INNVENTIA

04 . 06

Lignin extraction from black liquor

Per Tomani, Innventia

ABTCP-TAPPI 2010

43º Congresso e Exposição Internacional de Celulose e Papel

43rd Pulp and Paper International Congress & Exhibition

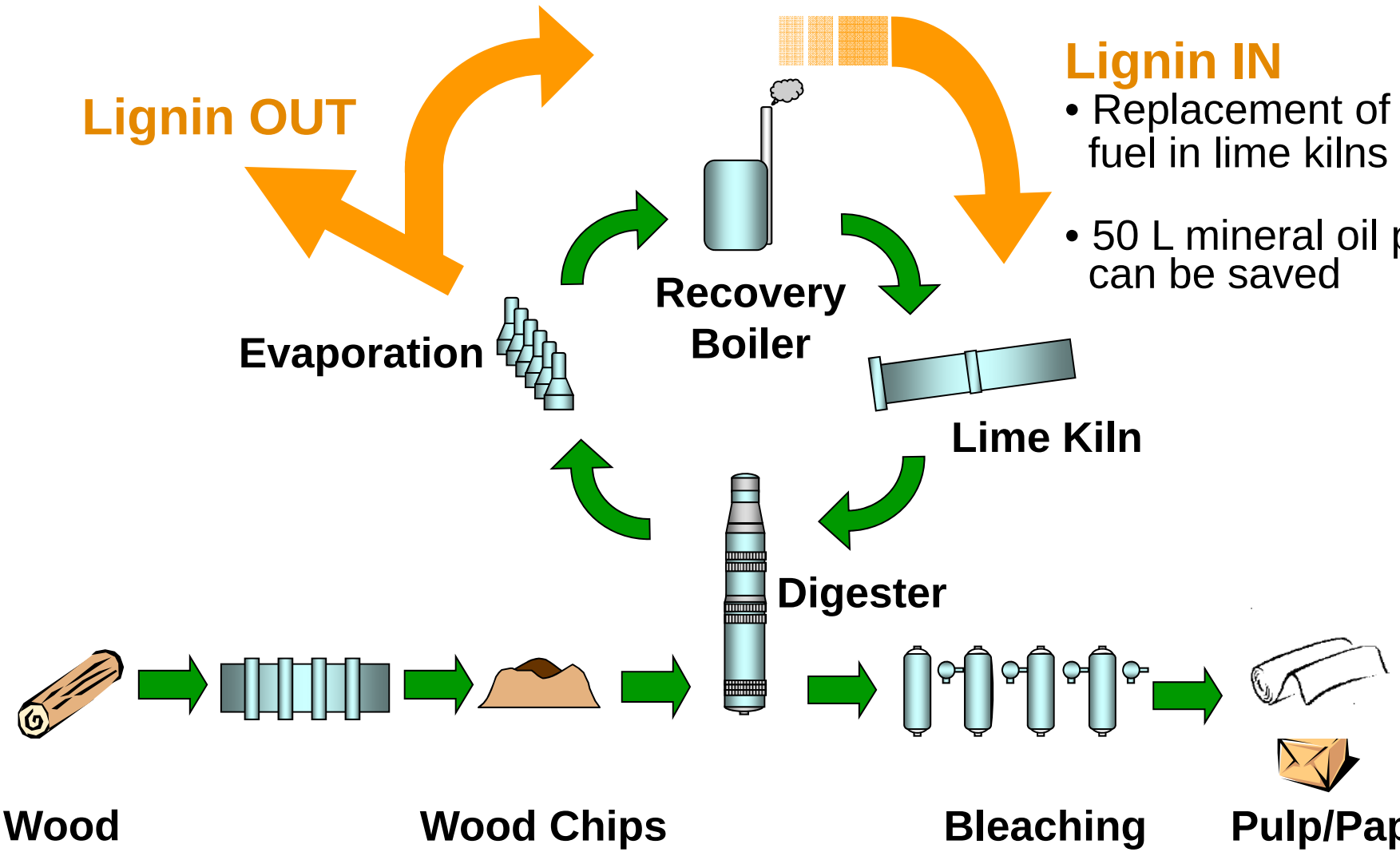
ABTCP

TAPPI

Outline

- My presentation will cover:
  - the LignoBoost process
  - touch on drivers
  - and consequences with lignin removal

The LignoBoost process



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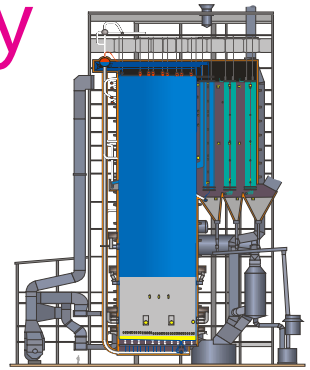
Lignoboost – Customer value today



- Increased pulp production
  - By reduced thermal load in the recovery boiler

- Reduced oil consumption – Go Green
  - Replacement of fossil fuel in the lime kiln with lignin

- Exporting revenue
  - Excess energy can be exported from market pulp mills to external users as energy, chemicals & materials

The LignoBoost R&D history

1997: Start to work on lignin removal

2001: Breakthrough

2003: Bench scale

2004: Pilot scale (container size)

2005: Full-scale trials in a coal-fired heat & power plant in Stockholm resulted in a customer for a demo plant

June 2006: Innventia buys an old lignin plant & re-builds it

22 December 2006: Start-up of the LignoBoost demo

May 2006 – Nov 2008: Delivery of lignin and R&D

June 2008: The LignoBoost concept is sold to Metso, but Innventia still owns the Demo plant for R&D purposes.

2010: Swedish Energy Agency decides to support Södra Cell Mörrum.

EU needs to give OK to this size of investment support.

