Multilayer Liner and Machine Technology

Jari Kataikko

Paper Technology Manager
Board and Paper Mills Business Unit
Containerboard

Valmet Technologies Ltd

Valmet Asia Pacific and India

Containerboard Market and Grades

Containerboard Machine Technology

Latest Innovations (selected ones)

Containerboard References (only shown in Saharanbur)
Valmet Technologies Ltd
Progress built on 220 years of industrial history
From cloth making to high-tech processes

1797 Tampereen Verkatehdas
1841 Götaaverken Raahe
1856 Tampella
1858 Beloit
1860 KMW
1868 Sunds Defibrator
1942 Rauma-Raahe
1951 Valmet
1999 Metso created through merger of Valmet and Rauma

Acquisitions
2000 Beloit Technology
2006 Kvaerner Pulping Kvaerner Power
2009 Tamfelt

End of 2013 Demerger to Valmet and Metso
2015 Metso Process Automation Systems to Valmet
Today Valmet is the market leader serving a global customer base

Unique offering
- Market’s widest offering combining process technologies, services and automation
- Research and development spend EUR 64 million in 2017

Market leadership
- Leading market position in all markets
  - Pulp #1–2
  - Energy #1–3
  - Board #1
  - Tissue #1
  - Paper #1
  - Services #1–2
  - Automation #1–3

Strong global presence
- 33 countries
- 120 service centers
- 87 sales offices
- 36 production units
- 16 R&D centers
- 12,000 professionals
  - EMEA 8,000
  - China 1,700
  - North America 1,200
  - Asia-Pacific 700
  - South America 500

Leader in sustainability
- Sustainability 360° agenda
- Four consecutive years in Dow Jones Sustainability Index
- Three consecutive years in Ethibel Sustainability Index Europe
- A- rating in CDP climate program 2017
Strong, global presence is a good platform for growth

Over 120 service centers, 87 sales offices, 36 production units, 16 R&D centers

North America
- 17 service centers
- 7 production units
- 8 sales offices
- 1,223 employees

South America
- 3 service centers
- 2 production units
- 5 sales offices
- 534 employees

EMEA
- 16 R&D centers
- 63 service centers
- 21 production units
- 54 sales offices
- 8,088 employees

Asia-Pacific
- 10 service centers
- 16 sales offices
- 727 employees

China
- 8 service centers
- 6 production units
- 3 sales offices
- 1,696 employees

Employees on December 31, 2017
Full scope offering for the pulp and paper industry

Technologies
1. Wood handling
2. Heat and power production
3. Chemical pulping
4. Chemical recovery
5. Pulp drying
6. Recycled fiber
7. Mechanical fiber
8. Stock preparation
9. Board and paper making
10. Tissue making

Automation
- Distributed Control System (DCS)
- Performance solutions
- Quality Control System (QCS)
- Profilers
- Analyzers and measurements
- Industrial internet solutions
- Automation services
- Process simulators
- Safety systems and solutions

Services
- Mill and plant improvements
- Spare and wear parts
- Paper machine clothing and filter fabrics
- Roll services
- Services for evaporation plants, power and recovery boilers
- Services for environmental equipment
Valmet’s customer focused research and development work

**Valmet’s R&D focus areas**

- Advanced and competitive technologies and services
- Raw material, water and energy efficiency
- Promotion of renewable materials

- 16 research and development centers
- Research partnerships with leading global universities and research institutes
- **EUR 64 million** R&D spend in 2017
- **1,400** protected inventions
Valmet Paper Technology Centers
Creative environment for paper and board development

Paper & Board Technology Center
Jyväskylä, Finland - 2 pilot machines
Järvenpää, Finland – Finishing technology
Inkeroinen, Finland – Fiber technology

- Fully equipped analysis laboratory
- Extensive expert network
- Joint development
- Customer pilot trials
- Training
Valmet in Asia Pacific and India
Local presence in Asia Pacific

24 locations, over 750 employees working for automation, pulp, energy and paper industries
Local presence in India
Serving the pulp, paper and energy industries

Gurgaon sales office
Vadodara Service Center
Chennai engineering, project execution and services hub

Over 140 employees experts in:
- project and process engineering
- plant design
- start up and commissioning services
- global sourcing
- automation
- services
Containerboard Market and grades
New Container board machines
Towards lighter basis weights and higher speeds

- More paper at the same raw material cost and higher speed
- Lower transportation costs
- Economic packaking
- Less packaking waste

Source: Operation speed development, containerboard grades, based on information with sample collection.
Technology Part focusing on TL and RCF

Paperboard grades

Cartonboards
- Folding boxboard (FBB)
- White lined chipboard (WLC)
- Solid bleached board (SBS)
- Solid unbleached board (SUB)
- Liquid packaging board (LPB)

