Welcome to Valmet in Sundsvall
# Program

## Meeting with investors in Sundsvall, September 10, 2015

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>09:35 am</td>
<td>Coffee and welcome</td>
</tr>
<tr>
<td>09:50 am</td>
<td>Presentation and discussion</td>
</tr>
<tr>
<td></td>
<td>Stefan Mattsson VP, Fiber Business</td>
</tr>
<tr>
<td></td>
<td>Lars Eklund VP, Service Business</td>
</tr>
<tr>
<td></td>
<td>Rickard Andersson VP, Biotech &amp; ES Business</td>
</tr>
<tr>
<td>12:00 pm</td>
<td>Lunch</td>
</tr>
<tr>
<td>12:40 pm</td>
<td>Pulse &amp; Innovation</td>
</tr>
<tr>
<td>01:10 pm</td>
<td>Site Tour</td>
</tr>
<tr>
<td>03:05 pm</td>
<td>Coffee and wrap-up</td>
</tr>
<tr>
<td>03:20 pm</td>
<td>Transportation to SDL Airport</td>
</tr>
<tr>
<td>04:20 pm</td>
<td>Departure to Stockholm</td>
</tr>
</tbody>
</table>
You will be given visitor’s personal protective equipment. These are mandatory in our laboratory and production facilities.
Smoking is not allowed in our premises.
The use of cameras or video equipment is prohibited.
(Special permission can be given)
If the emergency alarm rings or you are ordered to evacuate the building, stay with your host and follow his/her instructions:

- Follow the exit signs and take the shortest route outside.
- Do not use elevator and walk orderly in the stairs.
- Your host will guide you to evacuation point. Your host will inform when it is permitted to leave the evacuation point and give then any further instructions.
Valmet Sundsvall
Located in Sundsbruk

- 410 employees
- Technical experts in Pulping & BIO
- Office
- Fiber Technology Center
  - Pilot facility
  - Laboratory, Bleaching & Analysis
- Service Center
- 24–7 Services
The workshop

- Specialized in high alloy materials, complex welding and machining
- Highly skilled own manning, totally 92 persons
- Large network of external resources for maximized flexibility (+150)
- Integrated development with product design and project departments
The Fiber Technology Center (FTC)

- The cornerstone in our ambition of continuous product development
- Close co-operation with universities in Sweden
  - Chalmers
  - Kungliga Tekniska Högskolan (KTH)
  - Mid Sweden University
Valmet Pulp & Energy business line in brief
Pulp and Energy business line in brief

World-class pulp mill offering and complete delivery capability.

Global technology and know-how leader in bioenergy and multifuels.

A natural growth platform for environmental systems and biomass conversion technologies.

2014 figures
Orders received EUR 1,344 M
Net sales EUR 956 M
Employees 1,737

Position
#1-2 Pulp
#1-3 Energy

Net sales (2014)

- Pulp: 43%
- Energy: 57%

- North America: 25%
- South America: 42%
- EMEA: 6%
- China: 23%
- Asia-Pacific: 3%
Pulp and Energy offering
A range of solutions and technologies fulfilling our customers’ needs

Pulp

- Wood and pulp handling
  - Wood handling, fuel handling, pulp drying
- Fiber processing
  - Cooking systems, mechanical pulping, complete fiber lines
- Recovery
  - Recovery boilers, evaporation systems, recovery islands

Energy

- Heat and power generation
  - Fluidized bed boilers, bio-grate boilers, biomass and waste gasification
  - Boiler islands and small power plants

Biotechnologies and Environmental Systems

- Biotechnologies
  - Lignin recovery, pre-hydrolysis, pyrolysis, bio-coal
- Air pollution control
  - Flue gas cleaning and heat recovery for boilers
  - Odor and pulp mill balance control
  - Environmental systems for biotechnologies

SERVICES
Global pulp market
Packaging and tissue are driving the total paper and board demand growth

Global paper and board demand

Packaging: containerboard, cartonboard and other paperboard

September 10, 2015 | Sundsvall site visit | Stefan Mattsson, VP Fiber Processing | Source: RISI
Growth in packaging and tissue demand is expected to continue while printing & writing and newsprint are declining.