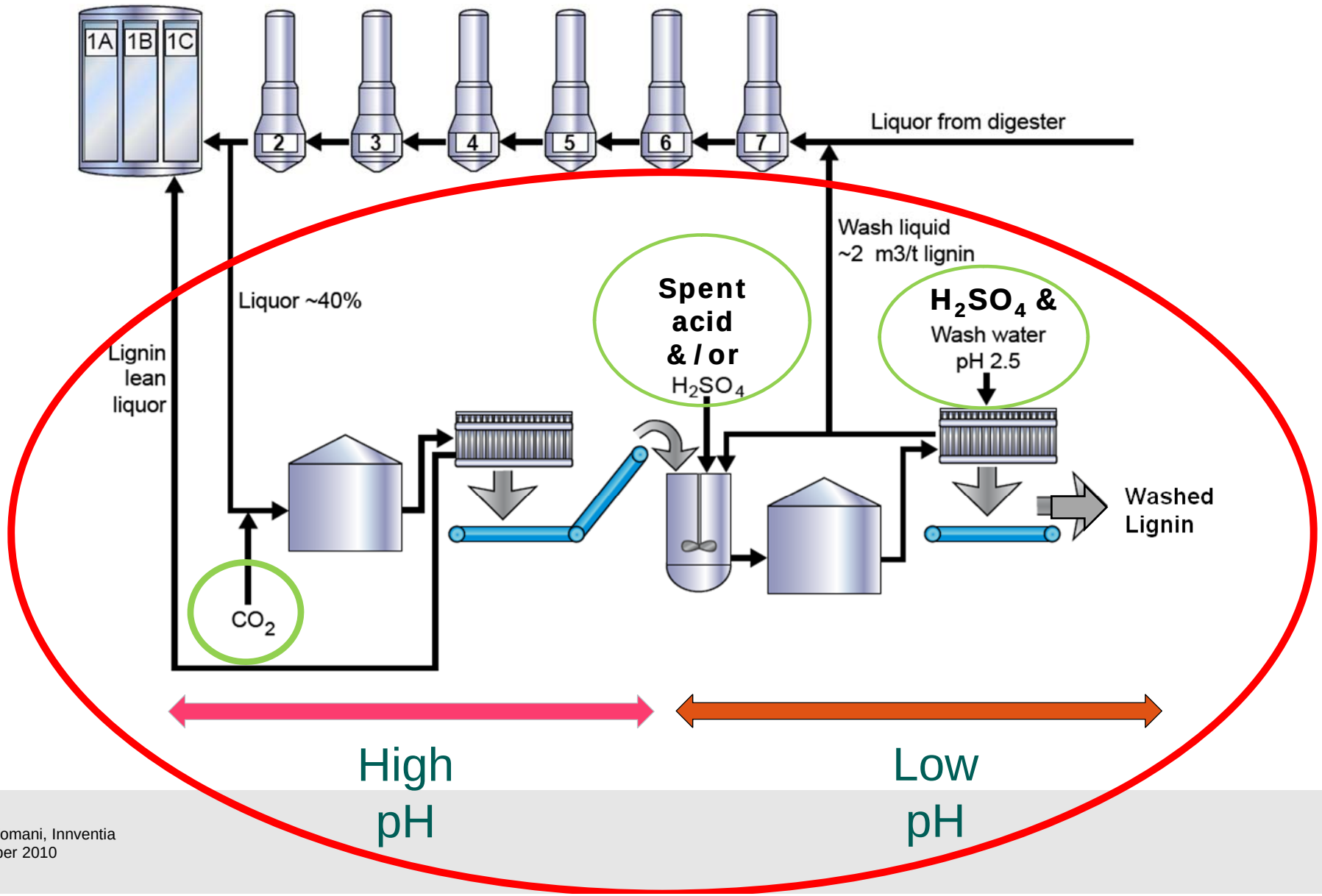
Typical LignoBoost SW lignin - from the demo plant

65-70 % DS
HHV (dry ash free): 26-27 MJ/kg

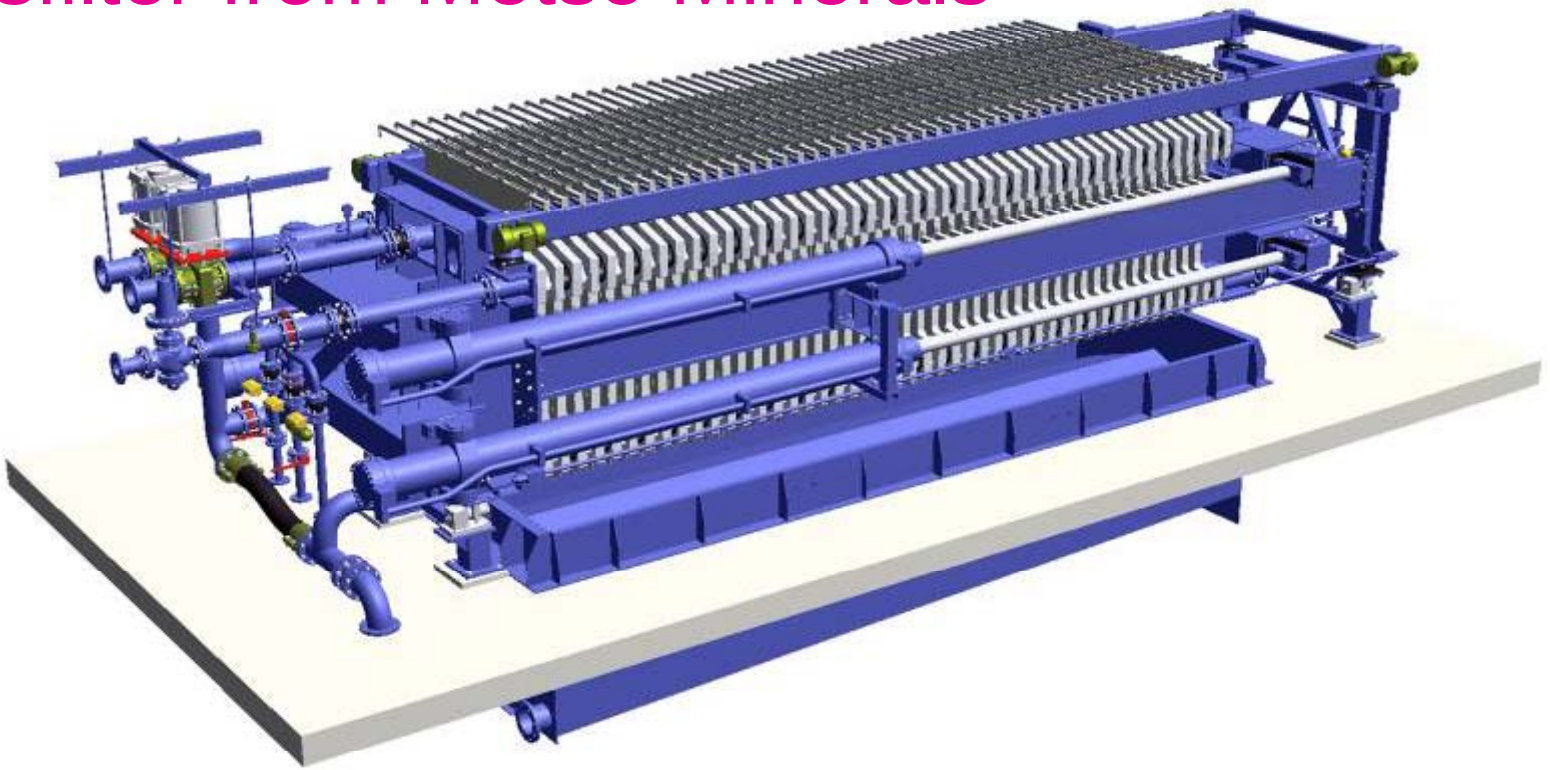
C: 63 - 66 %
H: 5.7 - 6.2 %
O: 26 - 27.5 %
S: 1.8 - 3.2 % ←
N: 0.1 - 0.2 %

Ash (dry): 0.2 - 1.4 %
Na: 120 - 230 g/kg ash
K: 25 - 80 g/kg ash

The LignoBoost process



Pressfilter from Metso Minerals



- Low residual cake moisture
- High capacity
- Fully automatic operation
- Low maintenance costs due to few moving parts
- Easy to replace filter cloths