Containerboards
- Kraftliner (KL)
- Recycled Liner (TL)
- White Top Liner (WTL)
- Coated White Top Liner (CWTL)
- Recycled Fluting (RCF)
- Semichemical Fluting (NSSC)

Special grades
- Core board
- Wall paper base
- Gypsum board
- Sack paper
- Others

Valmet
High quality containerboard – machine sections effect to board quality parameters

<table>
<thead>
<tr>
<th>Basis weight profile</th>
<th>Furnish</th>
<th>Short circulation</th>
<th>Headbox</th>
<th>Forming</th>
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Headbox
Valmet’s OptiFlo headbox product family

The solution for your specific papermaking needs

- Fit for purpose: all applications and paper machine sizes available
- Robust and modular construction, with high quality and cost efficiency
OptiFlo Fourdrinier ejector type of dilution
Sets new levels for basis weight CD profiling

- **Ejector type profiling feed straight to turbulence generator tubes:**
  - 30% better CD control response accuracy and power
  - 50% lower dilution line pumping energy consumption
  - Extreamly compact and clean headbox design
Forming section
### Multi-Fourdrinier ply selection

<table>
<thead>
<tr>
<th>1-ply</th>
<th>2-ply</th>
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<th>4-ply</th>
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2-ply multi-Fourdrinier, containerboard grades using recycled fibres

- Benefits:
  - Good solution especially for low basis weights
  - High dewatering capacity
  - Economical investment
  - Good strength properties
Basic definitions in forming

- **Dewatering**
  - Drainage capacity
  - Turbulence
  - Table activity
  - Retention

- **Formation**
  - Flocculation tendency
  - Shear forces
  - Turbulence
  - Table activity
  - Retention
Activity - Magnitude

- Effecting factors:
  - Foil angle
  - Foils width
  - Vacuum
  - Wire tension
  - Machine speed
  - Jet to wire speed ratio
  - Headbox consistency
Factors influencing dewatering and formation

- Low headbox consistency
  - flocculation tendency decreases
  - shear strength of fiber network decreases
- More table activity
  - more deflocculated stock
- Increased shear forces
  - more deflocculated stock
- Increased drainage
  - better formation, smaller floc sizes
- Higher freeness
  - usually worse formation (response to table activity decreases)
- Longer fibers
  - more flocculated stock
- Higher fiber coarseness
  - more deflocculated stock
2-ply forming section with on-top-Fourdrinier

Containerboard machine, consistencies

- **Headbox**
  - Consistency: 0.50-0.70%

- **Couching**
  - Consistency: 8-10%

- **Flat suction box**

- **High vacuum foilbox**

- **Low vacuum foilbox**

- **Foilbox**

- **Forming board**

- **Dryness**
  - 22-24%

- **Headbox cons.**
  - 0.30-0.50%
3-ply multi-Fourdrinier, containerboard grades using kraft pulp, OCC and/or virgin fibers

**Benefits:**

- Compact design
- High dewatering capacity
- Optimum furnish selection for each ply
- Good surface brightness (layer purity/coverage)
- Delivers gentle dewatering and the highest strength
Press section
## High quality containerboard

### Effect of press section

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Press section dewatering

- **UB dewatering**
  - Water pressed from sheet to felt
  - Felt carries the water to the uhle box where it is removed by vacuum
  - Open, heavy weight felts
  - Slow machines (pulp, packaging)
  - NA

- **Nip dewatering**
  - Water pressed from sheet through the felt to roll grooves or holes
  - Water removes out of the roll with the help of centrifugal force
  - Dense and/or light weight felts
  - Higher speed machines (P&W, tissue, higher speed packaging)
  - EMEA, China
OptiPress Center
High dewatering capacity

- Shoe press for excellent dryness
- Efficient belt roll doctoring and savealls
- Compact multi-fuction uhle box for optimized felt dewatering
- Optimal felt selection for secured water removal
OptiPress Linear
High dewatering capacity

Two shoe presses for high dryness
Four felts for excellent water removal and dryness
Compact multi-fuctional uhle box for optimized felt dewatering
Efficient belt roll doctoring and savealls
Board pressing concepts
With OCM technology (no cantilevering)

Basis weight
Typical design range
110-300 g/m² (22-61 lb/1000 ft²)

Machine speed
Typical design range
60-160 g/m²
(12-33 lb/1000 ft²)

OptiPress Linear
≤ 1200 m/min (4000 fpm)
Oper. 1050-1150 m/min
(3440-3770 fpm)

OptiPress Center
≤ 1600 m/min (5250 fpm)
Oper. 1250-1600 m/min
(4100-5250 fpm)

OptiPress Linear
≤ 1730 m/min (5675 fpm)
Oper. 1250-1600 m/min
(4100-5250 fpm)
Drying section
OptiRun main concepts