Paper consumption (Million tons)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Containerboard</td>
<td>+3.3%</td>
<td>+2.4%</td>
</tr>
<tr>
<td>Printing &amp; Writing</td>
<td>+0.4%</td>
<td>-0.3%</td>
</tr>
<tr>
<td>Cartonboard</td>
<td>+2.6%</td>
<td>+3.0%</td>
</tr>
<tr>
<td>Tissue</td>
<td>+3.5%</td>
<td>+3.7%</td>
</tr>
<tr>
<td>Newsprint</td>
<td>-2.3%</td>
<td>-3.5%</td>
</tr>
</tbody>
</table>

Source: RISI
World pulp demand

Fiber substitution by high quality virgin fiber wood pulp continues to grow

- World paper-making fiber demand is growing
- Virgin fiber demand is increasing
- The share of market wood pulp is increasing
- Industry offers different types of investment opportunities in different markets
- New bio-pulp mill concept offers opportunities especially in Europe and North America, and also in Latin America

**Paper making fiber demand**

- Million tons
- Total growth 2014-2019: 421 → 459 (1.7% p.a.)
- Virgin pulp: 164 → 168 (1.2% p.a.)
- Non wood pulp: 404 → 421
- Recovered paper: 179

Source: RISI 5 year forecast July 2015
Virgin fiber demand is concentrating on BHK, fluff and dissolving

**Integrated and market BSK and BHK demand**

**Growth estimates**

- **BHK**
  - 2.0%/a or 1.3 million t/a

- **BSK incl. fluff**
  - 1.2%/a or 425,000 t/a

- **Fluff**
  - 3.8%/a or 225,000 t/a

**BSK drivers**
- Growth of tissue paper throughout the world
- Steady rise in fluff pulp demand

**BHK drivers**
- Growth of tissue paper and high-quality boxboard
- Growing market share of woodfree papers relative to mechanical papers in P&W segment
- Advances in paper machine design, and more extensive use of BEK in woodfree papers

**Source:** RISI
Fluff pulp market

Almost all BSK fluff pulp is sold on the market to consumer product companies for conversion to absorbent products

Fluff pulp capacity by region

- World fluff pulp demand is approx. 5.6 million tons, growing steadily by about 3.8%/a or about 225,000 t/a up to 2019
- Capacity expansion outside USA is underway

Industry trends

- Growth in disposable diapers in the developing world and increasing usage of incontinence products in the developed world as population ages
- Swing capacity between fluff and BSK pulp production
- Brazilian BEK producers exploring options for using BEK in absorbent products
In 2015, demand estimate is 6.9 million tons.
- Present capacity is estimated to about 9.0 million tons.
- Estimated demand of 9.9 million tons in 2025, with 3.7%/a growth in 2013–2025 requires about 11 million tons of capacity, i.e. +2Mt, mainly through conversions.

Purity is an important characteristics of dissolving pulp

<table>
<thead>
<tr>
<th>Common end uses</th>
<th>Textile industry, non-wovens, cord and industrial yarn, cellophane, sausage skin, sponges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscose</td>
<td></td>
</tr>
<tr>
<td>Acetate</td>
<td>Cigarette filter tows, LCD films, high quality plastics, acetate yarn, fibers</td>
</tr>
<tr>
<td>Ethers/others</td>
<td>Food industry, pharmaceutical, cosmetics, special paints, binders and glues, artificial leather, explosives</td>
</tr>
</tbody>
</table>

End uses of dissolving pulps

- High alpha pulps 33%
- Low alpha pulps 67%
- Majority of the growth

End uses of dissolving pulp

Viscose
- Textile industry, non-wovens, cord and industrial yarn, cellophane, sausage skin, sponges

Acetate
- Cigarette filter tows, LCD films, high quality plastics, acetate yarn, fibers

Ethers/other
- Food industry, pharmaceutical, cosmetics, special paints, binders and glues, artificial leather, explosives