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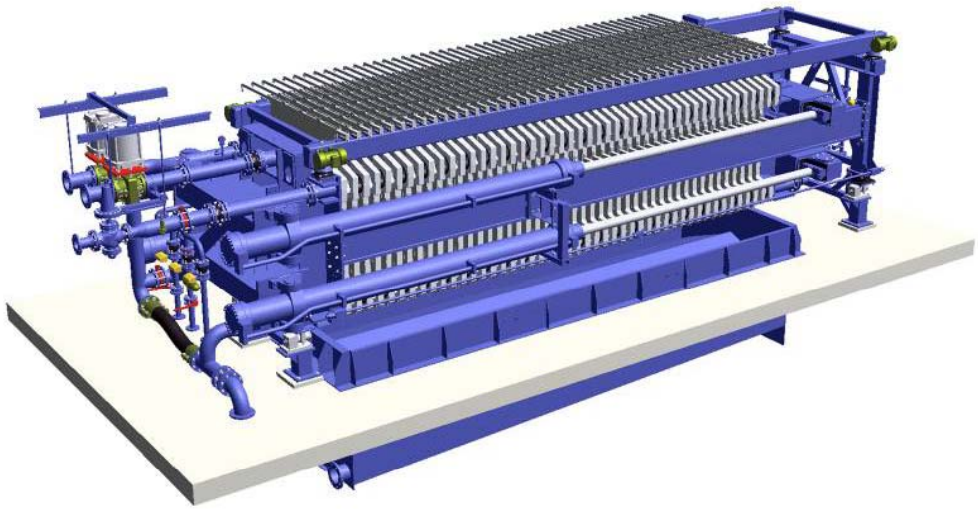
Pressfilter operation

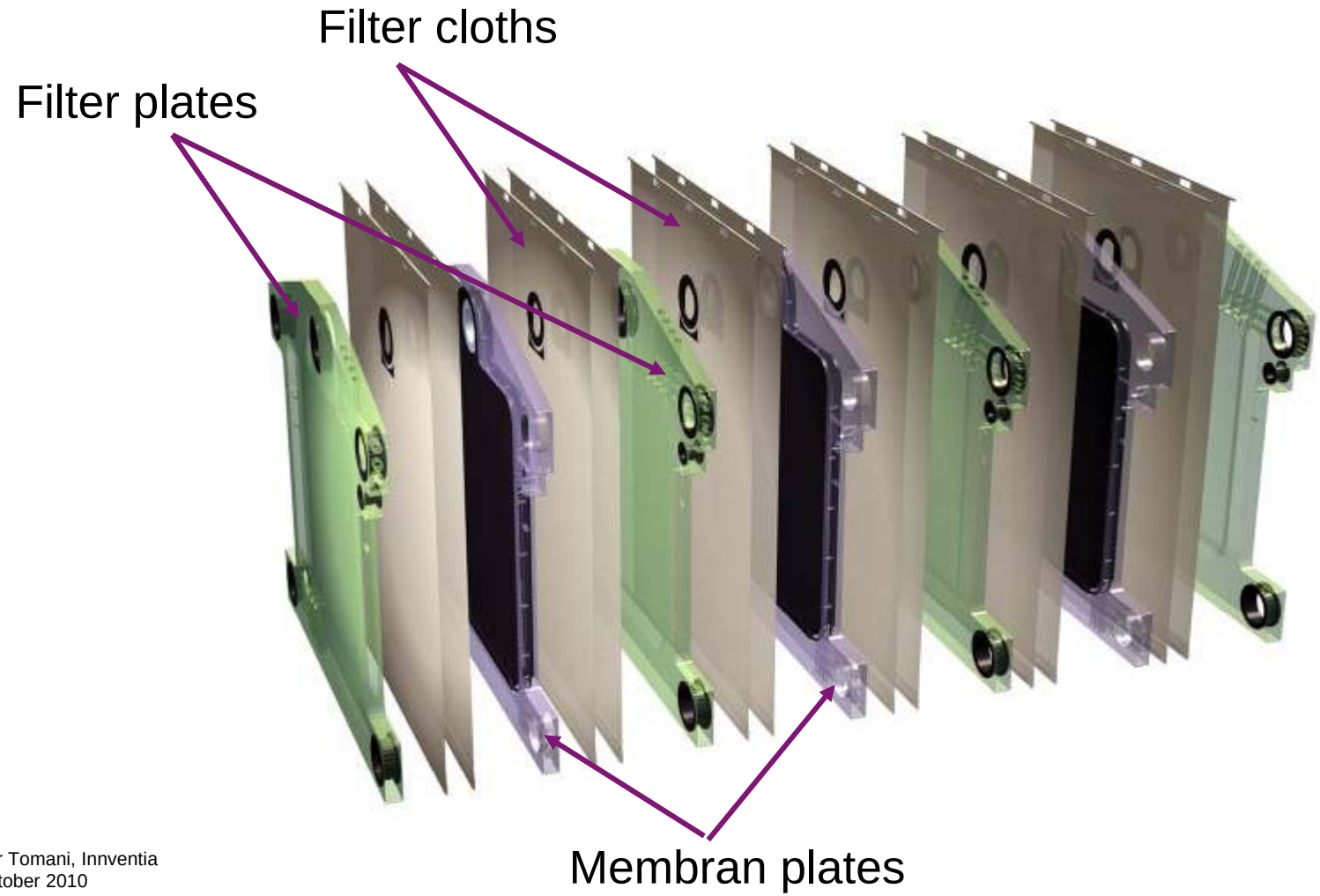
- Filling = Cake Formation & Filtration
- Membrane pressure
- Washing
- Membrane pressure
- Airblowing
- Open filter
  - Empty, Vibrations
- Washing of filter cloth
  - Vibrations
- Close filter
- Wait or Run



