USE OF MUF-ADHESIVES FOR STRUCTURAL WOOD PRODUCTS IN EUROPE

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Content

• Who is Dynea
• Structural wood products in Europe
• Adhesive types and wood species
• Production techniques
• Industry development 1990 until today
• The development and use of melamine based systems
Dynea today

- A global leader in creating high value adhesion and surfacing solutions for the wood processing industry and other industrial applications.
- Operating revenues of over EUR 1.2 billion
- Production at 52 sites in 26 countries
- Employs 2,900 persons

Global reach
Dynea sites worldwide

- Dynea resin site
- Dynea overlay site
- Dynea j.v. and associated companies
Structural Wood Products

- Gluelam beams
  - Standard
  - Project incl. curved
- Duo- and Trio-beams
- Japan export posts and beams
- Fingerjointed construction wood
- I-beams
- Building elements
Adhesive types

- UF-adhesives
- MUF-adhesives
- MF-adhesives
- PRF-adhesives
- PUR-adhesives
- EPI-adhesives

- Dynea has all technologies in the program
- Test/approval according to EN 301/302
  - PUR/EPI additional tests
- All except UF approved as type 1 adhesives

Wood species

- Spruce (Picea Abies, Abies alba)
- Pine (Pinus sylvestris)
- Larch (Larix decidua)
- Pre-impregnated pine
- Other species in smaller quantities, including hardwood
Production techniques (gluelam)

- Controlled room climate (EN 386)
- Climatised Wood
- Manual (spindle type) presses
- Hydraulic presses, auto infeed
- Continuous presses
  - Cold/warm/hot-curing or microwave heating
- Continuous and sequential presses, RF-heating
- Glue application
  - Separate
  - Mixed

MUF as structural adhesive

- The early modified MUF-adhesives
  - 3 C systems filled with Coconit
  - Mostly used for I-beams
- The introduction of the first light-coloured MUF
  - Dynomel L-725
  - Approved 1987
- Structural changes in the industry
Industry development 1990 - today

- From craftsmanship to industrial production
- Sawmills want to add value
- Introduction of standard beams
- Change in distribution channels
- Increase in plant capacities
- Market growth

Volume development

![Volume Graph](chart.png)
Reasons for market growth

• General growth in building activity
• More use of wood as construction material
• Change in building regulations
• More use of technically dried wood
• Glued wood replacing solid wood
• Emerging markets
• Overseas exports
  – 2006 close to 450 Mqm to Japan

Market situation 1990
Total 800 Mqm/12,000 tons

• PRF dominating with close to 2/3 of volume
• UF widely used for project beams, service class 1&2
• MUF growing with production of standard beams
Properties of the 1. generation

Melamine-Urea-Formaldehyde and Melamine-Formaldehyde resins (MUF, MF)

<table>
<thead>
<tr>
<th>Glue</th>
<th>Hardener</th>
<th>Dosage [pbw]</th>
<th>Potlife 20°C [min]</th>
<th>Presstime at 20°C [hours]</th>
<th>After cure time: [hours]</th>
<th>Assembly time 20°C/65%RH 350g/m² [hours]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prefere 4624²</td>
<td>Prefere 5024</td>
<td>20¹</td>
<td>120</td>
<td>12</td>
<td>&lt;192</td>
<td>1½</td>
</tr>
<tr>
<td>Prefere 4624²</td>
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<td>20¹</td>
<td>150</td>
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<td>&lt;192</td>
<td>1½</td>
</tr>
</tbody>
</table>

• Light coloured glueline
• Powder resin with liquid, resorcinol modified hardener
• Good RF-properties
• Rel. Short potlife and assembly time
• After curing (time to waterresistance) up to 8 days
• Used for std. beams, I-beams, fingerjointing

Development through the 1990’s

• Properties of the second generation MUF
• Introduction of the PUR
• Mixing and application equipment
• The Millennium Tower
Properties of the 2. generation

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<td>140</td>
<td>13</td>
<td>&lt;96</td>
<td>3</td>
</tr>
<tr>
<td>Prefere 4526</td>
<td>Prefere 5026</td>
<td>20</td>
<td>140</td>
<td>13</td>
<td>&lt;96</td>
<td>3</td>
</tr>
</tbody>
</table>

- Liquid/liquid system, easier handling
- Assembly time twice as long, suitable for big construction beams
- Aftercuring time half as long, faster delivery times possible
- Very good RF-properties