Global demand of dissolving pulp

- 2013: 6.3 million tons
- 2025: 9.9 million tons

Graph showing demand by region:
- Rest of the world
- Europe
- North America
- Rest of Asia
- Japan
- China

Source: Pöyry, Feb 2015
World market pulp capacity

Majority of the investments occur at market pulp mills

Source: RISI 5 year forecast July 2015

September 10, 2015

Sundsvall site visit | Stefan Mattsson, VP Fiber Processing

Source: RISI 5 year forecast July 2015
Top market pulp producers

Top 5: 27% market share; Top 10: 43% market share

Eldorado Cellulose
IP
Sundsvall site visit | Stefan Mattsson, VP Fiber Processing

Source: RISI, news
Future pulp capacity changes offer good project opportunities

New mills will be constructed in Latin America, Asia and Finland. New mid-sized installations are in demand in Asia-Pacific. Upgrades, rebuilds and conversions are done in the mature markets of North America and Europe.

Announced market pulp capacity expansions, 1000 t

Source: RISI, July 2015
North American fiber production

88% of the sites in the North America have over 30 years old pulp line(s)

Market pulp and integrated mills

<table>
<thead>
<tr>
<th>Technical age of pulp lines at site, years</th>
<th>Number of sites</th>
<th>Production t/a</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>5-9</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10-14</td>
<td>5</td>
<td>16</td>
</tr>
<tr>
<td>15-19</td>
<td>16</td>
<td>30</td>
</tr>
<tr>
<td>20-24</td>
<td>33</td>
<td>33</td>
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<tr>
<td>25-29</td>
<td>37</td>
<td>20</td>
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<tr>
<td>30-34</td>
<td>20</td>
<td>20</td>
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<td>35-39</td>
<td>17</td>
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<tr>
<td>40-44</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>45-49</td>
<td>11</td>
<td>11</td>
</tr>
</tbody>
</table>

Source: FisherSolve
Conditions for pulp investments

Projects have realized in locations where implementation and operating risks are acceptable. In addition, investors benefit from a sustainable competitive advantage.

- **General cost levels**
  - Strong USD relative to most currencies has reshaped the cost structure of pulp industry, with South America and Indonesia pulp mill projects becoming more interesting investments
    - High quality pulp – low total production costs
    - A lot of land can be planted in Indonesia
    - Restrict project implementation in highly developed economies

- **Good business environment**
  - Needed for capital intensive investments
  - Country risks, credit availability
  - China’s economy will remain one of the key global drivers

- **Infrastructure & Logistics**
  - Distance to raw material and to the markets

- **Technology**
  - Relative few suppliers offering full technology packages
  - Bio-concepts

- **Ready installed base**
  - North America offers strong rebuild market

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Source: Pöyry, RISI, news
Pulping process in a nutshell
Pulping process

FiberLine
Today's Focus

Not included in Valmet Scope

September 10, 2015
Sundsvall site visit | Stefan Mattsson, VP Fiber Processing
Valmet Process solutions
Chemical pulp - BSK / BHK / BEK/ Dissolving
Valmet FiberLine
Proven large scale efficient and reliable

- High yield >54.5% with Compact Cooking

- Maximized power to the grid
  - +9.6 MWh = 4.4 Million USD/a @ 1.75MT/a

- Benchmark in water consumption and effluent volumes with TwinRoll press
  - Saving 10 million m³/a @ 1.75MT/a

- Low maintenance cost with TwinRoll press
  - USD 8.5 million savings/10 years @ 1.75MT/a

- Good platform for Service growth and profit!
The modern Valmet kraft fiberline

Layout principle
TwinRoll™ Evolution - probably the best pulp washer in the market

Will be looked at during the Site tour

- Easy to install
- High capacity
- Reliable and flexible
- Optimized operation
- Low pressure demand
- Suitable for gravity feed
- Minimized operational and maintenance cost

~1,300 sold to date
Fiberline machine products
More than 100 various machine products

- Digesters
- Refiners
- Washers
- Screens
- Filters
- Mixers
- Tower equipment
  - Scrapers
  - Agitators
- Feeders
- Ozone reactors
- MC Pumps (Sulzer)
- Reactors
- Kilns