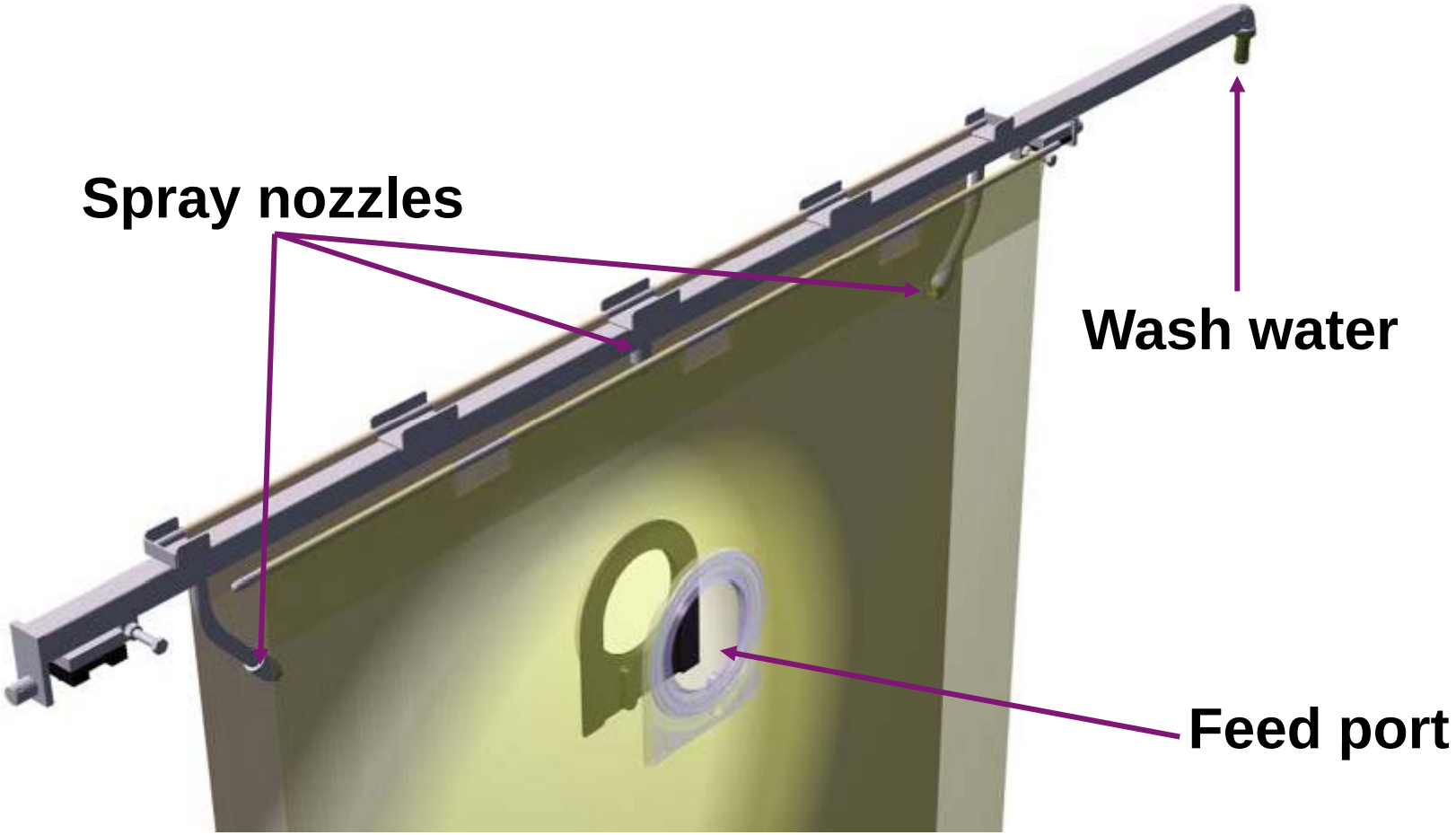
”Typical time”: 15-30 minutes

Arrangement of the filter plate pack

- Polypropylene plates
- Rubber membranes



Washing of the filter cloth



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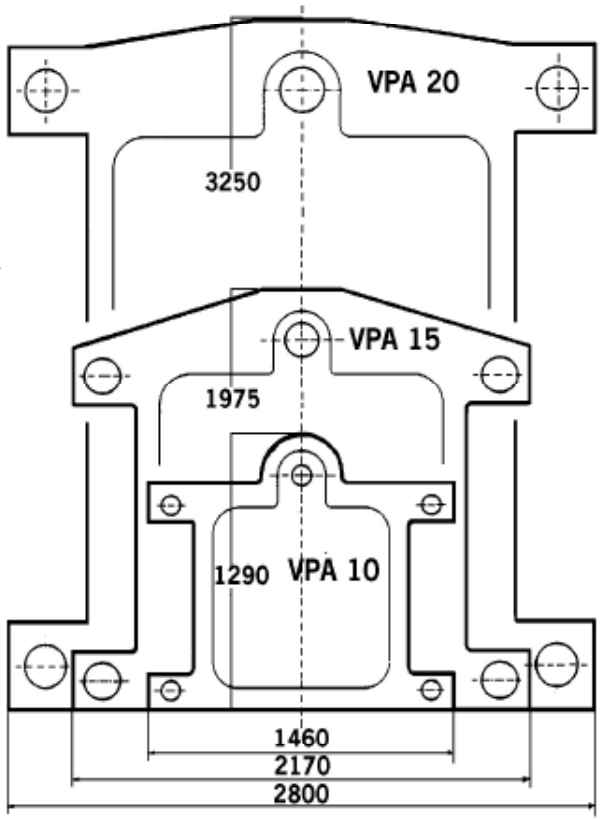
Sizes and chamber data

		Chamber depth mm	Volume litre	Filter area m^2	Drying Area m^2
Demo plant →	VPA 1030	32	20	1.3	0.65
	VPA 1040	40	25	1.3	0.65
50 000 / year →	VPA 1530	32	55	3.4	1.7
	VPA 1540	41	68	3.4	1.7
	VPA 2040	40	165	7.8	3.9
	VPA 2050	52	204	7.8	3.9

NEXT GENERATION WILL BE EVEN LARGER !



Key numbers for the LignoBoost process

Lignin production:

- 175 – 295 kg lignin/ton BLS
- Average: 240 kg lignin/ton BLS

CO_2-consumption:

- 150 – 320 kg/tonne lignin
- Average: 220 kg/tonne lignin

Acid consumption (H_2SO_4 &/or spent acid):

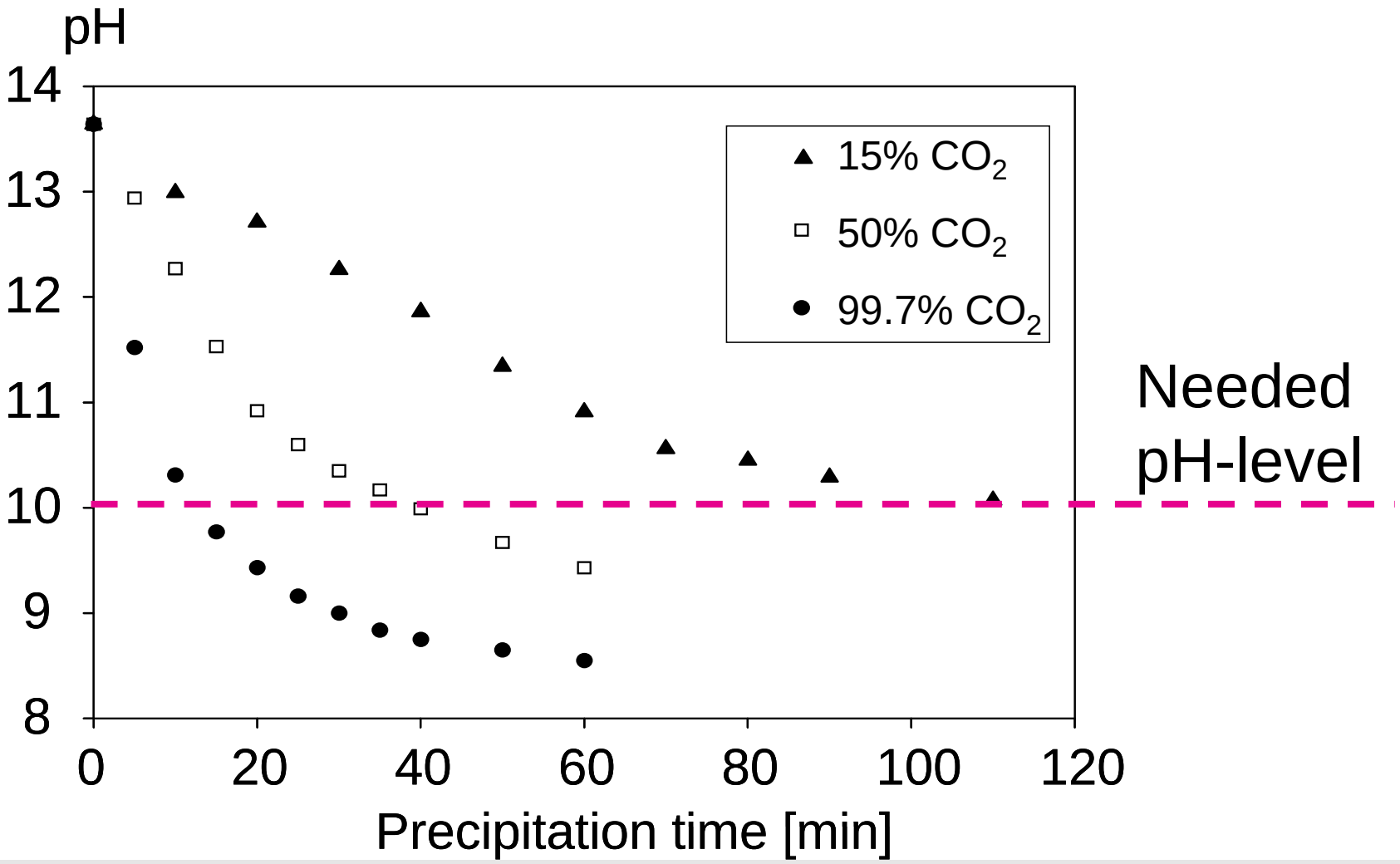
- 120 – 255 kg/ton lignin
- Average: 175 kg/ton lignin

