International Developments in Wood Adhesives

Selection of the Right Glue for the Right Job

Mark Nowicki
Technical Account Manager
Hexion Specialty Chemicals

Introduction

What is a structural wood adhesive?

Function - to bond two or more pieces of timber together with no reduction in any property caused by adhesive
Critical properties

- Stronger than wood
- Resistant to creep
- Heat resistance
- Cold resistance
- Fire resistant
- Resistant to timber treatments
- Safe to handle
- Durable for the lifetime of timber structures
- Suitable for all applications
- Low VOC
- Mitigation of risk - To minimise the cost of failure

Considerations in Adhesive selection

- Meets standards
- Meets building codes
- Ultimate application and end use market
- Timber species
- Process/manufacturing conditions
- Customer requirements
- Life cycle analysis
Adhesives to choose from

- Resorcinol and Phenolic (RF and PF)
- Melamine
- Polyurethanes (PUR)
- EPI/API
- MRF (Melamine Resorcinol)
- PVAc (Polyvinyl acetate)
- Hot Melts (with PUR)

Current regulations

- AS/NZS 4364:1996 is under revision
- New draft standard is not able to be used now
- Difficulty in choosing a new adhesive system
- Vastly different Global standards.
- Structural glue laminated timber must comply with AS/NZS 4364:1996
- ANZ Building codes over-rule any of these standards
Choosing an Adhesive

- Timber end use
- Durability
- Structural or non structural
- One part mix or two part mix
- Mixing and application equipment
- Adhesive use conditions
- Colour of glue line
- VOC
- Cost
- Proven 50 year performance history in ANZ conditions

Table for selection of adhesives based on risk

<table>
<thead>
<tr>
<th>Properties</th>
<th>Structural adhesives</th>
<th>Non-Structural adhesives</th>
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<tbody>
<tr>
<td></td>
<td>RF, PEF, HP, MDF, PUR</td>
<td>Mel, PVAc</td>
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<tr>
<td>Durability</td>
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<td>Heat and fire resistance</td>
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<td>Creep</td>
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<td>Marine and in ground contact</td>
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<td>Timber treatment</td>
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<td>Standards</td>
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<td>Building codes</td>
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<tr>
<th>Approved</th>
<th>Not fully established</th>
<th>Not allowed</th>
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52 Years in Service . . .
Glulam Grandstand – Matamata, New Zealand

Extreme environments- The real risk
Summary

For structural glue lamination, Resorcinols (phenolics) are the only adhesives that meet all the international standard requirements ensuring:

- Excellent durability
- Excellent heat and fire performance
- Excellent creep resistance
- Excellent performance in marine and ground contact applications
- Excellent resistance to solvents and any timber treatments
- Safe in handling when mixed in line and applied onto the joint automatically
- Low VOC’s
- Meet all of the most critical requirements of the various Building codes

Thank you
**Melamine Hybrid Adhesives (a combination of a Melamine and Resorcinol adhesives)**

**Pros:**
- Bonds are structural and strong in exterior situations
- Passes all EU and North American standards
- Moderate cost
- This system is used extensively in Europe and Canada in the manufacture of Glulam and finger jointed timber for exterior structural applications
- Very good in Radio Frequency applications

**Cons:**
- Generally only suitable for high volume manufacturing
- Not well accepted in Australia and New Zealand but will be approved if the revised AS 4364 standard is released
- The system has a resin and a hardener which is corrosive
- Does require high temperatures to ensure full curing (50-60 deg C)

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**Phenolic and Resorcinol Adhesives**

**Pros:**
- Very durable
- Structurally very strong with creep resistance similar to wood
- Resistant to marine and ground contact
- Easy to work with, single or two pot or can be mixed with excellent pot life
- Very cost efficient
- Excellent fire and heat resistance to the char point of timber as well as resistant to cold temperatures
- Excellent resistance to solvents and timber treatments
- Low VOC’s from final product
- Accepted through out the world based on 75 year performance history in plywood, OSB, Glulam, fingerjointed timber and LVL over 75 years
- Resorcinols have good gap filling properties

**Cons:**
- Phenolics need high temperatures to cure, over 100 deg C
- Resorcinols can be cured rapidly at ambient conditions
- Dark glue line
- Some safety considerations
**Polyurethane (PUR) adhesives**

**Pros:**
- Durable in exterior applications when fully cross linked
- It is a very strong adhesive
- Easy to work with and is a single pot system so no mixing
- Can be cured at ambient temperature by using moisture in the wood for cross linking
- Cure times can be adjusted to be very fast, down to five minutes at ambient conditions
- Excellent void filling and it does not shrink as it is a 100% solids product

**Cons:**
- Questions over complete cross linking as water is the hardener from the wood
- Has a tendency to foam on curing which can contribute to poor gap filling properties. More of an issue with the fast setting systems
- May creep and give way at hot temperatures or high humidities and fails some US and Canadian standards
- Can be quite expensive
- Fire resistance in fingerjointed timber and I beam is considered very poor based on US testing
- Low wood failure on some timbers especially wet wood. This is a very important requirement for some standards.

**Hot Melt Adhesives**

**Pros:**
- Durable and strong in interior or sometimes wet situations
- Easy to work with, just needs to be kept hot
- Is expensive
- Sets by cooling
- Cure times are very fast when cooled rapidly
- Good track record for performance
- Various grades can allow for good water resistance

**Cons:**
- It is a non structural adhesive and will creep under load
- Will re-soften with heat except for special grades
**Polyvinyl Acetate (PVAc) adhesives**

**Pros:**
- Durable and strong in interior dry situations
- Easy to work with and is generally a single pot system so no mixing
- Low cost
- Can be cured at ambient temperatures by losing moisture to the wood
- Cure times can be quite fast at ambient conditions
- Good track record for performance
- Various improved grades can allow for good water resistance but may require a hardener addition.

**Cons:**
- It is a non structural adhesive as it is thermoplastic (will creep)

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**Melamine Formaldehyde (Including Melamine Urea Formaldehyde resins)**

**Pros:**
- Durability depends on formulation
- Different standards classify from fully exterior to only suitable for interior wet application
- Structurally very strong with creep resistance similar to wood
- Fairly easy to work with, even though needs to have a hardener added thus requires mixing.
- Cost is very reasonable
- Can be cured at ambient temperature
- Excellent track record for structural performance in Glulam and finger jointed timber

**Cons:**
- Needs an corrosive hardener
- These adhesives are generally fairly slow to cure at ambient temperatures
API/EPI (An emulsion adhesive cross linked with an Isocyanate hardener)

Pros:
- Durability is excellent
- Bond strength is excellent
- Moderate cost
- Can pass the toughest durability and creep standards
- A wide range of formulations from structural to non structural
- This system is used extensively for the Japanese market in the manufacture of Glulam
- Low VOC
- Is able to be stained with no discoloration
- The press time at ambient conditions can be quite fast when compared to standard Melamine Urea adhesives

Cons:
- Generally only suitable for high volume manufacturing
- Not well accepted in Australia
- Performance is highly dependant on formulation
- Gap filling is very poor
- Has got a pot life issue as it is a two part mix and needs to be mixed in line