Dissolving Pulp
PEERS
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Dissolving pulp

Wood → **Dissolving Pulp** ← **Cotton Linters**

Manufacturing process

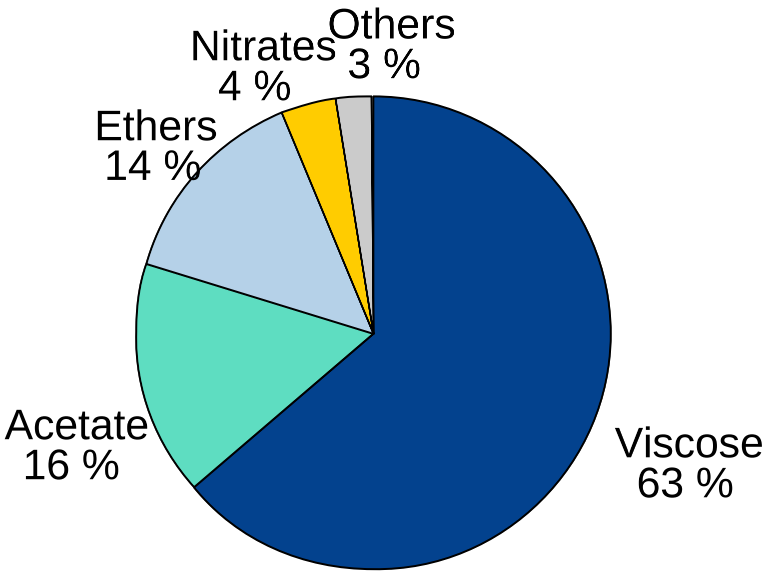
- **Ethering** → **Ethers**
  - Binders
  - Glues
  - CMC
  - Detergents
  - Food
  - Pharmacy
  - Oil drilling mud
- **Nitration** → **Nitrates**
  - Explosives
  - Lacquers
  - Celluloid
- **Acetylation** → **Acetates**
  - Acetate tow
  - Acetate filament
  - Acetate mouldings
  - Acetate films
- **Xanthation** → **Viscose**
  - Rayon staple
    - Textile
    - Non-woven
  - Viscose filament
  - Rayon cord
  - Industrial yarn
  - Cellophane film
  - Sponge products
  - Sausage skin
- **Others**
  - **CuO/NH_4OH**: Cupra*
  - **$ZnCl_2$**: Vulcan fibre
  - **H_2SO_4**: Parchment
  - **Latex**: Artificial leather
  - **Resins**: Laminating papers, Impregnation papers
- Filter paper
- Photo paper
- Specialty papers
- Grinding / moulding powder

*only from cotton linters, cupra is often classified as viscose fibre

Source: PÖYRY

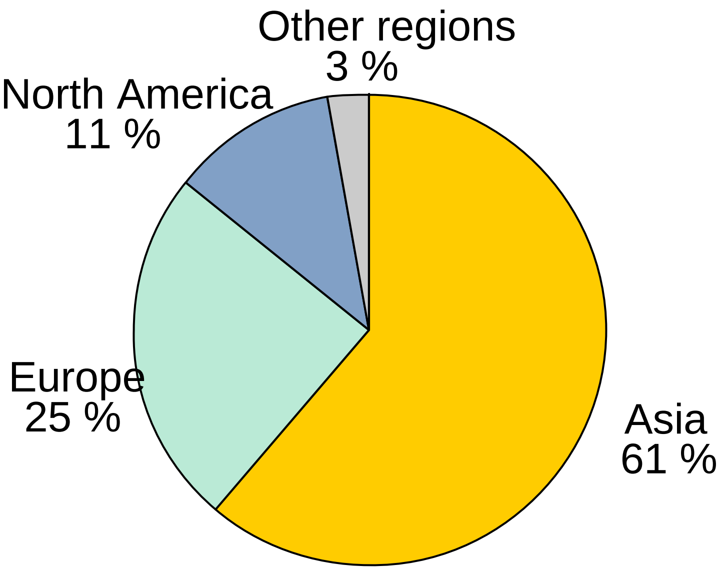
Dissolving pulp demand by end product and region 2008

End Product



Total market 4.2 million tons

Region

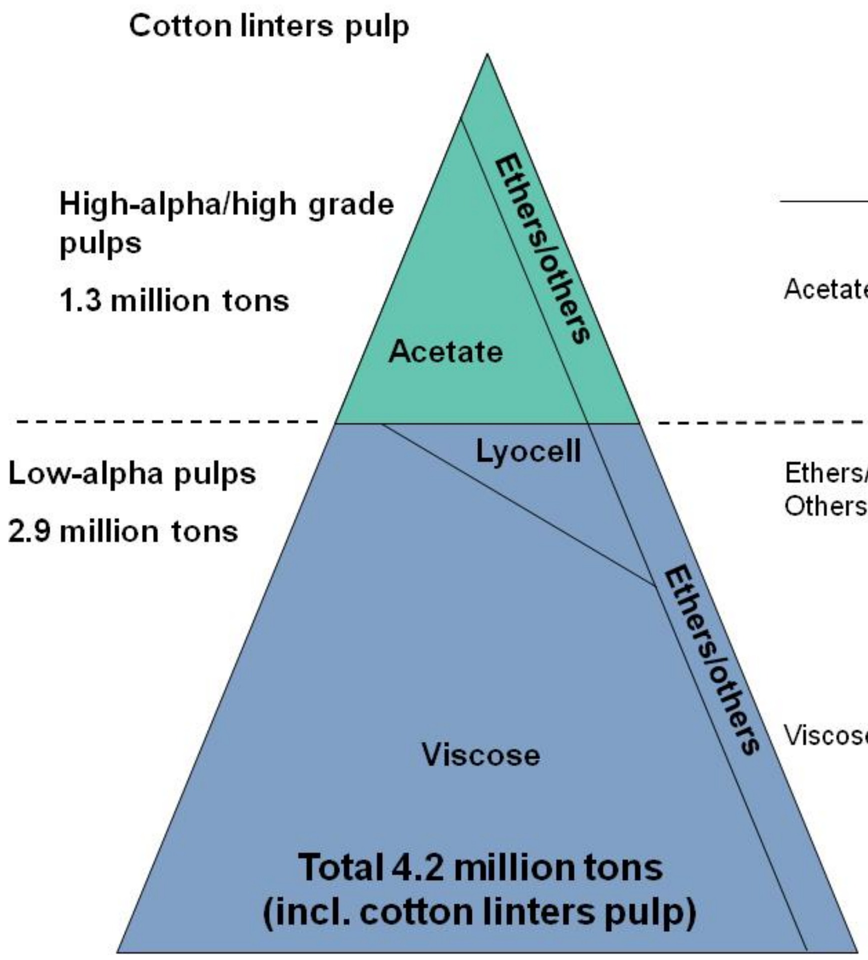


Total market 4.2 million tons

Note: Includes about 1 million tons cotton linters pulp.

