



Megatrends driving fuel changes and technological development

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Valmet Technologies Oy

Unique offering combining process technology, services and automation

Paper

- Board, paper and tissue production lines
- Rebuilds
- Stand-alone products

Pulp

- Wood and pulp handling
- Fiber processing
- Recovery

Energy

- Heat and power generation
- Air emission control
- Biofuels

Services

- Spare parts and components
- Maintenance and shutdown services
- Outsourcing services
- Production consumables
- Process support and optimization



Flow Control and Automation Systems

- Valves
- Valve automation
- Valve controls
- Distributed Control Systems (DCS)
- Quality Management Systems (QMS)
- Analyzers and measurements
- Services and Industrial Internet solutions

Leading technology supplier of biomass and multifuel boiler plants globally



Renewables to energy

Biomass to energy



Sorted waste to energy (RDF-refuse derived fuel)



Multifuel to energy

Co-firing biomass, waste (RDF, SRF) and fossil fuels (coal, gas)



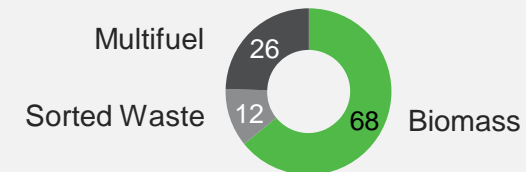
Industrial boilers

O&G / Process Gas Boiler plants
Heat recovery boiler plants

Air emission control

- Over 200 Bubbling Fluidized Bed boilers (BFB) since 1979 Capacity 10-400 MW
- Over 100 Circulating Fluidized Bed boilers (CFB) since 1980 Capacity 50 -1000 MWth
- Over 30 Modularized biomass power plants since 1999 Capacity 2-10 MW^e
- 8 Gasification plants for waste and biomass

Since 2007 ~100 new boiler plants
Total capacity ~ 12 000 MW_{th}



Fuels driving the fluidised bed development & material selection

From rule of thumbs to state-of-the art modelling tools



Towards carbon neutrality

Megatrends; resource efficient & clean world

Japanese energy turn – from nuclear towards biomass

2010s

Agro

Waste & waste wood

1990s

Biomass & Peat



CFB introduced for burning low-cost high-ash coal which PC can not handle



Material selection based on experience and rule of thumb was not sufficient anymore

Coal



Material selection based on fuel names, experience and material testing:
- Material temperature
- Cl content

1980s

Sludge & Bark



BFB introduced for combustion of bark and sludge

Understanding when material needs to be changed + max steam temperature (CAPEX, availability, efficiency)



Oil palms

Fruit bunch

Empty fruit bunches (EFB)

Palm kernel shells (PKS)

Fuels driving the fluidised bed development & material selection

Extensive academic network & co-operation with customers



Different corrosion regimes

Alkali chloride induced corrosion

Oxidation modelling

Material development

Coatings, FeCrAl



Intelligent and innovative solutions & technologies

Together we are more

Additives

Chromate formation

Double tube superheater

Low temperature corrosion

Plastic sleeves

Heavy metal (such as Pb) chloride induced corrosion

Megatrends have a strong influence on our business environment and on the FB development

We have defined three key megatrends that we carefully consider when making strategic choices.



Resource efficient and clean world

Climate change, environmental & sustainability awareness, circular economy and resource scarcity drive the need to improve resource efficiency and reduce emissions.



Digitalization and new technologies

Digitalization, automatization and new high impact technologies drive efficiency and new business models.



Urban, responsible and global consumers

Urbanization, increasing living standards, changing demographics, and globalization drive changes in consumer behavior and our customers' demand.

Material-related challenges in combustion

Furnace, empty pass, etc. wall panels

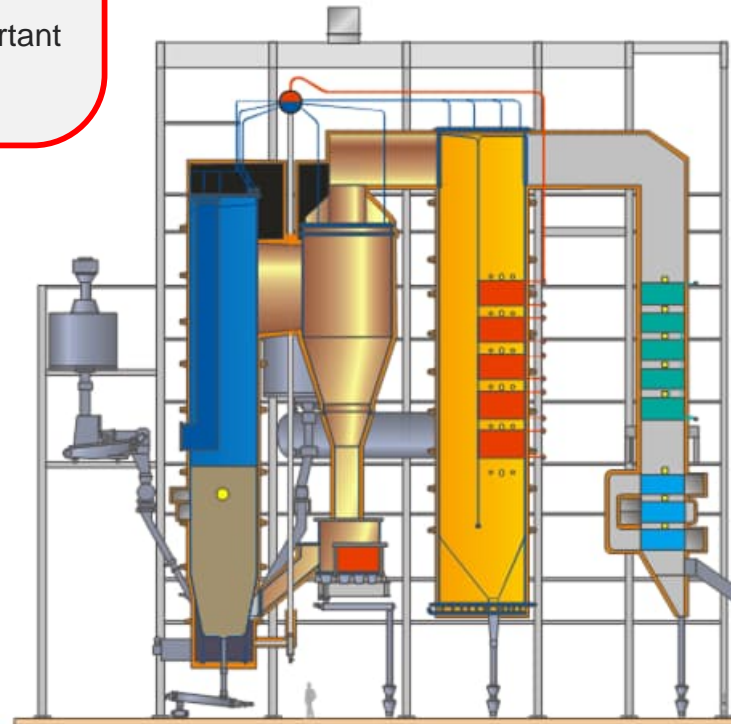
Solutions:

- Refractories
- Coatings (overlay welding, thermal spray coatings)

Future challenges & open questions:

- Higher temperature & pressure → increased furnace wall temperatures
- More complex fuel compositions
- Coating solutions are becoming more important
- Repairs of coatings

Corrosion, erosion - corrosion



Superheaters

Solutions:

- Austenitic stainless steels
- Tube shields
- Overlay welding (e.g. Inconel 625 ow)
- Additives & superheater location

Future challenges & open questions:

- Higher temperatures & more complex fuel composition
- Limit of existing material solutions?