Introduction of PUR-adhesives

- Gluelam “ÖkoPUR”
  - Gluelam made with MUF meet E-1/F****
  - MUF requires no solvents

- The rise and fall of the PUR in the gluelam industry
  - Adhesive cost/unit produced ~x2

- Market niches for PUR today
  - Duo/Trio, FJ, building elements
Mixing and application equipment

- Ready mixed glue
- Applied by ribbon spreader
- Mix-in, direct application

- Shown: Ribbon spreader from Oest, DE

Millenium Tower
Magdeburg, DE

- Year of construction 1999
- Height 60 m
3,300 qm gluelam beams
Glue: Prefere 4525

146 tons steel parts
Market situation 2000
Total 1.600 Mqm/19000 tons

- PRF, mainly Japan export beams and special projects
- UF, still some volume for projects, service class 1 & 2
- MUF/MF close to 50% of the market, also project beams
- PUR, gained market share into niche applications
- EPI, for Japan export posts

Properties of the modern MUF/MF

Melamine-Urea-Formaldehyde and
Melamine-Formaldehyde resins (MUF, MF)

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<th>Dosage [g/bw]</th>
<th>Potlife 20°C [min]</th>
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<th>Assembly time 20°C/65%R.H [350g/m²] [hours]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prefere 4535</td>
<td>Prefere 5035</td>
<td>15-35</td>
<td>135-60</td>
<td>12-4½</td>
<td>38-72</td>
<td>1½-1¼ (Mix: 2½-1½)</td>
<td></td>
</tr>
<tr>
<td>Prefere 4535</td>
<td>Prefere 5035</td>
<td>15-40</td>
<td>135-60</td>
<td>12-3</td>
<td>38-72</td>
<td>Approx. 2</td>
<td></td>
</tr>
<tr>
<td>Prefere 4720</td>
<td>Prefere 5020</td>
<td>10-100</td>
<td>20-130</td>
<td>1,5-8</td>
<td>12</td>
<td>1-2</td>
<td></td>
</tr>
</tbody>
</table>

- Wide range of mixing ratio giving great flexibility, one glue system
- Flexible glueline with new hardener technology
- Pressing time down to 1.5 hours
- Time to water resistance down to 12 hours
- Approved for mixed and separate application, face lamination and FJ
- Will comply with F**** requirements
- Excellent RF-properties
New application techniques, separate application Wash-Less

Machine from Oest, DE

Minimum waste, wash-water, And cleaning work.

Separate application FJ, matrix
Separate application FJ, rollers

Grecon

Jöma

Constructions with MF/MUF

- Leonardo da Vinci bridge, Norway
- Swimming hall in Nuuk, Greenland
- Shopping mall, Peek&Cloppenburg, Cologne
- Salt storage hall, Austria
Leonardo da Vinci bridge, Norway

Pedestrian bridge, built 2001

Swimming hall in Nuuk, Greenland

- Built 2002-2003
- Beams by: Lilleheden, Denmark
- Glue type used: -MUF glue from Dynea
Shopping mall, Peek&Cloppenburg, Germany

Combined glued and steel structure to support glass facade. Resistance to high temperatures important.
Salt storage, for Salinen AG, Austria
11,000 pallet places, 110 m long, 22.5 m wide
25 m tall
1,600 m² gluelam

Main reason for choosing wood to avoid corrosion
Market situation 2006
Total 3.000 Mqm/33.000 tons

- PRF, used for Japan export beams and some project beams
- UF still in use, but will disappear within 2008
- MUF has more than 60% market share (>90% in gluelam)
- PUR has grown with duo/trio, FJ and building elements
- EPI mainly for Japan export posts, but also for beams in Europe

The European market today

- Market development
  - Glued wood elements continues to grow
  - Strong growth in new markets and niches, I-beams, building elements
- Technology trends
  - Faster setting cold-curing systems
  - RF-curing
  - Separate application FJ
Conclusions

• MUF’s and MF’s have been in use for 35 years
• Today the standard system for gluelam production, both standard and project beams
• Will remain standard because of:
  – Proven, excellent glueline quality
  – Short pressing time/rel. long assembly time
  – Excellent RF-properties
  – Easy handling
  – Fulfils environmental requirements
  – Very cost efficient

Thank you for your attention