  Source: PÖYRY

Dissolving pulp end use segments

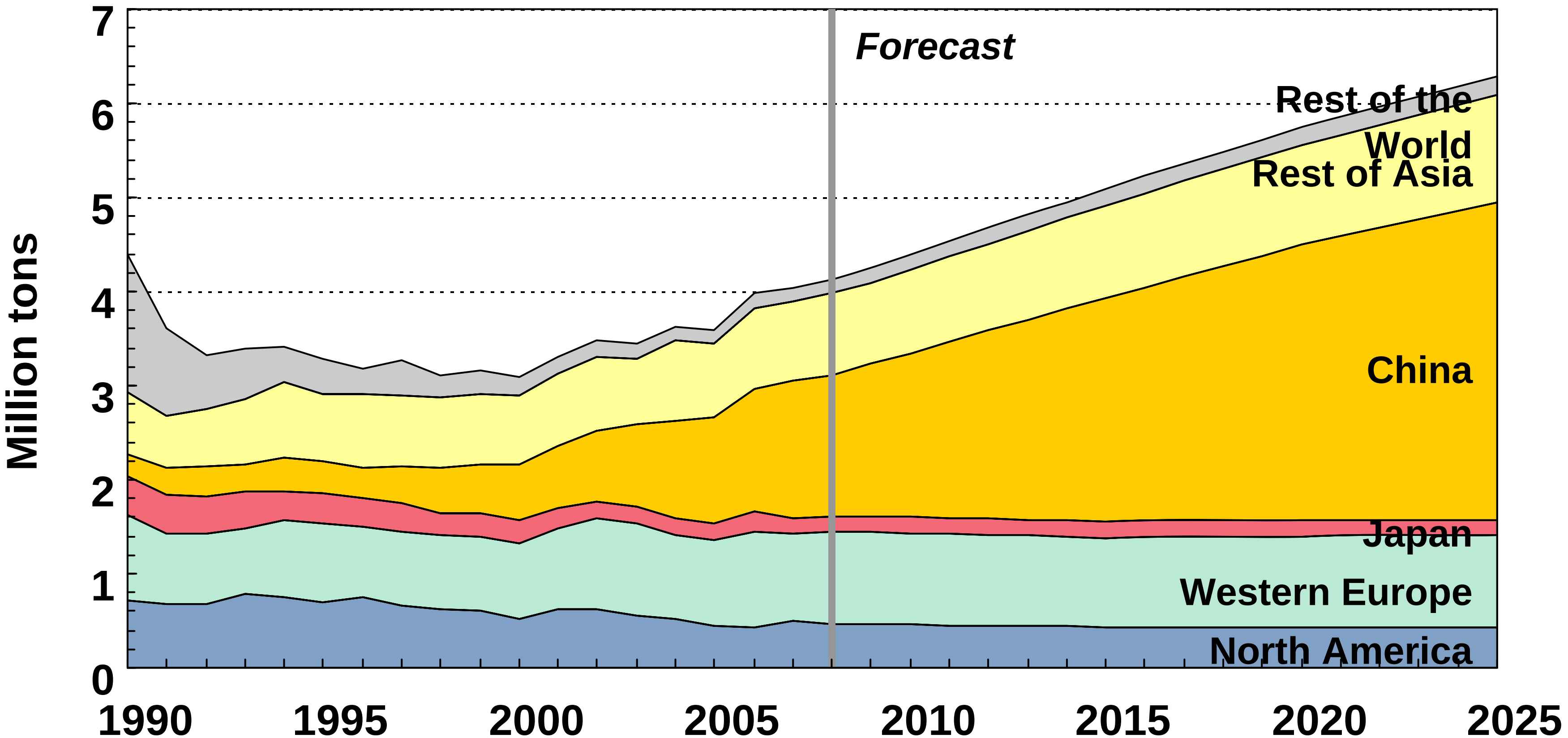


	Common end uses	Substituting products
Acetates:	• Cigarette tows • Films • High quality plastics • Acetate yarn, fibres	• Paper, cotton, synthetic fibre • Synthetic films • Plastic • Natural silk, cotton
Ethers/ Others:	• Explosives • Food industry • Pharmaceutical • Cosmetics • Special paints • Binders and glues • Artificial leather • Etc.	• Highly miscellaneous • Cotton linters pulp • Synthetic fibres, etc. • BHKP paper pulp (vs. low alpha CMC)
Viscose:	• Textile industry • Non-wovens • Cord and industrial yarn • Cellophane • Sausage skin • Sponges	• Cotton, wool • Synthetic fibres, fluff pulp • Steel and polyester • Polyethylene, polypropylene • Natural, collagen and plastic casings

Source: World Fibre Outlook, Pöyry

Consumption of dissolving pulp by region – Medium scenario

The world demand for dissolving pulp is expected to grow from 4.1 million ADt/a in 2008 to 6.3 million ADt/a by 2025



Source: PÖYRY

Demands for dissolving pulp

- End user is a chemical company – high requests for the quality on the pulp
- Uniform product
- High cellulose content
  - Controlled, adjusted viscosity (DP)
  - Viscosity adjustment over the whole fiberline -> viscosity control stages (Cooking,O_2, H, P, Z)
- High purity
  - low, adjusted hemicellulose content
  - high brightness
  - low extractives content
  - low, adjusted metal ion profile
  - High brightness
  - Low brightness reversion

Cooking

Basics of dissolving pulp cooking

- Removal and/or adjusting the amount of hemicelluloses
- Alkaline kraft pulping is not able to make enough hemicellulose removal
- There is a need for acidic conditions, which results in hydrolysis, bonds between sugars are broken down and dissolved

Hydrolysis of hemicelluloses

- Prehydrolysis kraft cooking
- Removal of hemicelluloses in the prehydrolysis stage
- Removal of lignin in the cooking stage
- Degree of hydrolysis and the purity of hemicelluloses relatively freely adjustable
- Possibility to use hydrolysate

Prehydrolysis stage

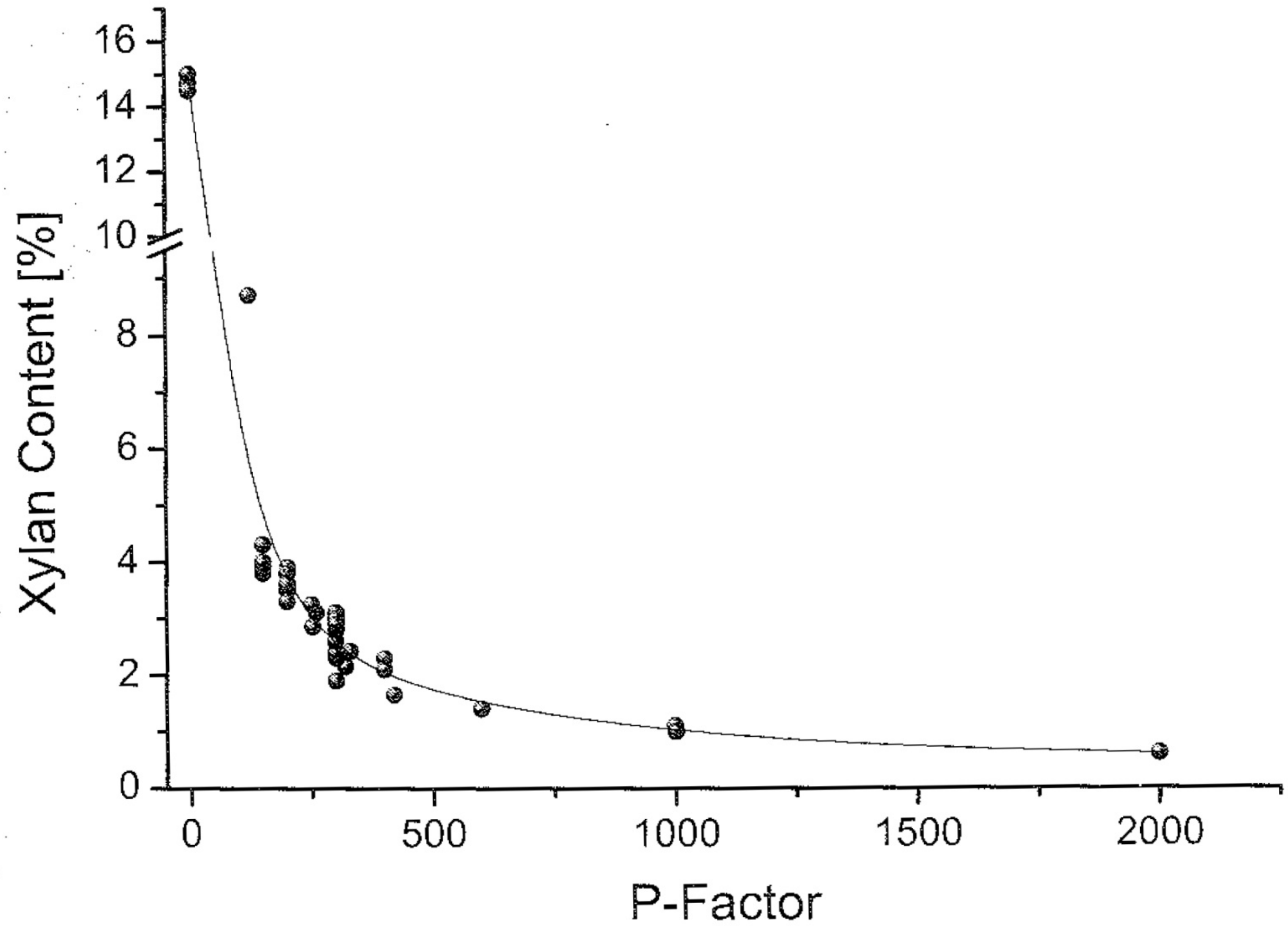
- Liquid or steam phase
  - Liquid phase, easy to adjust the pH
  - use of different acids, suplhur dioxide
  - conditions (time, temp, pH) easy to vary
  - Drawback: high volume of hydrolysate, no use (value) today