- **OptiRun Single**
  - single-fabric dryer section

- **OptiRun Single**
  - compact single-fabric dryer section

- **OptiRun Hybrid**
  - hybrid dryer section with single-fabric and double-fabric groups

- **OptiRun Hybrid**
  - hybrid dryer section with single-fabric and compact double-fabric groups
Runnability systems for high-speed machines

HiRun 4000
HiRun 2000
SymRun or (UnoRun)

Excellent sheet runnability
Effective tail threading
Less breaks
Draw reduction from press section
Operation principle of HiRun runnability system

Web

Fabric

Web with HiRun

No HiRun

HiRun space: high vacuum zone

Pocket space: normal vacuum zone

Maximal web stability
Surface sizing
OptiSizer product family

Size application solutions for specific papermaking needs

- Fit for purpose: all application methods and paper machine sizes available
- Robust and modular construction,

OptiSizer Pond
Pond application

OptiSizer Film
Film application

OptiSizer Spray
Spray on web application

OptiSizer Combi
Combined film, pond or spray application

OptiSizer Spray
Sizer with spray on roll application

OptiSizer Hard
Sizer with spray application on hard rolls

New design

Valmet
Surface sizing development

Pond sizing

Film sizing

Spray on web

Spray on roll

Spray on hard rolls + high nip load

Valmet
OptiSizer Film – main components

- Application module
- Beam
- Beam turning
- Nip loading
- Nip roll
- Return pan
- Drip pan
- Walkway
- Frame
Wide application area

- Also possible to have a multi-purpose sizer with coating and surface size application
Optisizer Spray application principles

- Contactless application of starch
- No return circulation or washing of the web
- Efficient mist recovery, encapsulated construction and edge sealing
Comparison of control parameters
Accurately controlled size amount is important

- **Spray**
  - Accurate control of wet film by adjusting feeding pressure
  - Fast response to changes in solid content due to low volume system

- **Film**
  - Reasonable control possibilities

- **Pond**
  - Size solids content is the only control parameter

Starch amount controllability

Rod profile and rod loading

Nozzle opening & pressure

Size solids content
OptiSizer Film vs Spray for Rec. Containerboards

**OptiSizer Film** - Sizer with film application

- State-of-the-art size press
- Limited strength for high basis weight
- Low starch solid and higher steam consumption
- Cleanliness issues with recycled fibers
- Rolls cover and consumable costs relatively high
- Need a web break to change rod and rod bed.

**OptiSizer Spray** - Sizer with film with spray application

- Revolutionary sizing process
- Adjustable strength properties for recycled board
- High starch solid (12 – 14%), lower steam consumption, higher production
- Clean starch circulation with non-contact application
- Minimal consumables and long roll lifetimes
- Nozzle module could be change during the turn-up
Valmet automation solutions and services (MCS, QCS, DCS)
Remote online monitoring in addition to site support
Valmet Performance Center access to the expertise you need

Valmet expert network

Valmet Performance Center

Customer experts

Local Valmet experts

Global equipment fleet

Remote monitoring and optimization
On-demand expert support
Data discovery and analysis process

Performance Centers for:

Energy
Pulp
Board & Paper
Tissue
Automation

Automation
Latest Innovations
Latest Technology for Board making
OptiFlo layering Headbox

Unique technology that uses a thin layer of water as a headbox wedge to minimize flow disturbances between stock layers which allows the forming section to consolidate the stratified paper structure.
Unique technology that uses a thin layer of water as a headbox wedge to minimize flow disturbances between stock layers which allows the forming section to consolidate the stratified paper structure.
Water Layering Technology Opportunities
Optimal and Flexible Dosaging

Wire
Water
Tank
Aqua
circulation
Cationic starch

Water
Layer
screen
Aqua
feed
Aqua
pump unit
New layering technology provides possibilities to adjust quality and strength properties. Cost savings can be achieved by using different furnish qualities, cheaper raw materials, and functional wet end end additives between the layers.
Using headbox for optimal chemical dosaging

Improved strength: Optimal feeding point for active starch interaction
Water Layering Technology Opportunities

Optimal and flexible dosaging → what else can we do?

- Aqua pump unit
- Aqua circulation
- Wire Water Tank
- Refined fibers
- Cationic starch
- Water Layer screen
- Colloidal silica
- Colloidal silica
- Colloidal silica

15 February, 2019
Water Layering Technology
Optimal and flexible dosaging for improved quality

- Cationic starch
  - Dry strength additive
  - Retention helper

- Colloidal silica
  - To maximize starch content in paper
  - To help on drainage

- Refined fibers
  - To maximize bonding ability between layers
  - To further improve starch retention paper

= Fibre

- Best possible strength-drainage-retention combination
Excellent layer purity
Vacuum Assisted Forming Board with OptiFlo