Na/S balance

- Very important to collect information about the existing Na/S balance!
  - How is spent acid used?
  - How much spent acid is handled and available for LignoBoost?
  - Todays level of Recovery Boiler Dust purge?

- We will need to add at least some fresh H_2SO_4

Buy CO_2, get it “for free” from flue gases or from a ethanol production site?



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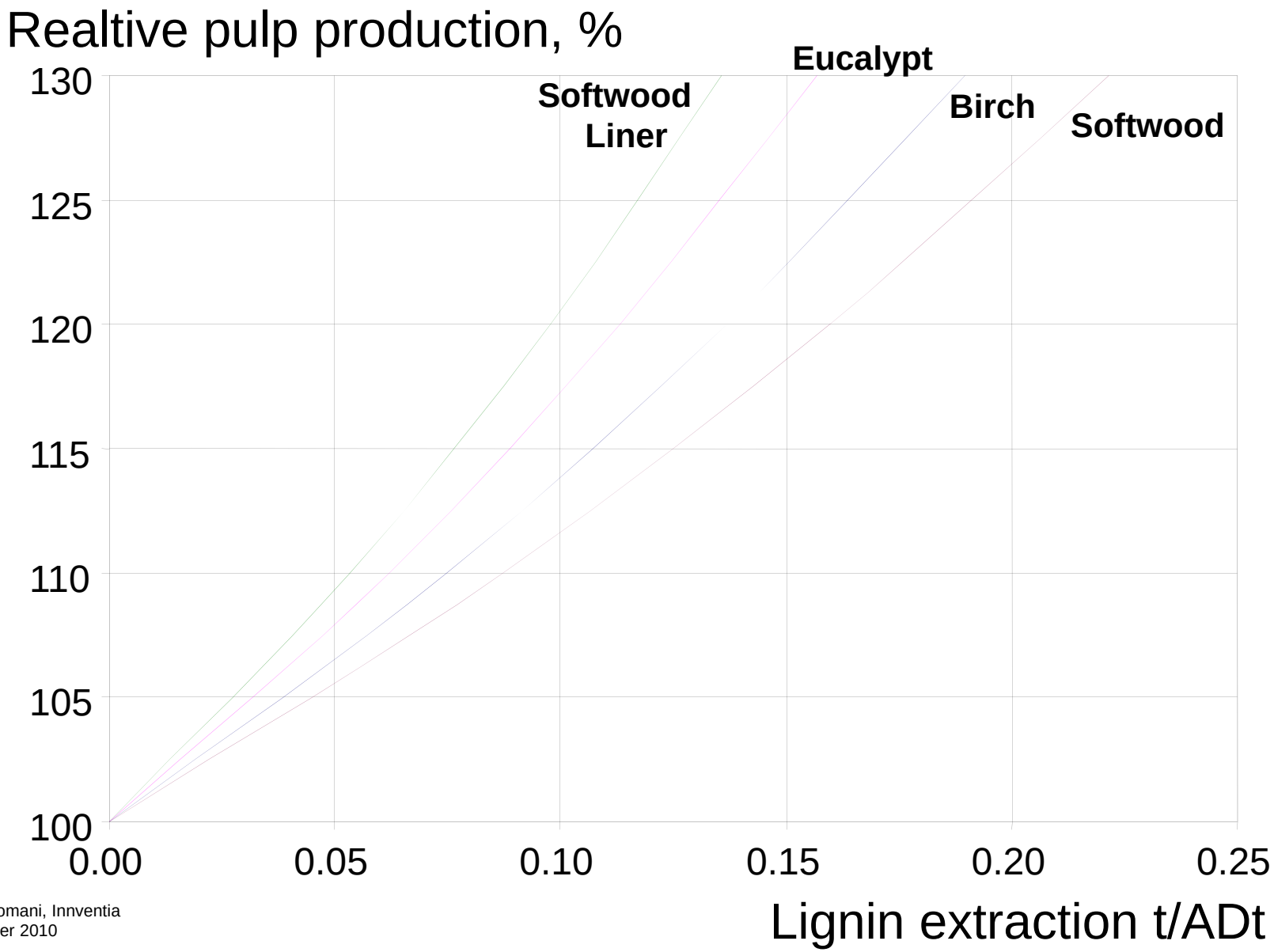
Reference: Henrik Wallmo, PhD Thesis
Chalmers Univeristy of Technology
Sweden