=> Only steam phase as a prehydrolysis stage is economically viable

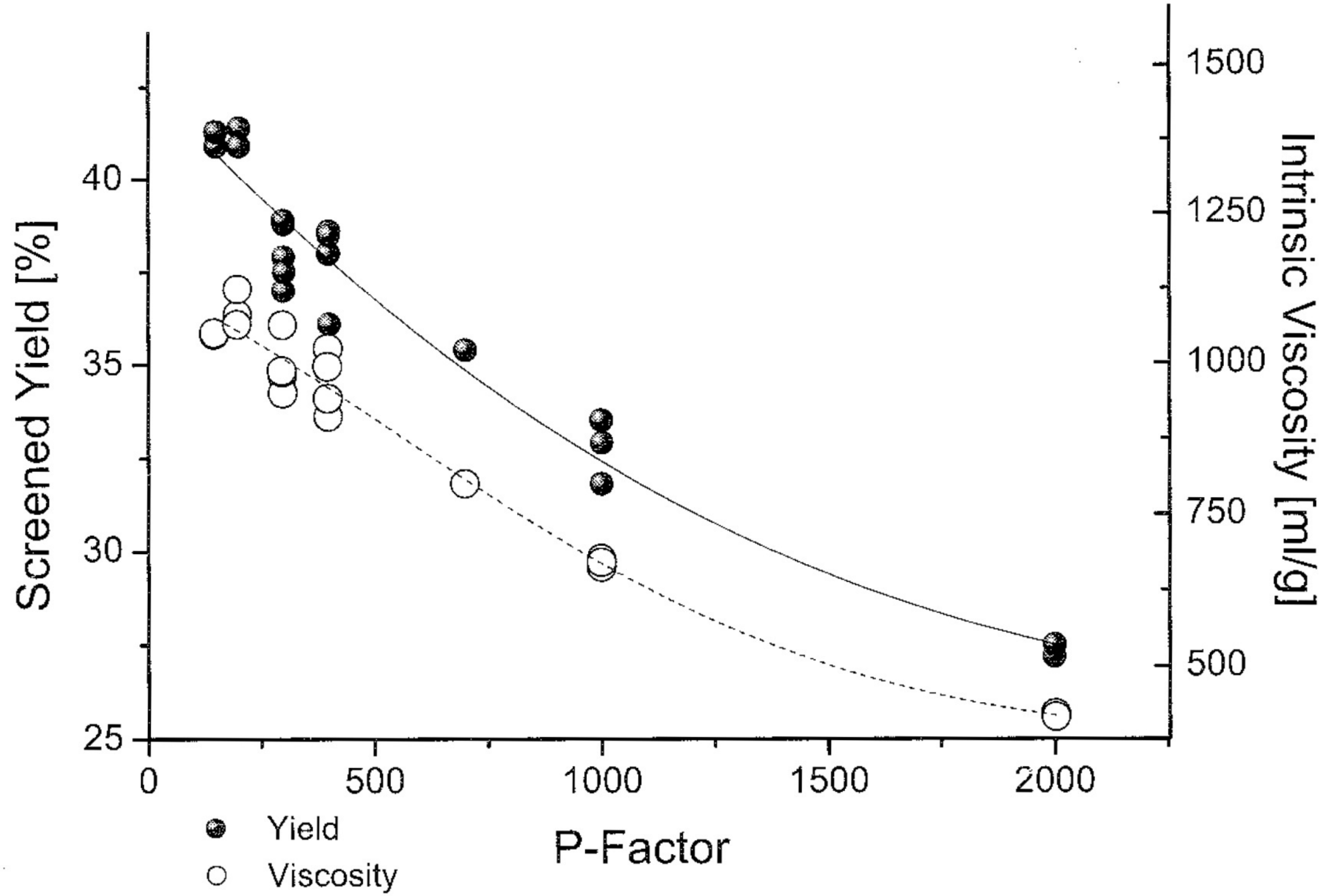
Steam hydrolysis

- Direct LP and MP steam
- 160-180 deg C
- No additional chemicals, water
- The effect comes from AUTOHYDROLYSIS
  - the acids from wood release protons during steaming creating acidic conditions

- The effect of steam hydrolysis depends on
  - wood species
  - wood age
  - moisture content
  - Temperature
- Control of prehydrolysis by P-factor