Machines are good for service business!
Summary
Pulp summary

- Good Market opportunities
  - New Mills
  - Rebuilds
  - Upgrades

- Well received products
  - CapEx
  - OpEx
  - Sustainability
## Pulp initiatives going forward

<table>
<thead>
<tr>
<th>Customer excellence</th>
<th>Capitalize on Northern hemisphere softwood opportunities</th>
</tr>
</thead>
</table>
| **Leader in technology and innovation** | Significant R&D investments focused in increasing cost competitiveness  
Further commercialization of new offering of Pulp and Energy business line targeting in >20% of orders received from new offerings |
| **Excellence in processes** | Savings through efforts in the field of procurement, and through further development in the utilization of cost competitive countries opportunities  
Continued focus on lowered cost of product quality  
Innovation and renewal  
Lean Operations in all we do |
| **Winning team** | Unified local presence close to customers, suppliers and partners  
Focus on global processes and competence development  
Being a good place to work at |

September 10, 2015  
Sundsvall site visit | Stefan Mattsson, VP Fiber Processing
Services

Lars Eklund,
VP Performance Parts

Site visit to Sundsvall
September 10, 2015
Contents

Services session, Sept 10, 2015

1. Services
2. Service for Fiber customers
3. Performance parts
Services
Services business line in brief
Empowered to serve the pulp, paper, and energy industries

Sustainable services for energy production, fiber processing, paper, board and tissue production lines
Committed to sustainability, customers’ profitability, optimized production and maintenance, long-term partnership

2014 figures
Orders received EUR 1,055 M
Net sales EUR 989 M
Employees 5,230

Market position
#1-2 Services

3,800 pulp and paper mills worldwide, of which over 50% purchase services from Valmet
400 customers outside the paper industry

Net sales (2014)
- Rolls and Workshop Services: 29%
- Mill Improvements: 19%
- Performance Parts: 12%
- Fabrics: 15%
- Energy and Environmental: 25%

Europe
- North America: 47%
- EMEA: 28%
- South America: 11%
- Asia-Pacific: 7%

Valmet
Services competitors and market position

Room for growth

Valmet’s market share is ~13%

<table>
<thead>
<tr>
<th>Competitor type</th>
<th>Competitor Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global competitors with full offering</td>
<td>VOITH, ANDRITZ</td>
</tr>
<tr>
<td>Product specific competitors</td>
<td></td>
</tr>
<tr>
<td>Local competitors</td>
<td></td>
</tr>
<tr>
<td>Maintenance outsourcing competitors</td>
<td></td>
</tr>
</tbody>
</table>

Market size: EUR 7.5 billion

Market growth: ~2% p.a.
Valmet Services
Leading technologies and expertise close to customers

- Increased reliability
- Improved performance
- Reduced costs

Global presence with comprehensive offering

- Local service shops and service experts
- Permanent presence at customer sites

Long-term partnership with focus on quality and safety improvements

- Products and components
- Maintenance and repair programs
- Process consumable programs
- Maintenance outsourcing
- Production improvement projects
- Analysis & consulting, remote data management
Service for Fiber customers
Services growing the fastest in Pulp and Energy

Pulp and Energy
- Fiber
- Chemical recovery
- Power plants

40% of the world’s pulp is made with Valmet machines
New capacity has higher service potential

Source: RISI 5 year forecast July 2015

Million tons

- 2009: 61
- 2014: 67
- 2019: 76

Total 9.5 million tons

2.7% p.a.

North America 23%
Europe 24%
Asia 16%
Latin America 36%
Africa, Middle East & Oceania 2%
Pulp price has an impact on Services

EUR/tonne vs USD/tonne NBSK prices

- NBSK Europe (USD)
- NBSK Europe (EUR)
Expansion of service capacity in growth areas

New Service centers and expansions of existing

- **Araucaria, Brazil**
  - Full scope service center for Fiber
  - Open 2012
  - Logistic center 2016

- **Jakarta, Indonesia**
  - Full scope service center for Fiber
  - Open 2016 (12)