Possible pulp production increase

Flue gas limited recovery boiler, constant DS and air excess



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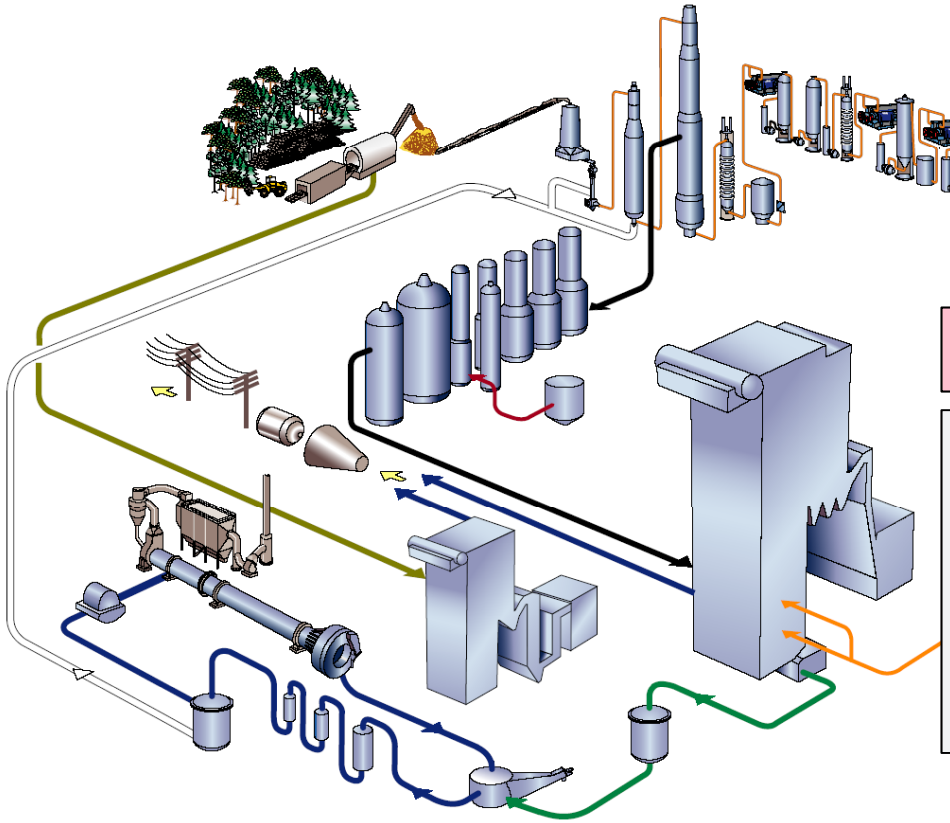
Energy situation in mill

Summary/Steam balance



Recovery boiler 15.2 GJ/ADT

Evaporation	5.1 GJ/ADT
Fibre line	4.9 GJ/ADT
Pulp drying	3.0 GJ/ADT
Others	1.0 GJ/ADT
Total need	14 GJ/ADT

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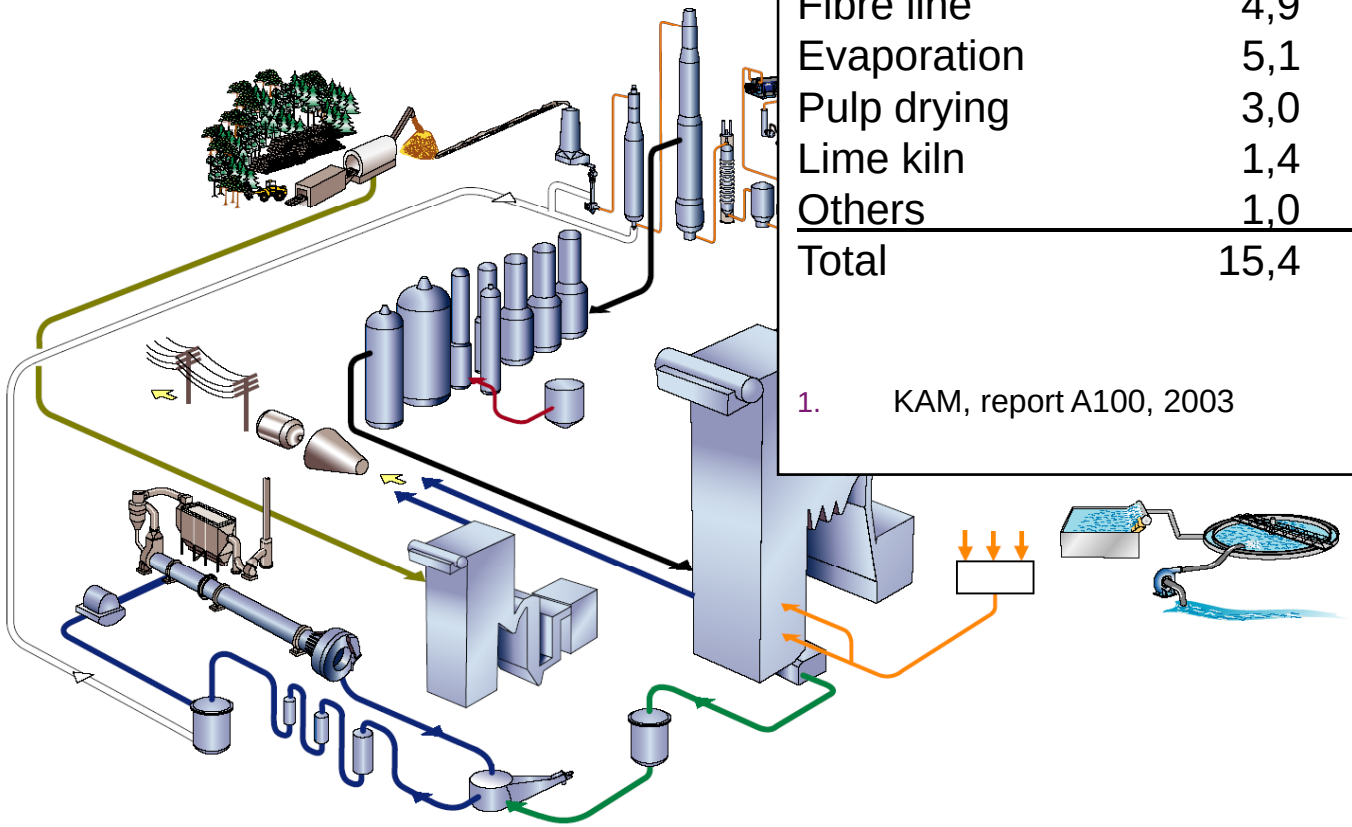
Reference:

Johansson, M., “Heat transfer and Hydrodynamics in Falling film Evaporation of Black Liquor”, Chalmers University of Technology, 2008.

KAM, report A100, 2003

Energy situation in mill

Steam saving potential



Bleached kraft pulp energy consumption average today and best available technology, GJ/ADt (1)

	Average	BAT
Fibre line	4,9	3,2
Evaporation	5,1	4,0
Pulp drying	3,0	2,2
Lime kiln	1,4	1,4
Others	1,0	0,0
Total	15,4	10,8