E. urograndis /Sixta2006/



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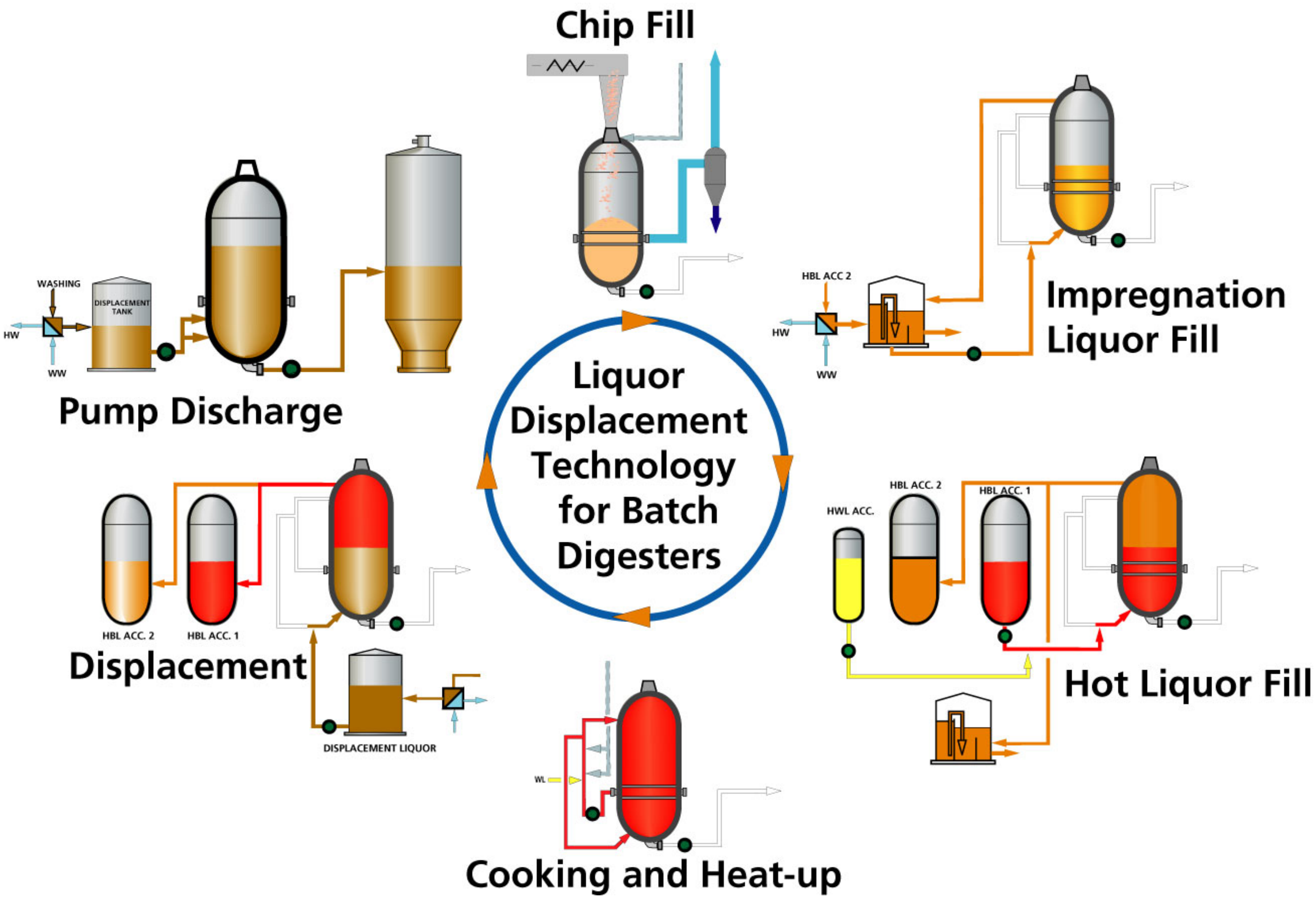
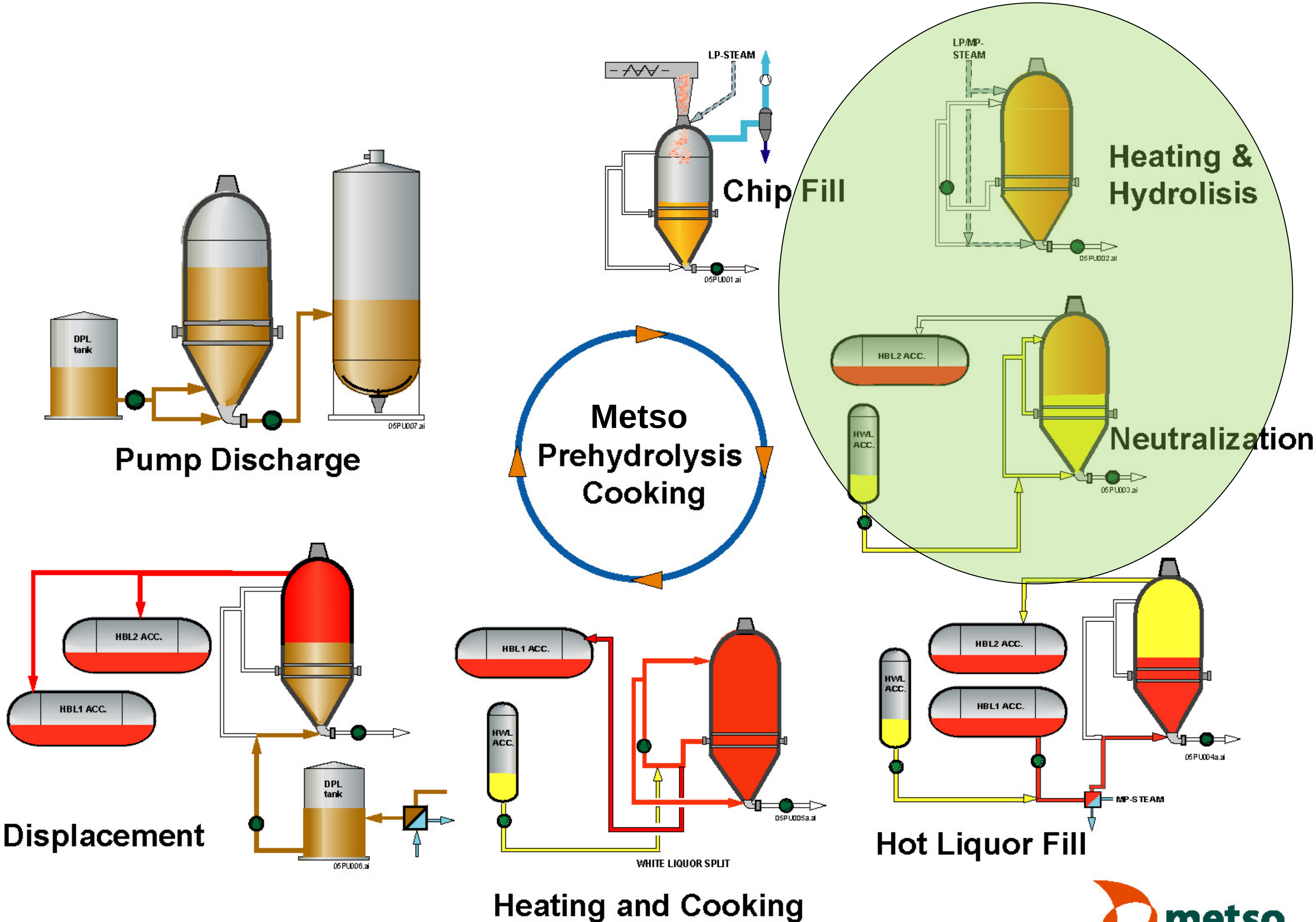
Displacement Batch Cooking




LP-STEAM
Chip Fill
05PU001.ai
LP/MP-STEAM
Heating & Hydrolisis
05PU002.ai
HBL2 ACC.
HWL ACC.
Neutralization
05PU003.ai
DPL tank
05PU007.ai
Pump Discharge
Metso Prehydrolysis Cooking
HBL2 ACC.
HBL1 ACC.
DPL tank
05PU006.ai
Displacement
HBL1 ACC.
HWL ACC.
05PU005a.ai
WHITE LIQUOR SPLIT
Heating and Cooking
HWL ACC.
HBL2 ACC.
HBL1 ACC.
05PU004a.ai
MP-STEAM
Hot Liquor Fill

05PU009a.ai

Metso Batch Dissolving Cooking Features

- Steam hydrolysis
  - LP + MP steam for hydrolysis
- Strong alkali neutralization
  - WL pad
- Modern kraft cooking
  - HBL treatment
  - Cooking liquor addition
  - Uniform cooking
  - Gentle discharge
  - Low emissions

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Typical operating figures for market pulp Metso Batch cooking

		HARDWOOD	SOFTWOOD
LP-steam consumption	kg/adt	120-160	120-160
MP-steam consumption	kg/adt	400-500	400-550
Power consumption	kWh/adt	20-25	25-30
Alkali consumption	% EA as NaOH	17-19	20-22
Yield	% on wood	51-53 (@kappa 18)	47-48 (@kappa 30)

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Operating values dissolving pulp - examples

LP-Steam	400-500 kg/Adt
MP-Steam	550-750 kg/Adt
Prehydrolysis temperature	160-170 deg C
Prehydrolysis time	20-60 min
Total sequence time	300-350 min
Cooking yield	35-39 % on wood
Pulp viscosity	600-1200 ml/g
Pentosan in pulp	As low as 1.5% on pulp

Factors affecting the values

- Wood quality (species, moisture…)
- Dissolving pulp quality (rayon, acetate…)

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Brown Stock Washing

Brown stock washing and screening

- No major differences with kraft pulping
- One important thing is that the knot/reject amount is lower than in kraft pulping
- Carry over to O_2-stage could be higher than in normal kraft pulp – however depending on the end-product viscosity level
- Barrier washing – good control for conditions to O_2-delignification and bleaching -> stable and controllable pulp quality