Alkali- and heavy metal chloride induced corrosion

Air preheaters


Solutions:

- Austenitic stainless steels
- Plastic sleeves to increase surface temperature
- Temperature control

Future challenges & open questions:

- Higher efficiency requirements → lower temperatures at the cold end
- Price of the existing material solutions
 - Non-pressurized component

Hygroscopic salt induced corrosion



Megatrends driving technological development

Valmet's BFB delivery with lignin as a primary fuel

Orlen 2G ethanol plant

ORLEN Poludnie's S.A., Jedlicze, Poland

Capacity 48 MW_{th}

Fuel Lignin (from cereal straw), wood chips

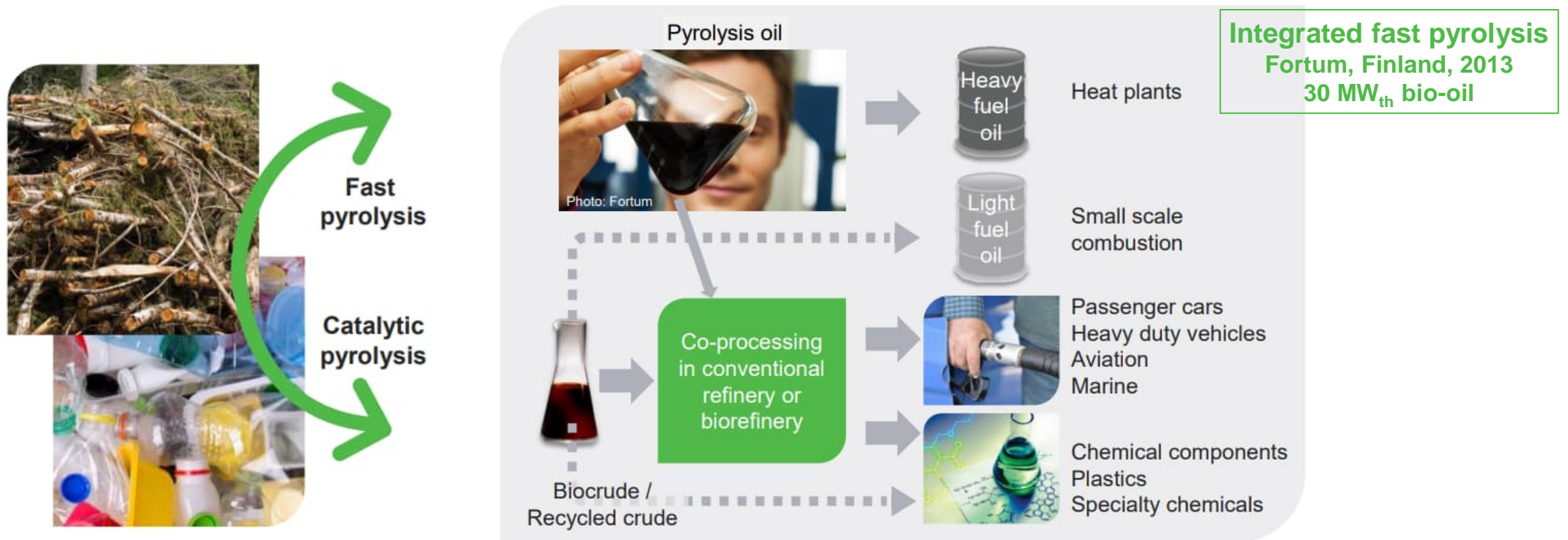
Start-up 2024

Valmet's delivery includes BioTrac pretreatment with a capacity to process approximately 400 tons of dry straw per day, combined heat and power (CHP) plant and a Valmet DNA Automation system.

Ethanol process byproduct, lignin, is used as fuel in the BioPower CHP plant, producing all steam for the ethanol plant and power.

New revenue from bio and waste streams

High-value products via pyrolysis, routes and potential



Catalytic pyrolysis:

Project LignoCat – joint development with partners
To develop catalytic pyrolysis technology that produces a refinery suitable biocrude from lignocellulosic feedstocks

Scaling up to industrial pilot & industrial demo plant

Circa ReSolute

Production of 1,000 tonnes of bio-based solvent Cyrene™ per year

Target 2030: 80 000 tonnes of annual production

Valmet's delivery includes a Valmet Pyrolyzer system, a Valmet CFB boiler and a Valmet DNA Automation system



Oxy-combustion Carbon Capture process
Post-combustion Carbon Capture

Summary

Megatrends driving fuel changes and technological development

- The main trends today are related to new low carbon fuel sources, resource efficiency and circular economy
- Recycling and recovering material fractions & converting them into valuable products
 - Only the rest, non-recyclable fractions will end in combustion
 - Fuels are becoming more complex and challenging from a chemical composition point of view
- Wishes for increased efficiency and temperatures will pose more challenges for material selection and material development
- New revenue from bio and waste streams → new processes and technologies
- Understanding corrosion and material degradation mechanisms are essential and required in the future