1. KAM, report A100, 2003

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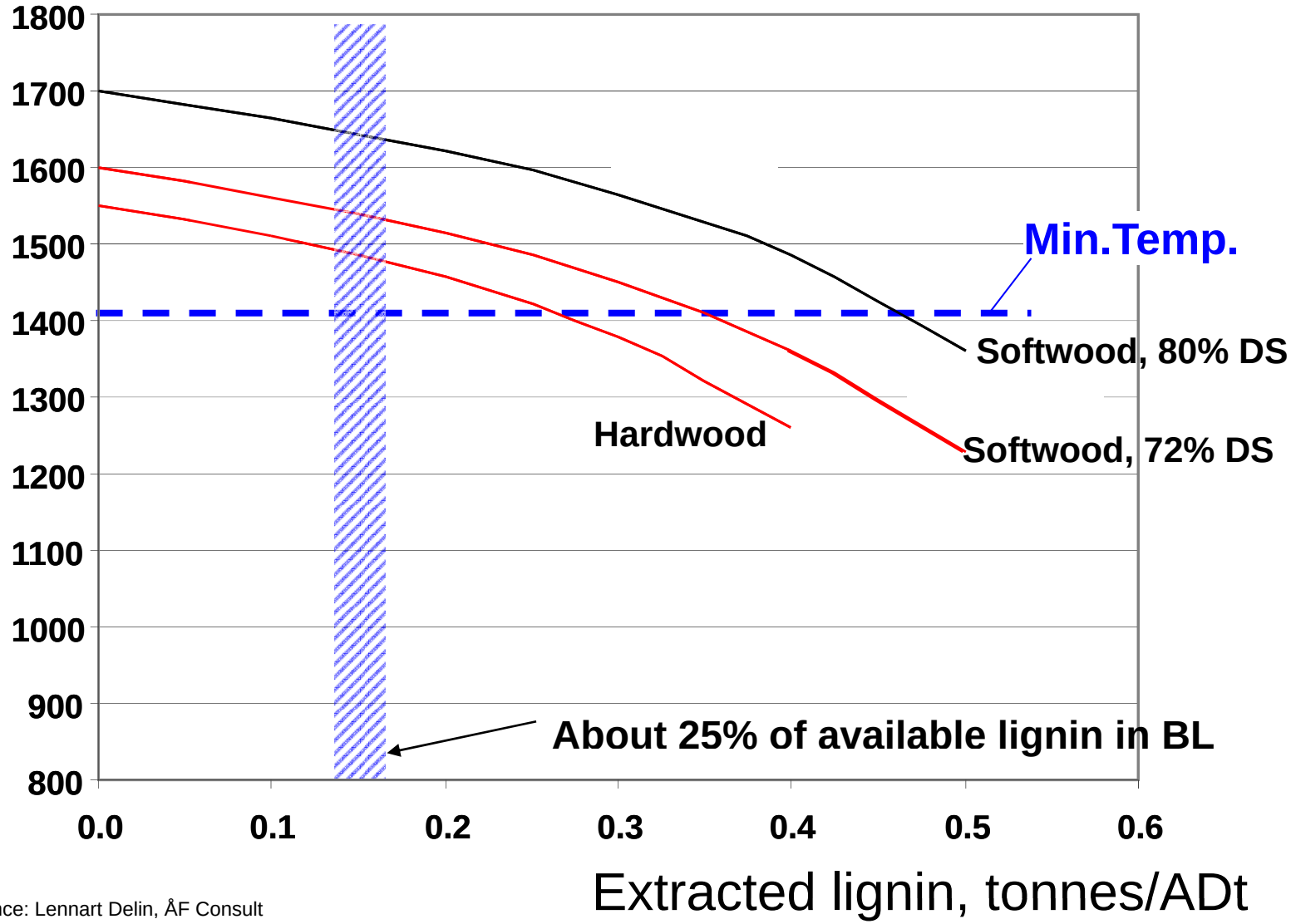
Adiabatic combustion temperature, C

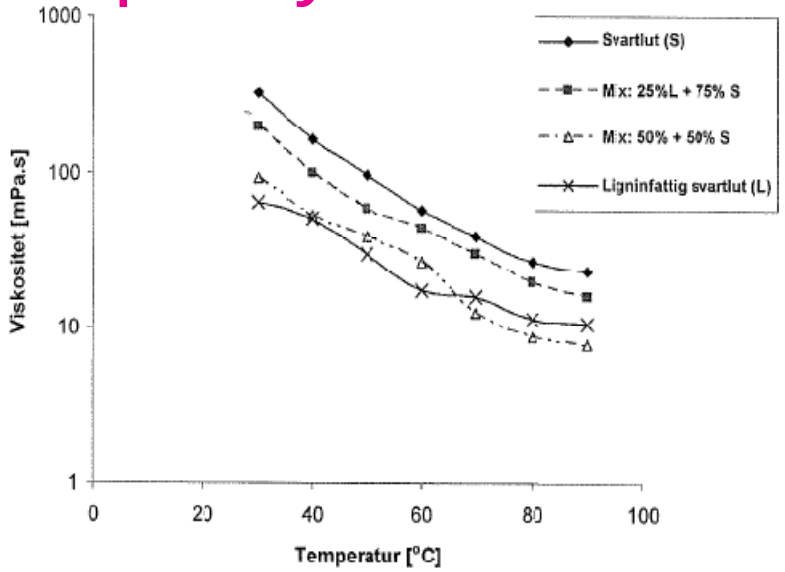


Reference: Lennart Delin, ÅF Consult

Impact of lignin extraction on black liquor properties and evaporation capacity

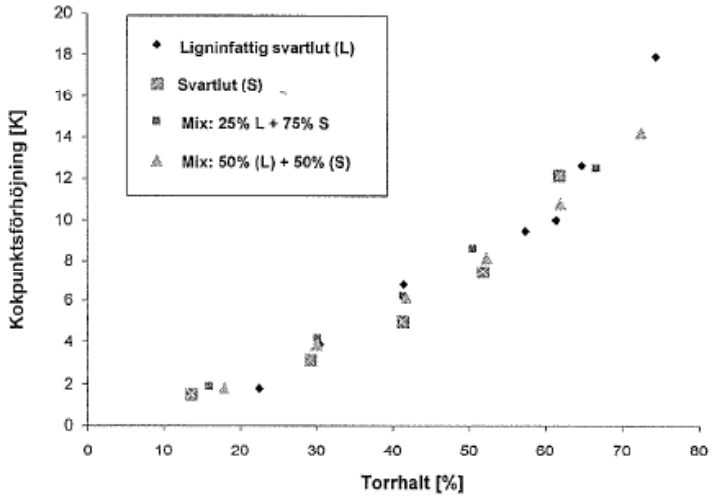
Black liquor properties

- The black liquor viscosity will be slightly lower with lignin extraction.
- Very small impact on the boiling point elevation (BPE) by lignin extraction.



Impact on evaporation capacity

- Most likely the evaporation plant capacity will remain or be slightly improved by the lignin extraction
- The point of crystallization (risk for scaling) might change due to the changed inorganic composition.
- Increased evaporation demand from lignin wash water corresponds to 2 m^3/ton lignin or 0,25 m^3/ADt at 25% lignin removal rate.



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Reference: Ali Moosavifar, PhD Thesis
Chalmers Univeristy of Technology
Sweden

Costs according to a R&D Programme

Cost for a LignoBoost plant producing 50 000 tonne lignin/year (7 t/h lignin plant). This lignin production is calculated as dry but produced as 65% DS lignin cakes.