Technology features:
- Stabilizes jet landing
- Prevents stock jump

Benefits:
- Improve layer coverage
- High initial dewatering capacity
- Controlled fiber mat formation
VacuBalance vacuum-assisted forming board

Comparison with traditional forming board

VacuBalance vacuum-assisted forming board

- Minimized pulsation
- Minimized stock jump
- Very high dewatering capacity
- Very wide operation window
- Excellent for layering

Conventional forming board

- Sensitive for stock jump
- Heavy pulsation
- Low dewatering capacity
- Fixed operation window
- Not suitable for layering
Effect of headbox & former on layer purity

Conventional headbox and non-suitable forming board

Non-optimized slice jet quality with forming board mixing of top and back layer
Effect of headbox & former on layer purity
Water Layering and Vacuum assisted forming board technologies

Solution

Result

Water Layering Technology together with Vacuum assisted forming board produces smooth forming table activity without mixing of layers.
30% less starch needed with new Aqua layering technology

- Flexibility
- Aqua has a rapid starch feeding response, unlike conventional technology with a long delay time
- With Aqua layering technology, strength targets are achieved with almost 30% lower starch dosing
- Aqua layering enables totally new ways to utilize raw materials, like refined OCC, refined broke, selected fiber fractions or even reject.

This gives revolutionary improvement possibilities
Reference case: revolutionary example:
Significant cost savings and method of optimizing mill performance

- Reject from WWTP chemical flotation is returned directly to the Aqua layer
- This has offered totally new optimization possibilities on the furnish side
- Next phase is to utilize fines and fiber from white water
OptiSizer product family
Size application solutions for specific papermaking needs

- Fit for purpose: all application methods and paper machine sizes available
- Robust and modular construction,

OptiSizer Pond
Pond application

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Combined film, pond or spray application

OptiSizer Spray
Sizer with spray on roll application

OptiSizer Hard
Sizer with spray application on hard rolls
OptiSizer Hard - benefits

- State-of-the-art size press
- Limited strength for high basis weight
- Issues with runnability and sheet breaks
- Cleanliness issues with recycled fibers
- Rolls cover and consumable costs relatively high

OptiSizer Film - Sizer with film application

- Revolutionary sizing process
- Excellent strength properties for recycled board
- Uncompromised runnability
- Lower web tension
- Clean starch circulation with non-contact application
- Minimal consumables and long roll lifetimes

OptiSizer Hard - Sizer with hard nip rolls and spray application
High nip pressure increases strength

Sheet wetting = good penetration ≠ good strength

Low pressure

- Fiber to fiber distance relatively large
  - Large porous volume
  - Small pressure for liquid diffusion

- Starch in pores, not in fiber junctions
- Penetration of starch is small

High pressure

- Fiber to fiber distance relatively small
  - Small porous volume
  - Large pressure for liquid diffusion

- More starch in fiber junction points
- Better starch penetration

Improves surface strength
Implements surface and internal strengths
SCT strength tests internal strength of paperboard

- SCT testing applies compressive stress across the sheet thickness
- For good burst results, internal strength needs to be improved
  → Better starch penetration needed

Source (paperboard specimen photo): http://www.rbi.gatech.edu/sites/default/files/documents/Predicting%20Box%20Compression%20Strength_3.pdf
Burst tests surface strength of paperboard

Web under bending load

Maximum stress at surfaces

• Burst testing
  – Maximum stress at the surfaces
  – Compression stress at the bottom
  – Tensile/pulling strength at the top

→ For good burst results, surface strength need to be improved
Comparison of sizer concepts

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<td>+ No need for overdrying</td>
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<td>+ Good evenness of size</td>
<td>+ Good size coverage</td>
<td>+ Small starch recirculation</td>
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<td>+ Controllable size amount</td>
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<th>Pond sizer [Con]</th>
<th>Optisizer Film [Con]</th>
<th>Optisizer Hard + Spray [Con]</th>
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<tr>
<td>- Web wrinkling and tension problems → poor runnability, sheet break sensitivity</td>
<td>- Rod &amp; cover wear with recycled base</td>
<td>- For high solids contents and added sizing agents there is risk of spray nozzle blocking and spray beam contamination</td>
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<tr>
<td>- For pond stability, starch viscosity/solids limited</td>
<td>- Rod blocking with contaminants</td>
<td>- High size viscosities (&gt; 50 mPa*s) not possible</td>
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<td>- High wetting → large steam consumption</td>
<td>- Large amount of starch recirculation</td>
<td>- Challenges if color dyes are used in size press due to spray evenness if small wet film is desired</td>
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<td>- High size recirculation → starch contamination</td>
<td>- Strengths for high BW</td>
<td>- Remainder film lost in doctoring (not recirculated)</td>
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<td>- Overdrying for profiles</td>
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Thank You

- Recycled fiber and stock preparation systems
- Paper and board machines
- Automation systems
- Paper machine process systems
- Services