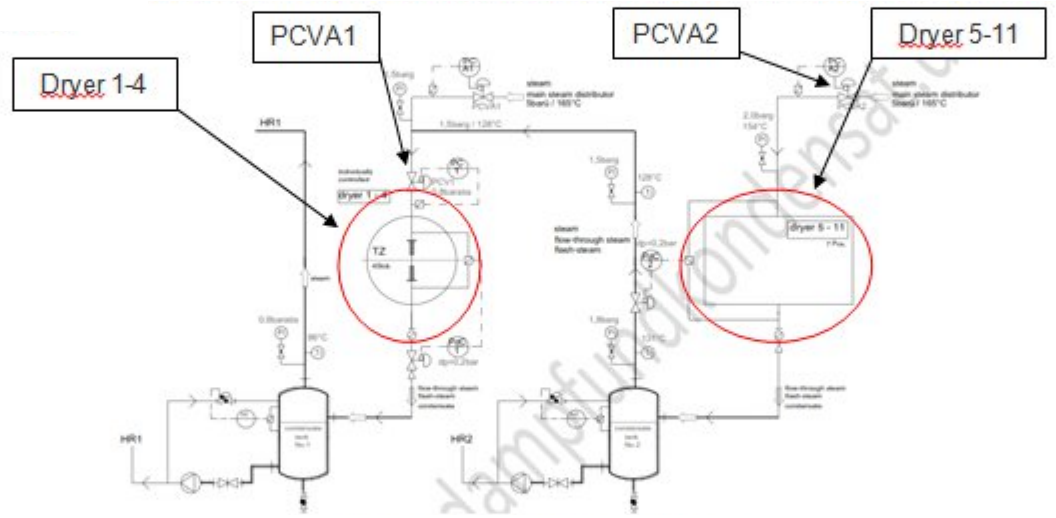
Source: Pulp & Paper Magazine

Energy efficiency measures in paper production

Control system – Reduction of blow through losses by keeping the pressure difference

As mentioned in section earlier the blow through losses can be recovered in a cascade system. In order to optimise the utilisation of the cascade system then it is important that each section of the system in in balance. In the example below two groups of dryers are to be balanced.

The balance between the two systems are made by the pressure valves. The pressure in the condensate vessel must be lower the pressure valves.



Energy efficiency measures in paper production

Control system – Reduction of blow through losses by keeping the pressure difference

- Other controlling factors can influence the control (keeping the pressure difference) of the cascade system
- **Paper break:** The condensation in the dryers drops immediately, because the dryers are no longer cooled by the paper. Where nothing condenses, nothing flows in, that means the steam consumption drops immediately after the paper break.
- **Dryers are flooded:** Because of wrong adjustment at the process control system by the operating staff, or a mistake of the measuring and control technology, or as a consequence of damages at the drainage elements or the steam joints the differential pressure drops. Then the condensation in the dryer rises and floods the syphon shoe. This may also happen if the drainage systems are not designed in the right way or the dimensioning does not correspond to the actual steam request. If the dimension of the siphon pipe or the siphon shoe is too small then amount of condensate cannot be completely discharged.
- **Heating up the paper machine:** For heating up the pm only a small amount of steam is necessary and there are the same conditions like in the case of a paper break.

Energy efficiency measures in paper production

Control system – reduction of down time

- There are a number of ways to reduce down time in the paper industry. Down time leads to an increased; specific energy consumption, labour costs, loss of product, decreased production etc.
- The following examples for causing down time are chosen:
  - Paper breaking: Paper breaking can be caused by the presents of impurities (described in mores details in the next section), inconsistency of fibre in the head box, bad performance of the dewatering and drying system etc.
  - Impurities: Shives, sands, pitches, slimes and deposits are defined as impurities. In the paper production the pulping process, material pre-treatment process and papermaking process must be equipped with devices to remove the impurities. Impurities can cause paper breaking, increased drying, reduced quality and damages to equipment.
  - Change of production

Energy efficiency measures in paper production

Water savings

There is a close relationship between energy and water consumption in the pulp and paper industry and therefor water savings are included.

- Production of water
- Reuse of fibre
- Thermal recovery
- Etc.

Energy efficiency measures in paper production

Water savings - Effective use of white water

White water belongs to resources.

- The power of pumping up, chest agitator operation and refining is converted into thermal energy, and is stored in the system, where its temperature is increased. Then it is used for steam adjustment. The white water separated by the concentration filter and wire of the papermaking machine contains fibers and filler, which can be re-used as materials.

Major points for white water reuse

- The quality and manufacture requirements are different according to each plant, so properties, distribution and freeness of the temperature, concentration, pH value, fibers, filler, etc. are also different. Recovered materials, application of the white water, product quality after use, the manufacturing requirements for fibers must be studied, based on the current analysis value, settling test, and filtering test. Based on the result of this study, flow sheet and material balance, water balance are prepared. The improvement of the existing equipment and introduction of the new equipment should be determined by a careful study, with consideration given to the opinion of the operator.

Energy efficiency measures in paper production

Water savings

- Strategic water management program
- Good housekeeping.
- Cooling towers.
- Reducing cooling tower bleed-off
- Once-through cooling water reuse.
- Minimizing hose water use.
- Use of water efficient building fixtures
- Optimizing shower water use.
- Water efficient bleaching
- Vacuum pump seal water conservation.
- Direct white water reuse.
- Mechanical pump seals
- Chemi (belt) washer
- Carbon dioxide brownstock washing
- Etc.

Energy efficiency measures in paper production

Emerging energy Efficiency Technologies

- Black liquor gasification.
- Magnetically-coupled adjustable-speed drives.
- Laser-ultrasonic web stiffness sensor.
- Steam cycle washer for unbleached pulp
- Microwaving logs.
- Gas-fired paper dryer.
- Advanced fibrous fillers.
- Bio treatment.

Energy efficiency measures in paper production

Emerging energy Efficiency Technologies

- Bio treatment.
- Electrohydraulic contaminant removal
- Lateral corrugator.
- Multiport dryer.
- Directed green liquor utilization pulping.
- Impulse drying.

Assignment No. 4

- **Discuss in groups the different emerging Technologies –**
  - **Present stats**
  - **Pro and cons**
- **Other Technologies ?**

FRIDOLIN MÜLLER HOLM

Chief Project Manager,
Master of Science in Engineering

Mobile: + 45 31 75 17 14
fmh@viegandmaagoe.dk