Total investment cost:	USD* 12-18 million
Operational cost:	USD* 60-110 / tonne dry lignin USD* 11.5 / MWh (+/- 30 %)

Reference: The FRAM2 R&D Programme, 2005-2008

*1 USD = 7 SEK

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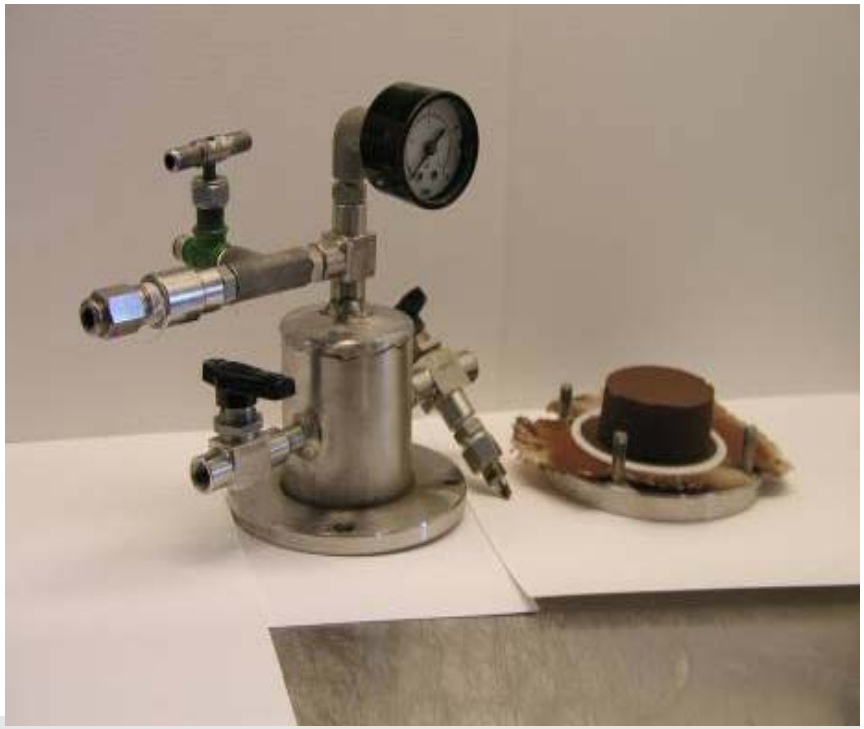
Some experiences

- The LignoBoost process is connected in **parallel** with the recovery cycle and will not interfer with the ”normal” pulp production if disturbances in LignoBoost.
- Possibilities to store the lignin product = Pulp Mill Energy Balance Optimisation
- **First part** of the LignoBoost-concept was in **commercial operation 1994 to 2005** by Borregaard LignoTech in Bäckhammar Sweden. This result in a ash-rich lignin water slurry. Continuous operation with **only one yearly maintenance stop** scheduled together with the pulp mill. Production of lignin on a level of **6 000 tonnes/year**. This means **well-proven technology.**
- **The second part** of the LignoBoost-concept, which result in a clean product & high dry solids, is tried by Innventia on a level of **4 000 tonnes/year in the demonstration plant** in Bäckhammar.
- LignoBoost-concept **does not include development of new equipment**. Instead we use conventional equipment, put together in a new way for a new application.
- **Key component** (press filters) in the LignoBoost-concept **is conventional technology, very well-proven equipment** in the mineral industry. Fully automatic equipment. Very large sized filters in the mineral industry.

Collection of data to see if LignoBoost fits in your pulp mill

- Screening of potential
  - Step 1: Laboratory scale trials at Innventia

Laboratory-scale equipment;
*~ **10g** lignin per filtration-batch.*



Collection of data to see if LignoBoost fits in your pulp mill

- Screening of potential & collection of design data
  - Step 2: Pilot scale trials at your pulp mill

Precipitation & ageing

Pilot scale equipment;
~ ***0.5 – 1 kg*** *lignin per filtration-batch*

Filtration

The LignoBoost Demo Plant

Possible to test your black liquor, produce your lignin and verify design data in real scale

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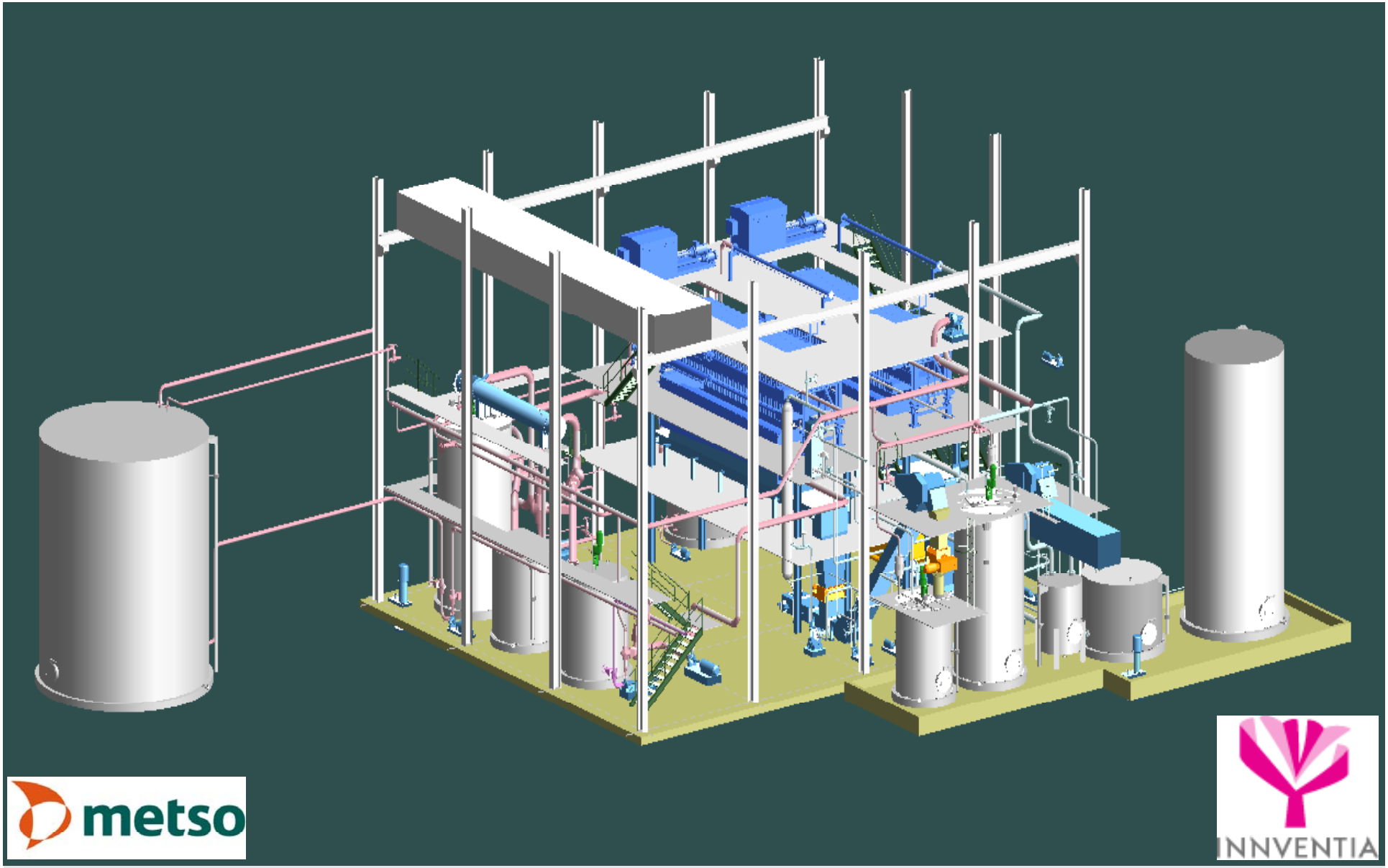
Thank you for your attention!



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