Oxygen delignification

Oxygen delignification

- Single, two-stage or no O_2
- Decision based on the following:
  - End-product viscosity – required viscosity loss in O_2-stage
  - Softwood / hardwood
  - Only dissolving grade / also kraft pulp
- Pulp viscosity can be controlled by temperature and alkali charge in the oxygen stage

Bleaching

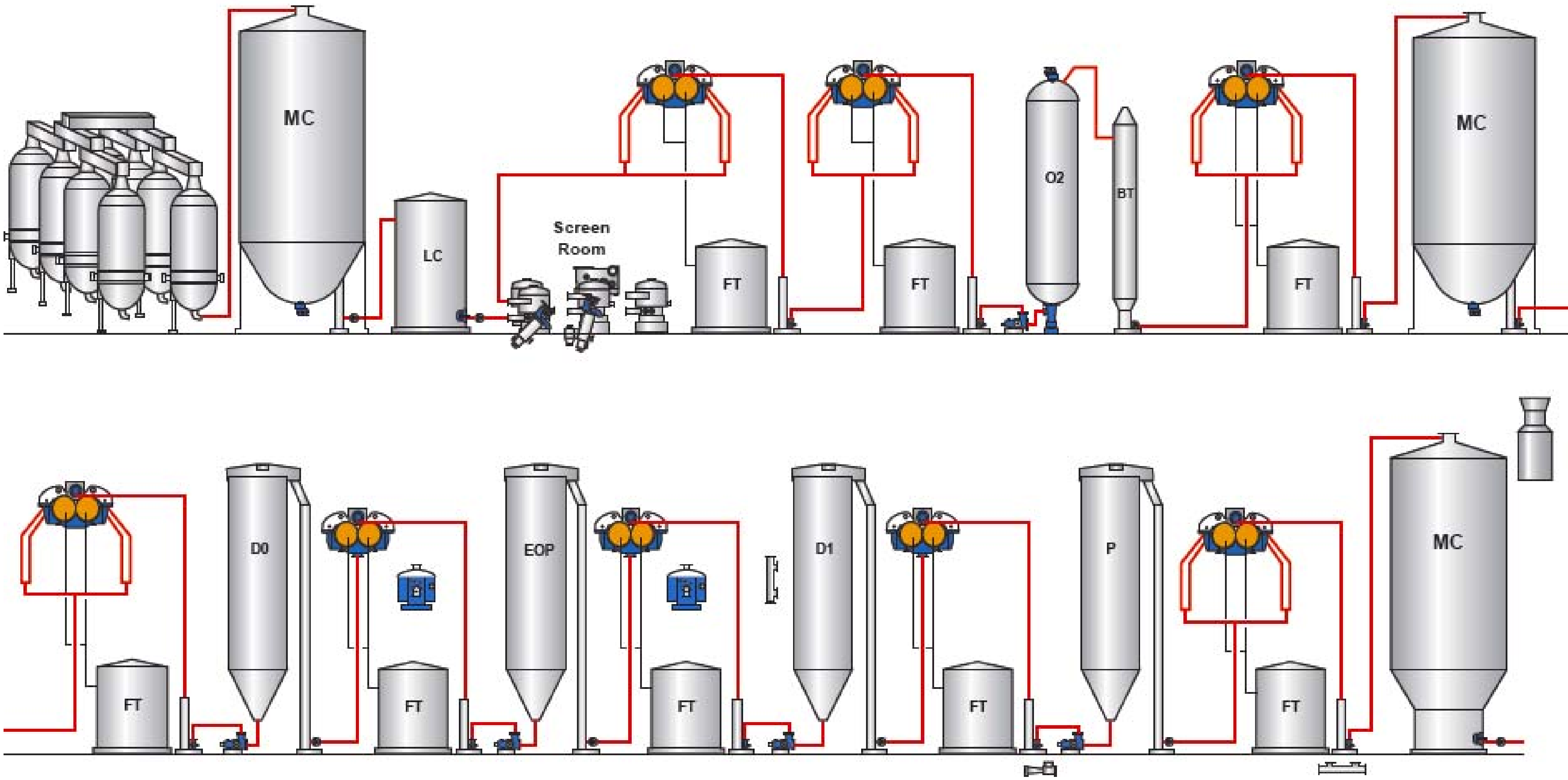
Bleaching

- There should be a possibility to control the viscosity in 1-2 stages (Oxygen delignification/bleaching) depending on the request for end-product quality
- Normally a sequence for high brightness is needed
- Normally a sequence for low brightness reversion is needed
- Demineralized wash water needs normally to be used in the last washing after bleaching

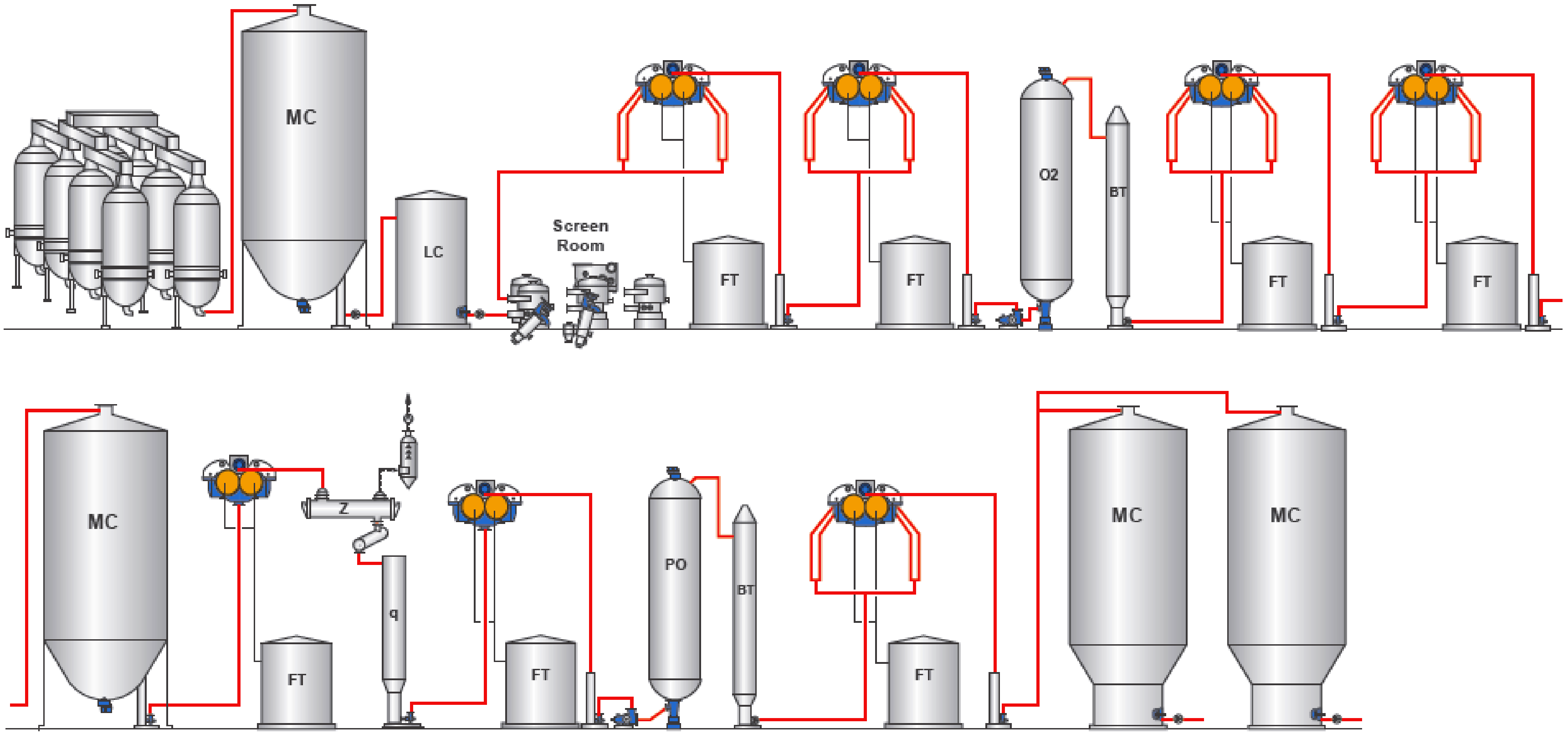
Possible bleaching sequences

- In the past:
  - C-E-H-D
  - C/D-EO-H-D
- Future
  - D-EOP-D-D
  - D-EOP-D-P
  - O-D-EOP-D-D
  - O-D-EOP-D-P
  - O-A-Zq-P