- **Expansion in Wuxi, Zibo and Shanghai, China,**
  - New resources in existing centers
  - Expansion of logistic centers
  - Screen basket expansion 2014
Performance parts
Services offering
Comprehensive life-cycle services offering

Rolls and Workshop Services
- Rolls
- Roll covers and maintenance
- Workshop services

Mill Improvements
- Upgrades
- Components
- Expert services

Performance Parts
- Spare parts
- Processes Parts

Fabrics
- Paper machine clothing
- Filter fabrics

Energy and Environmental
- Services for evaporation plants, power and recovery boilers and environmental equipment

Valmet
A selection of parts
Parts

eServices

1.1 million parts

60,000 Orders per year

100,000 deliveries yearly

One order every 6 min
Parts market size is big and growing

Market and key competitors
Uniqueness of parts business and development areas
Different type of parts, different drivers

- Increased reliability
- Reduced costs
- Improved performance

Convenience - speed

Spare parts

Performance - savings

Process parts
Spares are reliability (convenience) driven
Supported by 4 global logistic centers

- Increased reliability
- Reduce costs
- Improved performance

Convenience - speed
Spare parts

Performance - savings
Process parts
Speed is critical for spares growth

- **Actions for speed**
  - Quotation and order handling in local service centers
  - 4 global logistic centers with local sourcing and global supply
  - Tailor-made customer Inventory solutions
  - IT tools for customer easiness and internal efficiency
New IT tools for enhanced customer experience
Tools launched and implemented in 2014 and 2015

<table>
<thead>
<tr>
<th>Internal efficiency – faster response</th>
<th>Simplify life for customer</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stream</strong></td>
<td><strong>eParts book</strong></td>
</tr>
<tr>
<td>• Global search and communication tool</td>
<td>• Electronic customer machine documentation</td>
</tr>
<tr>
<td>• Linking all Service Centers</td>
<td>• Hot-links to eServices</td>
</tr>
<tr>
<td></td>
<td>• On-line access to parts information</td>
</tr>
<tr>
<td></td>
<td>- Price &amp; availability</td>
</tr>
<tr>
<td></td>
<td>- Part details</td>
</tr>
<tr>
<td></td>
<td>1,100,000 articles</td>
</tr>
</tbody>
</table>

**Value based pricing (VBP)**
- Pricing based on value drivers like complexity, customer value & competition
- Improved price quality, efficiency and customer trust

**eServices**
- On-line access to parts information
  - Price & availability
  - Part details
  - 1,100,000 articles
Process parts performance driven
Agreement based business

- Increased reliability
- Reduce costs
- Improved performance

Convenience - speed
Spare parts

Performance - savings
Process parts
Process parts
Energy, capacity and production cost focus

• New production capacity
  – Parts center established in Shanghai, China, doctoring and screen baskets
  – New capacity in added in NA, coater blades

• R&D initiatives
  – Focus on product renewal
  – Additive manufacturing, 3D

• Local technology competence
  – Sales by technology focus

• Focus on agreements
  – Flexible offering model
# Creating customer value via flexibility

Make your own mix of technical scope, stocking, pricing and technical support

<table>
<thead>
<tr>
<th>Technical scope</th>
<th>Inventory management</th>
<th>Pricing agreement</th>
<th>Valmet support</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process parts</td>
<td>Stock at customer site</td>
<td>Results based model</td>
<td>Expert services</td>
</tr>
<tr>
<td>Fabrics</td>
<td>Reserved stock at Valmet</td>
<td>Production based model</td>
<td>Process expert support</td>
</tr>
<tr>
<td>Roll covers</td>
<td>Deliveries based on prediction / demand</td>
<td>Flat rate TCO model</td>
<td>Shutdown / maintenance support</td>
</tr>
<tr>
<td>Spare parts</td>
<td>Invoicing per usage / transaction</td>
<td></td>
<td>Inventory management support</td>
</tr>
</tbody>
</table>

Valmet support:
- eServices
Summary
Performance parts summary

- Service and performance parts are growing
- New service capacity for Fiber customers in Brazil, China and Indonesia
- Investments and development in process parts supporting growth targets
- Speed and convenience are main drivers for spares growth
- 3D printer for metal can change the game
Additive manufacturing – 3D printing of parts
Will change the game
Global biotechnologies market
Biotechnology drivers create new demand

