# Adhesives



The printed version of this article appeared as, "Going for Pump Productivity. Pumping plywood adhesives efficiently requires customization," by Ron Thompson and Brent Clemsen, in *Panel World*, November 1994, pp. 30 - 31.

Plywood adhesive recipes will vary in corrosive, abrasive, viscosity, and shear-sensitive properties. Because of these variations, no single pumping principle or material of construction is ideally suited for all adhesives. Productive pump life can be maximized, however, by selecting a pumping principle and by customizing a pump with a variety of materials of construction specifically tailored for a particular adhesive.

**Corrosion**

A corrosive liquid interacts chemically with the materials of construction and wears away some of the materials of construction in a uniform pattern. The strength of a corrosive liquid depends on its concentration and temperature. An easy method of testing the corrosiveness of a liquid is to submerge wafers of the various materials of construction under consideration into the adhesive and monitor the effects over time. Although most adhesives are not overly corrosive, this severe property warrants some discussion due to recipe variations.

Because corrosion is a chemical reaction, the best defense is to select a material of construction compatible with the adhesive's pH level. Adhesives with higher pH levels are alkaline, so iron or steel materials of construction work best. Stainless steel is more expensive but provides good protection against both acidic and alkaline liquids and is especially useful in applications where the liquid cannot be contaminated.

Lowering the temperature will help reduce the corrosive nature of the liquid, but this must be weighed against the temperature characteristics of the adhesive. In fact, some phenolic and urea adhesives may need to be pumped at an elevated temperature in order to retain their adhesive properties, or to prevent balling up and/or hardening.

Iron and ceramic bushings offer good corrosion resistance, whereas bronze bushings offer little protection. Carbon graphite bushings provide excellent corrosive resistance but are too soft for an even greater problem among adhesives--abrasion.

**Abrasion**

Like corrosion, abrasive liquids also promote pump deterioration. But rather than chemically break down materials of construction, abrasive liquids contain particles which beat away against the material. Abrasive wear is uneven and is often noted by grooves which follow the mechanics of the flow. To test abrasiveness, place a small

drop of the liquid between two glass slides. An abrasive liquid will cause a scratchy, grinding sound. Although this test is subjective, with practice it can be related to the potential for pump wear.

Adhesives use fillers such as ground corn cobs, sawdust, or ash. Unless variables such as filler hardness, sawtooth size, and wood dryness are controlled, the abrasiveness of each batch will vary because particle size and hardness determine abrasiveness. Moreover, while some adhesive recipes are only slightly abrasive, others are highly abrasive slurries.

**Combating abrasion and corrosion**

Regardless of the abrasiveness level, one of the most effective means of combating abrasion is to operate pumps at slower speeds. This reduces particle velocity and dramatically reduces pump wear. In fact, running a larger pump at slower speeds is a common method of solving abrasion problems. Of course, this depends on the abrasiveness of the product and the fiscal requirements of using a larger pump, but sometimes it is more cost-efficient to utilize longer-lasting larger pumps at slower speeds than it is to frequently replace smaller, faster pumps.

Another successful system configuration is to keep the differential pressure as low as possible. Not only does a low differential pressure reduce abrasion, but lower differential pressure reduces slip, thereby reducing the related liquid velocities that tend to increase the aggressiveness of many corrosives.

Proper material of construction selection may also impede wear. For example, a pump constructed of hardened materials offers good protection against abrasion.

Bushings can also be constructed in a variety of materials that combat abrasion. Although cast iron and carbon graphite bushings are acceptable, excellent performance has been achieved with tungsten carbide bushings. Tungsten carbide bushings must be used with a hard shaft material, however, and a tungsten carbide-coated shaft is one option.

Colomony coating offers good corrosion and abrasion resistance, inexpensively. Like tungsten carbide bushings, Colomony-coated bushings must be used with a hardened shaft.

Mechanical seals are recommended for the kinds of abrasive particles found in plywood adhesives because their hardened faces impede wear. To be most effective, a mechanical seal should be flushed with the adhesive to help prevent buildup around the seal faces which can cause them to hang up or "spin". The right mechanical seal can also solve more than one pumping problem. Abrasion-resistant single mechanical seals are available that can handle viscosities up to 55,000 cSt / 250,000 SSU.

**Viscosity**

Viscosity is a measure of a fluid's resistance to flow. Phenolic and urea formaldehyde resins are quite viscous and thus add extra challenges to an application. Viscous liquids can reduce pumping efficiency because they require more time to completely fill pump head cavities. Finally, viscous liquids can also damage pump parts and put undo strain on the pumping system in general.

Energy efficiency can be enhanced by reducing pump speed. Viking internal gear

pumps, for example, operated at slower speeds, allow the thick adhesives to completely fill the cavities between the rotor and idler teeth. Although the intermeshing idler and rotor teeth create a near-perfect suction, reduced speeds assure a higher level of energy efficiency.

A "steel-fitted" internal gear pump provides outstanding strength and durability. Rotor strength increases significantly and helps prevent damage attributable to highly viscous liquids.

**Shear-Sensitivity**

A shear-sensitive liquid is one that is altered as it passes through the shearing motion of the pump. For example, food solids such as olives and cherries are shear-sensitive, and many pumps will destroy the solid particulate. Plywood adhesives can also be shear-sensitive, depending on the specific recipe. For some, product degradation due to shearing may result in decreased adhesion or "stickiness."

Two basic options exist for handling shear-sensitive liquids. First, a low-shear pump can be used. Rotary pumps offer good smooth-flowing characteristics. If they are fitted in stainless steel, they can be used in latex applications to minimize moisture contamination.

The other alternative is to reduce the speed of the pump. Fortunately, this is often already the case in plywood adhesive applications. As discussed earlier, slower speeds are more efficient for viscous liquids--the effects of abrasive particles and corrosives are reduced and shear-sensitive liquids remain intact.

**Conclusion**

As a family, urea and phenol formaldehyde resins work well with a variety of pumps. But because of individual differences in the recipes, no single pump is ideal for every adhesive in every mill. However, generalized starting points can be established.

First, slower pump speeds handle highly viscous liquids efficiently, reduce pump wear due to abrasion, and provide shear-sensitive motion. Lower differential pressures help minimize abrasion and corrosion.

When it comes to materials of construction, internal gear pumps constructed of hardened cast iron provides good protection against abrasion. Stainless steel materials are an option for highly corrosive adhesives or for applications involving latex-based adhesives.

Tungsten carbide bushings, used with a hardened shaft, withstand the abrasive effects of plywood adhesive well. Mechanical seals, the standard steel technology for corrosive liquids, provide excellent abrasion resistance.

Cost-effective, prolonged pump life is obtainable in plywood adhesive applications despite the unique and oftentimes severe properties of the adhesives. These benefits are usually realized when suppliers and customers work together to specify a pumping principle and customize the materials of construction of the pump, bearing, seal and shaft to a particular adhesive. Customized pumps, able to accommodate a variety of materials of construction, are the key to meeting the diverse challenges associated with diverse plywood adhesives.