Fiberline for Dissolving Pulp - ECF bleaching



Fiberline for Dissolving Pulp - TCF bleaching



Bahia Pulp experiences

- Metso Cooking and Fiberline gives good opportunities to produce different qualities of dissolving pulp
- Knowledge comes only with hands on practice
  - Different pulp behavior in the digester than with normal kraft pulp
  - How to control the viscosity in the whole fiberline
- Lot of issues which may be “small” during design phase but have a significant influence on the operation if not correct
- Very much different approach to quality than producing market paper pulp
- More requirements for preventive maintenance
- Metso has a running reference and hands on practice of designing and producing dissolving pulp – with excellent quality (according to end-user requirement)

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Process differences

- Kraft and Dissolving pulping have different yields, charging and other results. Some key data for both market pulp and dissolving pulp are shown in the table below.

		Kraft SW	Diss SW	Kraft EUC	Diss EUC
Digester Kappa number	-	Ref	-	Ref	-
Digester yield	%	Ref	-	Ref	-
Charge	% EA as NaOH	Ref	+	Ref	+
Steam cons	kg/Adt	Ref	++	Ref	++
Oxygen kappanumber	-	Ref	--	Ref	--
Oxygen delign yield	%	ref	+/-	ref	+/-

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Specific loads for key departments

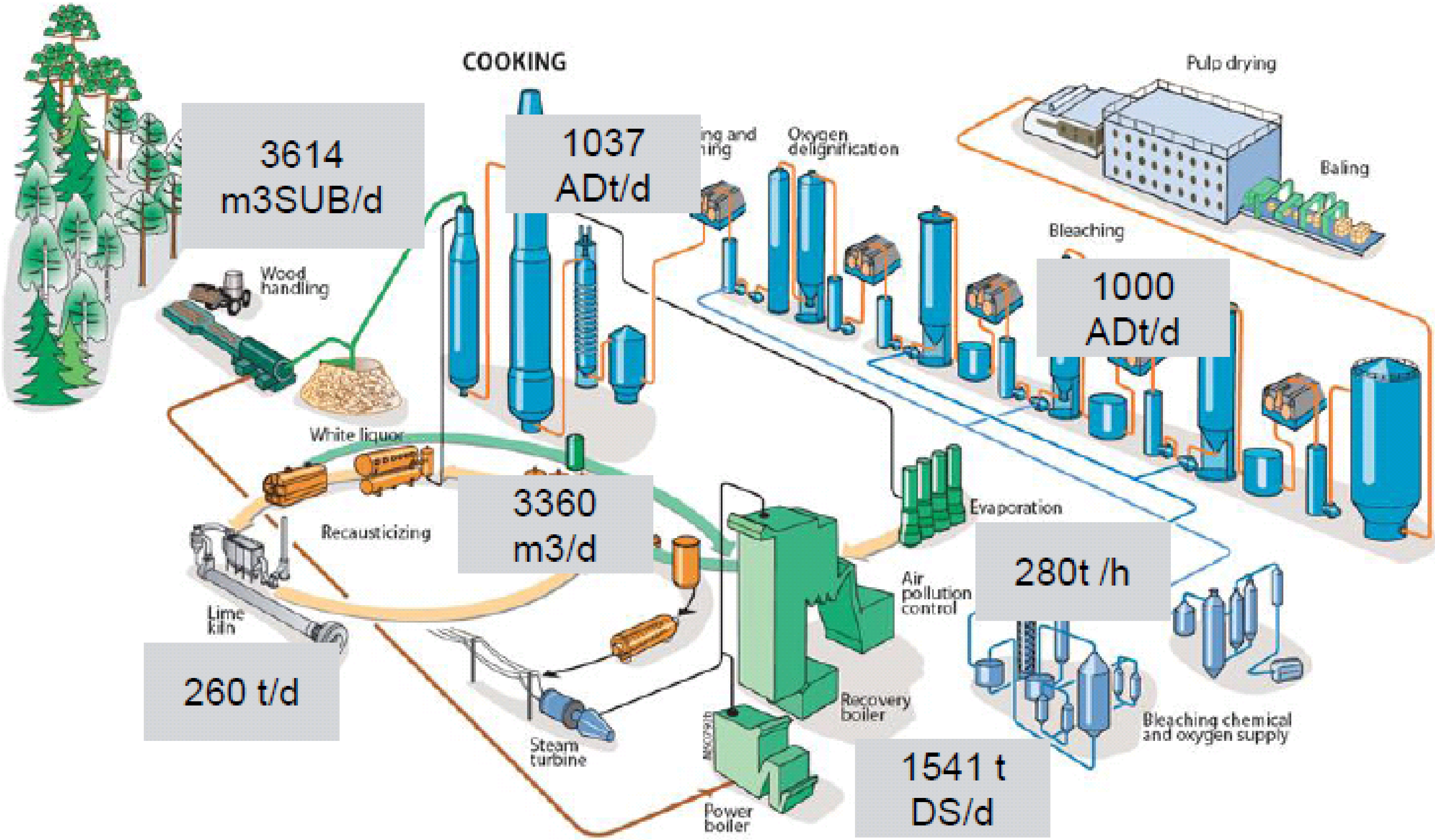
- Specific data are given below for SW / HW used for kraft and dissolving pulp.
- However, the numbers will vary depending on raw material and product quality. Done for general dissolving pulp.

		Kraft SW	Diss SW	Kraft EUC	Diss EUC
Wood consumption	M3 SUB/ADt	5.0	6.1	3.6	4.5
WBL conc	% DS	18	20	17	20
Evap need	t evap/Adt	7.1	9.3	6.7	9.1
Spec DS-flow	T DS/Adt	1.8	2.5	1.6	2.3
Spec WL flow	M3/Adt	3.7	5.4	3.4	5.2