Drivers may differ somewhat depending on technology and market

In general

- Strong market demand on bio based products
- Ethanol and non-fossil based chemicals and materials market demand
- Making use of waste streams by adding value
- De-bottlenecking of existing plants
- New products and revenues from existing processes
- Incentives and political decisions
Our traditional business and customers form sound foundations for our biotechnologies

Pulp Mills
• Number one in chemical pulping
• Decades of experience and references in wood handling systems, cooking systems, complete fiber lines, evaporation systems and recovery islands as well as odor control

Heat and Power Generation
• Largest boiler and plant supplier in biomass and waste sector
• Extensive experience in fluidized bed boilers, bioGrate boilers and air pollution control systems

Proven Solutions for Industry

Biofuels
• Gaseous fuels
• Liquid fuels
• Solid fuels

Bio-based chemicals & materials
• Monomers and polymers
• Composites
• Fine and specialty chemicals
Bio-based products are any products – fuels, chemicals, materials – made from renewable resources

Plant material and municipal waste – biomass – are turned into electricity, fuels, intermediates for the chemical processes and materials

<table>
<thead>
<tr>
<th>Biofuels</th>
<th>Bio-based chemicals</th>
<th>Biomaterials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bioethanol (1G and 2G)¹</td>
<td>• Replace chemicals derived from fossil petroleum</td>
<td>• Materials made from petrochemicals can be replaced with materials made from biomass</td>
</tr>
<tr>
<td>Biodiesel (1G and 2G)²</td>
<td>• Reduce pollution</td>
<td>• Useful and biodegradable alternatives</td>
</tr>
<tr>
<td></td>
<td>• Increase efficiency</td>
<td>• Reduction of fossil based products</td>
</tr>
<tr>
<td></td>
<td>• Limit the hazardous materials in the manufacture and use of chemicals</td>
<td>• Utilization of byproducts and residues</td>
</tr>
<tr>
<td></td>
<td>• Replace fossil raw material based petroleum</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Decrease the greenhouse gases</td>
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Valmet serves the emerging biotechnologies markets

Our focus is on lignocellulosics and waste raw materials

1) First generation biofuels: produced directly from food crops such as corn or sugar cane.
2) Second generation biofuels: produced from non-food crops such as wood, organic waste, food crop waste, specific biomass crops
Examples of bio-based products and main players

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<thead>
<tr>
<th>Biofuels</th>
<th>Bio-based chemicals</th>
<th>Biomaterials</th>
</tr>
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<tbody>
<tr>
<td><strong>Products</strong></td>
<td><strong>Sugar platform / Commercial products (of fermentation process)</strong></td>
<td><strong>Products</strong></td>
</tr>
<tr>
<td>Bioethanol (2G)</td>
<td>Aspartic acid, Algal oils, Farnesene, Itaconic acid, Isobutanol, Lactic acid, N-butanol, Succinic acid, Polyhydroxyalkanoates, 1,3-Propanediol</td>
<td>Bio-based plastics, as a product example Main material PET</td>
</tr>
<tr>
<td>Biodiesel (2G)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Commercial scale producers</strong></td>
<td><strong>Key players</strong></td>
<td><strong>Number of players such as</strong></td>
</tr>
<tr>
<td>MOSSI GHISOLFI</td>
<td>Cargill, Braskem, PURAC®</td>
<td>BASF, Dow, PURAC®, NatureWorks, Metabolix, Novamont</td>
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Source: Pöyry, company web pages, news,
Biotechnologies market

Market drivers

- Emerging market for converting biomass into fuels, chemicals and materials
- Growth of energy, transportation, and chemical industry sectors
- De-bottlenecking and making value from waste and residues
- Volatile due to changes in regulations and oil price

