

Adhesives

Adhesives play a prominent role in wood construction. They are used for:

- The manufacture of laminated products
- As a means of increasing the structural rigidity of sheathing/joist combinations in floors and of affixing non-structural panel products
- End joining dimension lumber
- Repair

Adhesives Used for Laminated Products

Structural composites such as plywood, oriented strandboard (OSB) and wafer-board, prefabricated wood I-joists, laminated parallel strand lumber (PSL), laminated veneer lumber (LVL) and glulam are dependent upon adhesives to transfer the stresses between adjoining wood fibre.

Interior use wood products such as particleboard, which is used for furniture and for some structural applications such as flooring underlay, and hardwood plywood, which is used for furniture and decorative paneling, also rely on adhesives for laminating wood material.

The selection, application rate, and curing conditions for adhesives for these products is controlled at the point of manufacture. A brief discussion of the principal adhesives used in these products is presented to address questions which some times arise about permanence of bond, reliability, resistance to environmental factors, and emission of volatile chemicals into buildings.

There are two principle types of adhesive used for the manufacture of Canadian wood products. These are urea-formaldehyde (UF) which is suitable for interior use products and phenol-formaldehyde (PF) which is used for exterior applications.

Interior Wood Products

Urea-formaldehyde adhesive is a thick creamy syrup which cures to a colourless solid.

UF adhesives are very economical and fast curing but are not suitable for damp conditions. For this reason, UF glues are used for panels intended for nonstructural use such as particleboard and hardwood plywood.

UF adhesives are non-staining and therefore have the further advantage of not blemishing the high quality expensive face veneers used for hardwood panels for interior finish applications.

The raw materials for UF adhesives are derived from natural gas through the intermediates of ammonia for urea and methanol for formaldehyde.

Exterior Wood Products

Phenol-formaldehyde (PF) adhesives are a dark purple-brown colour and give the dark glue lines associated with products such as plywood and OSB.

Known as the phenolics, they are a derivative of crude oil and the principle resins approved for the manufacture of wood products intended for exterior applications.

PF adhesives are used for the manufacture of glulam, PSL, LVL, plywood, and OSB/waferboard.

PF adhesives are somewhat more expensive than UF adhesives and exhibit lower levels of formaldehyde emissions.

Various types of extenders such as walnut shell flour, Douglas fir bark flour, alder bark flour, and wood flour are used to moderate the cost of PF glues, control penetration into the wood fibre, and moderate strength properties to suit the materials being bonded.

Resorcinol-formaldehyde (RF) adhesive is a phenolic substance which is more reactive than the PF adhesives. Being more reactive means that curing is faster and takes place at room temperature and below. Otherwise these glues have the same basic properties as the PF adhesives. However, high cost of the resorcinols means in practice that they are often blended with the PF adhesives to moderate the cost.

Emissions from Wood Product Adhesives

Formaldehyde is a chemical used in the manufacture of many contemporary products including, for example, upholstery, permanent press clothing, and carpet. It is also a component of the adhesives used to manufacture most wood panel and composite products. Formaldehyde is an allergic irritant to some people when the time and level of exposure is high. Effects are compounded when a building has air change rates below accepted standards.

The level of formaldehyde emission from any new product is time dependant. Emission level is highest when the product is new, and decreases steadily as the time in service increases.

Housing and Urban Development (HUD) in the United States has set limits on the amount of allowable formaldehyde which may be emitted for building materials and contents. These levels are recognized in Canada and in the US.

Wood products made with PF adhesive wood products are substantially below the HUD limit for formaldehyde emissions. Emission standards for products made from UF adhesive products are also below the limits established.

Wood products made with PF adhesives have a low level of formaldehyde emission because the phenol resins chemically fix the formaldehyde.

Since the formaldehyde component of UF adhesives is not completely chemically fixed by the urea, some is free to dissipate. Adhesive manufacturers have met HUD standards by reducing the formaldehyde content and consequently increasing the amount of adhesive and the curing time.

Wood products containing formaldehyde meet or surpass present HUD standards. With standards for formaldehyde emissions expected to become increasingly stringent, chemists

will be challenged to formulate acceptable low cost adhesives for the wood and other products which house and furnish modern living and work spaces.

Sheathing and Panel Application

There are many adhesives available to improve the structural performance of building elements or to apply non-structural panels in a way that does not leave surface blemish on the panel, as would nailing.

These field applied tube type adhesives are available in many types suitable for both interior and exterior use. The recommended application temperature can range between -10 and 40°C (15 and 105°F). These fast setting adhesives can be used to bond wood and panels to metal, gypsum wallboard, concrete, and foam insulation.

Where floor sheathing is affixed to joists with a field applied elastomeric adhesive in addition to nails or screws, improved vibration and deflection can be gained. In this situation, the joists and sheathing act as a single composite section and increases in spans of 5 to 10 percent when compared to nailed or screwed floors are possible.

Repairs to Wood Members

As with all building materials, wood is subject to damage if exposed for a long period of time to adverse conditions, if original design was faulty, or if overstressed due to loadings beyond design specifications.

Damage assessment requires the analysis of a structural engineer. In some cases, on site repair rather than replacement may be possible.

Where a repair is recommended by a structural engineer qualified in designing and supervising repairs, it may require the use of epoxy adhesives. The procedure for such repair will usually mean sealing the area to be repaired using a high viscosity epoxy with putty-like properties which is trowelled over cracks and holes to contain the epoxy repair material. The putty is also used to embed injection and vent port hoses to accept pressure injection equipment.

A low viscosity two-part epoxy is then pumped into the injection port until all areas of the crack or defect are filled as evidenced by escape of epoxy through the vent port.

Once the epoxy repair has cured, the excess epoxy can be chipped and sanded away to restore the appearance of the member.