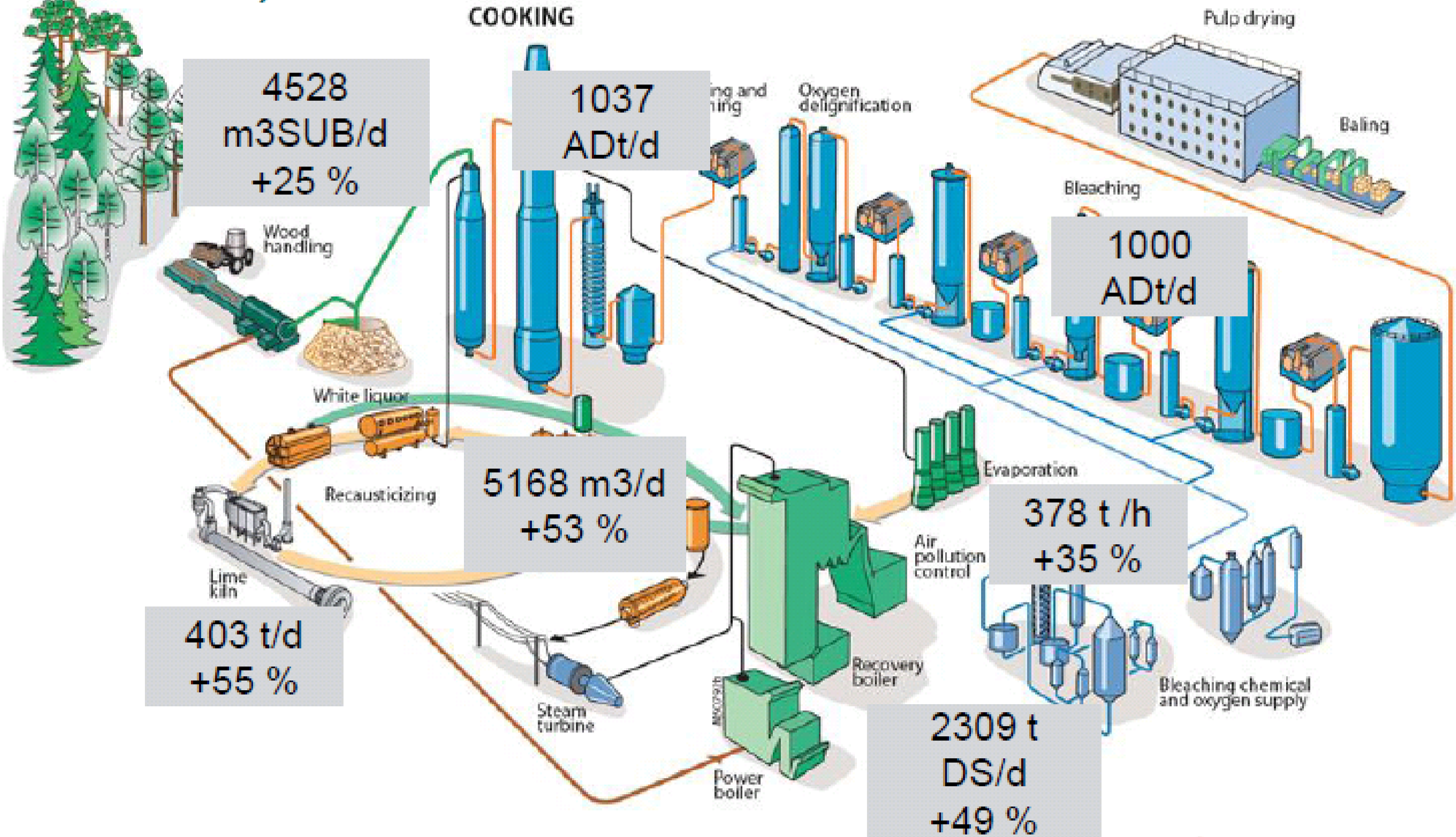
Heat values

- Dissolving pulping have lower yield – more organic part to BL.
- But also the white liquor charge is higher.
- Without splitting the wood into different carbohydrates the organic part in the black liquor will be slightly reduced. Calculated to be reduced with 1 %.
- The heat value for dissolving pulp is estimated to be about the same or slightly below for kraft pulp liquor.
- Very much dependent on extractive level in the wood and can vary much.

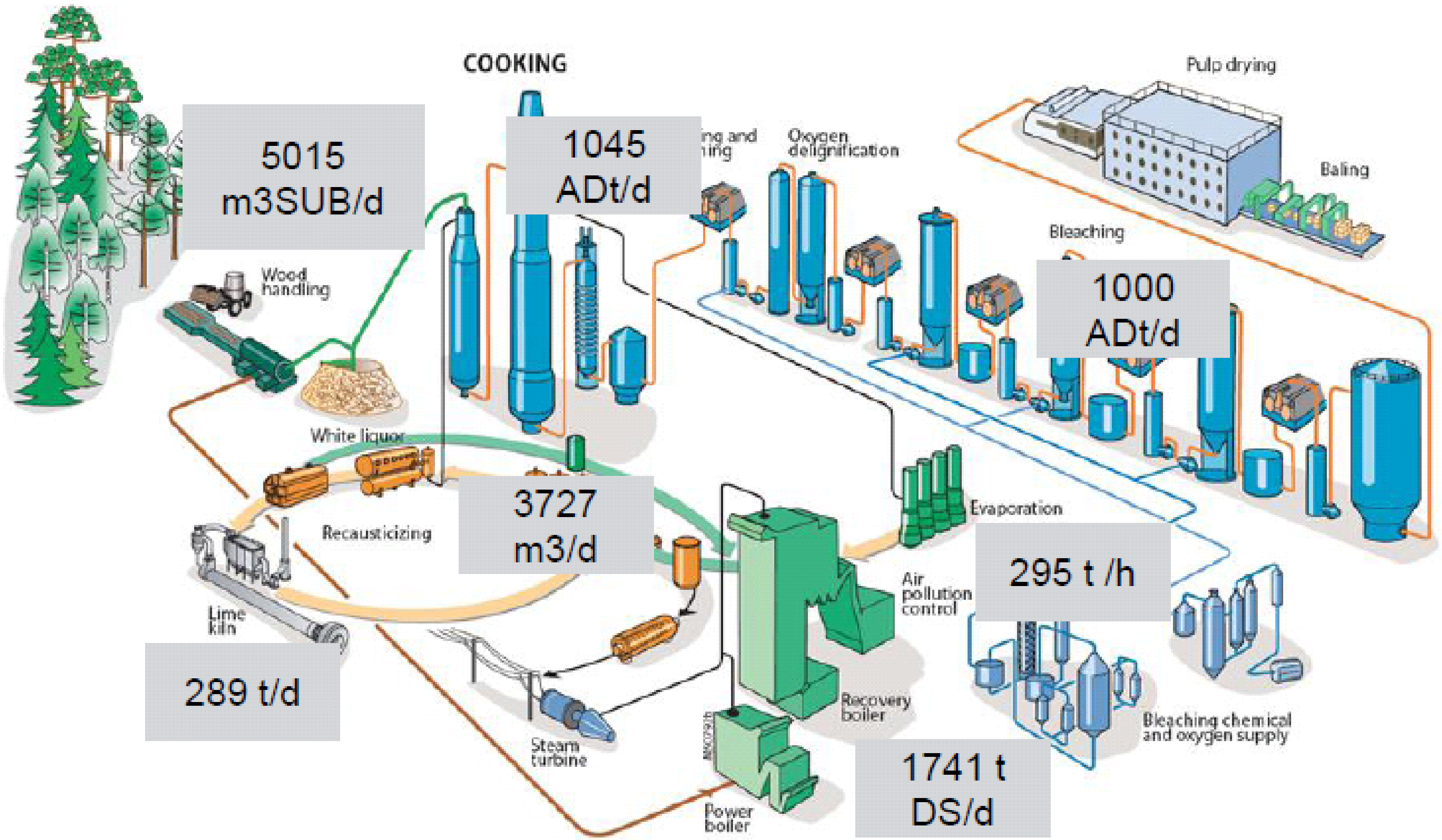
Reference for EUC – Kraft Process 1000 Adt/d