Industry trends

- Partnerships, mergers and acquisitions proceed in search of synergistic know-how, value chains and value networks, business concept, process and equipment optimization
- Huge number of companies; some fail, others continue to move steadily towards commercialization
- Conversion of biomass to chemicals and materials instead of or in addition to fuels in search for economic viability
- Location at the source of feedstock to reduce transportation costs and other costs associated with feedstock aggregation
- Alternative feedstocks, e.g. waste or gas
Valmet’s biotechnologies offering
Valmet’s biomass conversion technologies

Penetrating the market in steps through references

- **LignoBoost** system for extracting lignin from kraft black liquor
- Solutions for **prehydrolysis** of biomass to sugars and lignin for further refining to fuels or chemicals
- Complete production lines for **steam exploded black pellets** and revamps of existing white pellet plants
- **Pyrolysis** solutions for bio-oil production
- **CFB gasification technologies** for biomass and waste gasification

**Facts**
- Commercial scale lignin separation installations in operation since 2013
- Several prehydrolysis pilot scale deliveries. First demonstration scale plant in operation in 2012. Commercial scale being offered.
- Bio-oil pilot production since 2009, first demonstration scale plant in operation in 2013
- Commercial scale gasification of biomass and waste since 2011

**Results**
- New revenue streams for pulp mills and biomass power plants
- Reduction of emissions
- From fossil fuels to utilization of sorted waste and biomass
- Alternative renewable fuels
Valmet is committed in R&D: We continue to move our customers’ performance forward

**Our customers’ present and future needs drive our R&D forward**

- Close co-operation with our customers
- Wide and synergistic competence base
- Extensive global research network
- Own R&D centers with pilot operations
- Long track record in development and scale-up

- Increased production efficiency and availability
  - Improved cost competitiveness
- Widened raw material base and fuel mix
  - Maximum value from renewable raw materials
- Minimum environmental impact

September 10, 2015  © Valmet  |  Rickard Andersson, VP Biotech & ES
Long-term R&D cooperation with partners produces results – pyrolysis as an example

1980’s
The first laboratory studies by VTT

1990’s
The first pyrolysis R&D projects in Finland

2007
Technology development consortium - Valmet, UPM and VTT
The first cold model tests at Valmet’s R&D Center in Tampere

2009
Fortum joins the development consortium
Oil production at Valmet’s R&D Center

2007
Combustion tests
Planning for a commercial-scale demonstration plant

2010
2012
Deal to construct Joensuu bio-oil plant – Fortum and Valmet

2013 - R&D projects on pyrolysis oil upgrading

2013
Commissioning of Fortum’s Joensuu plant

Produced bio-oil = heating for 10,000 houses in cold Nordic climate
LignoBoost™
– Lignin
How can pulp production be increased when lignin is extracted from black liquor?

- Lignin has a high heating value (about 26 MJ/kg DS) and it creates ~35% of the dry solids content in the recovery boiler.
- The recovery boiler is limited by the heat load and many mills run their boiler close to the maximum limit.
- When lignin is removed prior to combustion, the dry solids content and the overall heating value of the black liquor is decreased.
- The thermally off-loaded recovery boiler can then take a larger flow of black liquor.
Lignin is a versatile product
Applicable as a fuel or intermediate for chemicals and materials

- Lignin is structurally and chemically very complex high molecular weight material containing different aromatic building block components.
- The variability of structure will naturally lead to mixtures of products when converting lignin.
- The exact details of biomass feed and lignin recovery process will result in lignins of differing properties in e.g. molecular weight distribution, solubility, number of free phenolic, hydroxyl and carboxyl groups etc.

Photos: Compliments to Innventia
Lignin separation as part of pulp mill process

LignoBoost lignin separation process connected to pulp mill chemical recovery
- Lignin can be utilized as renewable fuel replacing fossil fuels and as new bio-material for many industries

**Domtar Plymouth, USA**
- Annual yield of 25,000 tons lignin
  - Decreased use of fossil fuel
  - Increase of pulp production capacity by 5% and efficiency by off-loading the recovery boiler
  - Domtar sells recovered lignin as BioChoice™ product

**Stora Enso Sunila mill in Finland**
- LignoBoost plant produces 50,000 metric tons of dried lignin per year
Bio-based Fuels, Chemicals and Materials
We contribute to bioethanol and bio-based chemicals with our proven solutions.