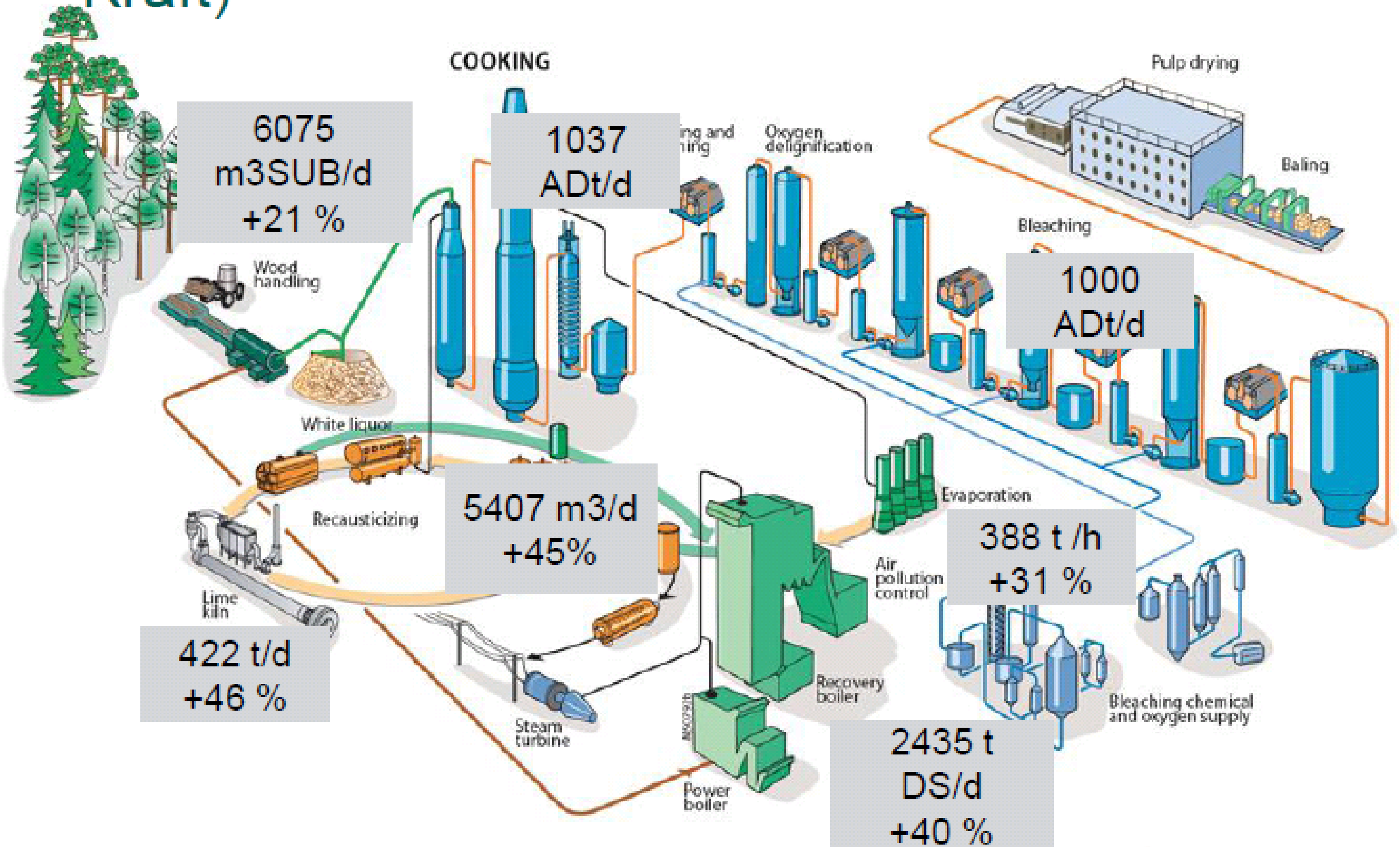
Dissolving pulp EUC 1000 ADt/d (balance / % of Kraft)



Reference for SW – Kraft Process 1000 Adt/d



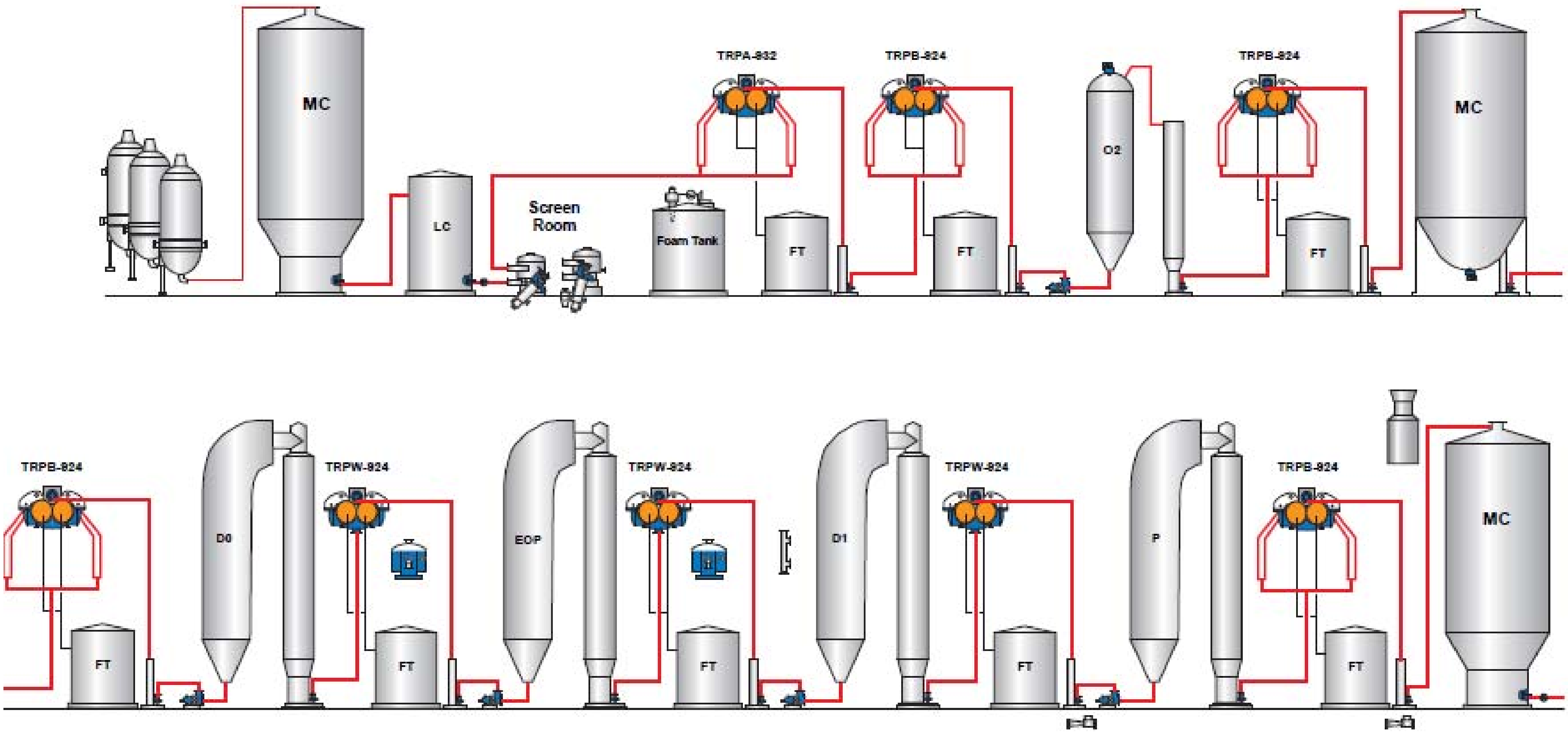
Dissolving pulp SW 1000 ADt/d (balance / % of Kraft)



Conclusions on department sizing

- Dissolving pulp will require much bigger recovery area compared to normal kraft pulp – reason is lower yield and higher charging in cooking.
- The organic portion of the dry solids to the recovery boiler is slightly lower when producing dissolving pulp. Resulting is somewhat lower heat value.

Typical DP Fiberline



Summary

- End-product specifications determine the design
- Cooking with steam prehydrolysis
- Washing in brown stock with presses in order to control the carry-over to O_2/bleaching thus control the viscosity drop
- Barrier washing in bleaching to get sharp controllable stages – control the viscosity drop
- ECF/TCF solutions possible – Ozone one alternative for viscosity control
- Decisions regarding kraft/dissolving pulp ratios and raw material have an impact on the design