Biomass handling -> Pre-hydrolysis -> Separation -> Enzymatic hydrolysis -> Fermentation

- Automation
- Power plant

Biomass -> Evaporation -> Lignin separation

- Molasses
- Lignin pellets
- Ethanol

Valmet Partner
Production of climate-friendly bioethanol from agricultural waste

Second generation bioethanol produced from agricultural waste
Up to 1,000 tons of cellulose ethanol from around 4,500 tons of wheat straw

Key results
• Biofuel cuts CO₂ emissions by about 95% compared to fossil-based
Steam Explosion – Bio coal
Steam explosion technology for bio coal

- Zilkha Biomass Energy LLC and Valmet have signed a collaboration agreement in the field of steam explosion. The parties will work together to develop a joint global offering.

- Steam exploded bio coal provide a number of benefits compared to traditional wood pellets
  - Improved durability, water-resistance, higher energy content, lower shipping costs, and reduced dust problems compared to other types of bio-based pellets.
Integrated Pyrolysis – Bio-oil
Biotech and Environmental Systems case example: Additional revenue from bio-oil

Fast pyrolysis of biomass integrated to a fluidized bed boiler

Production of bio-oil by pyrolysis from forest residue and other biomass

Renewable bio-oil production of 50,000 t per annum

Key results

• Results in significant reductions in CO₂ emissions

• Bio-oil can replace heavy fuel oil in heat and power generation and might be further refined to transportation fuel

• Integration provides maximum energy efficiency
Global environmental systems market
Environmental systems are part of our traditional offering with 500 references

- Valmet provides proven systems to pulp mills and energy sector
- Valmet has delivered 500 air pollution control systems
Market drivers

- Very large and growing global market in air pollution control
- Tightening emissions legislation and stricter directives globally
  - USA, Europe
  - China biggest market & increasing
- Aging power plants and pulp mills
- Increasing energy efficiency

Energy

- Industrial Emission Directive (IED) - EU
  - Large combustion plant
  - Medium combustion plant
  - Waste directive
- Aging power plants, in EU, 45% of power generation capacity is more than 30 years old – APC rebuilds
- Life span thinking of plants
- Energy efficiency – heat recovery especially in the Nordics

Pulp

- Odorless mill, environmental acceptance
- Capacity increases - debottlenecking
- Aging pulp mills - ESP rebuilds
- Chemical balance control - sulphuric acid production

Industry trends
Valmet’s offering in environmental systems
Extensive offering of air pollution control systems

- Dry, semidry and wet flue gas cleaning processes for removal of particular and gaseous emissions
- Condensing scrubbers and heat exchangers for recovering heat from flue gas
- SNCR and SCR technology for NOx reduction
- Odorous gas treatment and chemical balance control systems for pulp mills processes

Facts
- Complete flue gas cleaning and heat recovery systems
- Odor and mill balance control for pulp mills
- 500 air pollution control references

Results
- Minimum emissions
- Reliable and proven technology solutions
- Increased plant efficiency
- Fuel savings
Meeting BAT emission levels with lowest life cycle cost

Valmet’s scope of delivery

- Selective catalytic NO\(_x\) reduction (SCR) for each boiler
- Wet limestone flue gas desulfurization (FGD)
- Take over in 2016 to 2018

Key results

- Meeting BAT emission levels with lowest life cycle cost

**Case**

**Flue gas cleaning**

CIECH Soda Polska

**Inowroclaw CHP plant**

Four pulverized coal boilers, each 140 t/h, built in 1970’s by Lentjes

Steam and electricity is used in production of soda

Investment in emissions to meet IE Directive requirements
Summary
Biotech and ES summary

- Valmet serves the emerging biotechnologies markets
- Our focus is on lignocellulosics and waste raw materials
- We build on our knowledge base, but continue the development to fit the emerging business
- Valmet provides proven Environmental Systems to pulp mills and energy sectors
- Very large and growing global market in air pollution control
- Tightening emissions legislation and stricter directives globally drive the business
Questions?