Section V:

Getting the Most Out of Your Wood

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Process Overview: Rough Mill and Gluing

The purpose of the rough mill and gluing is to remove defects and convert the dried rough lumber into rectangular shapes or "blanks" of lumber or veneer that will be used to make the furniture components. The typical functions of rough mill and gluing include:

- planing
- sawing
- gluing and joining (including lamination)

Potential Wastes: Solid and Hazardous

- wood
- sawdust
- glue
- volatile air emissions

Waste Reduction Options/Case Studies/Checklists

Remove Defects from Rough Lumber Efficiently

Significant wood can be saved if care is taken when removing defects as the rough lumber is cut. Combining the cutting of multiple long and short lengths on the same rough lumber board will improve yield and reduce wood waste. New equipment and technology such as "rip first" methodology, automatic board advancing, and computerized vision scanning to identify defects and cutting patterns are being developed and applied.

Benefits

- improved yield
- less wood waste

Finger Jointing

Finger jointing is the joining of two short sticks or boards end-to-end to form a longer one resulting in less waste and better material utilization. The pieces are joined and glued end-to-end by a finger joint. Any piece shorter than seven inches can be used. Equipment is available that can machine the joints, apply the glue and press the pieces together. The finger jointing process can provide significant increases in material utilization while reducing wood waste.

Equipment is available to quickly cure glued joints using penetration heating devices such as radio frequency fields which can speed the curing and improve the quality of the joint.

Benefits

- improved yield
- less wood waste

Recycle Wood Waste and Sawdust

Recycling options include:

- use in particle board, chip core, laminates
- shredding or grinding for use as animal bedding, mulch or decorative landscaping material (this also reduces storage volume)

- use in pulp and paper manufacturing
- using as fuel for energy

Benefit

- convert low- or no-value wood into higher-value product

Cautions

- some wood wastes need to be dried, pelletized, and/or transported before being used as fuel which adds equipment and expense
- burning treated or coated wood can release regulated hazardous air pollutants
- brush up on applicable regulations before installing and operating a wood boiler
- waste streams should not be combined (i.e. mixing wood with glue with sawdust from rough mills) as it may inhibit optimal secondary use

Utilize Proper Gluing Techniques

There are three situations to check prior to gluing wood together which can lead to unwanted wood waste.

1. Moisture content of wood
2. Un-true surfaces
3. Inactive surfaces

Once the glue is applied to the first piece and then transferred to the second, curing, or solidification of the glue takes place. It is important for the glue to be completely set before removing the assembly from the press. Otherwise the glued joint becomes a stress point.

Moisture Content

Under 12 percent moisture content (MC), the commonly used adhesives for wood are not affected by MC directly--that is, the strength of the glue and the chemistry of gluing does not vary with different MCs. However, MC does affect gluing in other ways.

First, when the wood is very dry (under 6 percent MC), it is very absorptive. When glue is spread on dry wood, the liquid in the glue (usually water) is almost immediately extracted from the adhesive. Unless the glue joint is completed immediately, this rapid absorption of liquid will lead to a very weak joint due to premature thickening and setting of the adhesive. And the reverse is also true--for higher MCs the length of time required for the glue to set is extended.

Second, when the MC of wood changes, the size of the piece changes--shrinks or swells. If the wood's MC is not in equilibrium with the air's moisture content, then the pieces of wood being glued will change size. If they change size before the pieces are glued together, then it is likely that the gap between the adjacent pieces will exceed 0.006 inches, meaning that the glue joint between them will be weakened. If they change MC after being glued, then the pieces may shrink or swell differently. Several effects of this delayed shrinking or swelling are

- development of stress on the joint, which can often lead to cracks in the end of glued up panels, and
- uneven shrinkage resulting in different thickness and uneven surfaces. (Note: This delayed shrinkage and swelling is also sometimes called delayed warp.)

For more information on moisture content, see "Maintain Adequate Relative Humidity Levels" in Section IV.

Housekeeping

Keep glue containers covered whenever possible to prevent chemical vapors from escaping, and keep out moisture and oxygen, prolonging shelf life.

Periodic maintenance and calibration (where possible) of glue applicators provides proper transfer and prevents waste.

P2 Gluing Technologies

The seven general categories of contact adhesives used by the wood furniture industry are solvent-based, epoxy resin, urea-formaldehyde resin, hot melt, heat seal, aqueous-based and polyvinyl acetates (PVA). Solvent-based, urea-formaldehyde resin and some epoxy resin adhesives contain ingredients which can generate significant air emissions. Hot melt, heat seal, aqueous-based and PVA adhesives do not generate significant air emissions at wood product manufacturers and are considered alternatives to solvent-based adhesives.

PVA glues are aqueous-based synthetic latex systems and is the primary glue for solid wood. Its vinyl acetate monomer is regulated; however it makes up less than 0.4 percent of the adhesive, so emissions are low. PVA adhesives are widely used in furniture assembly, and their use in veneering and laminating is increasing.

Hot melt adhesives cure as they cool and are used primarily for edge banding applications. Polyurethane refractive (PUR) hot melts are a common wood furniture hot melt adhesive.

Heat seal adhesives generally are applied to the back of flexible laminates by the laminate manufacturer and then heat sealed with low temperature and pressure to panels by an automated roller or press system at the furniture manufacturer. Unlike hot melts, it does not reflow if reheated. Concern for emissions here is with the laminate manufacturer who might choose to switch to aqueous-based products to reduce regulatory burden.

Aqueous-based adhesives are used in laminating, too, typically applied with spray guns. The adhesives can take 30 minutes or more to adequately set before bonding, and six hours or more for a total cure time after bonding. However, some of these type adhesives can set and cure in comparable times to solvent-based adhesives. Standard fan drying works well but compressed air should be avoided as it tends to dry the adhesive too quickly. Check to see if there is urea-formaldehyde in your adhesive as this emission becomes federally regulated.

Haworth Case Study
Holland, Michigan

Haworth is a large manufacturer of all types of office furniture. Haworth switched to a two-component, aqueous-based, formaldehyde-free contact adhesive for the manufacture of fabric-wrapped flipper doors for overhead storage compartments. Haworth had to purchase new spray equipment to apply the two-part adhesive. The new adhesives instantly bond a variety of fabrics. Haworth believes the new adhesive system produces a more consistent quality product.

Drying ovens are no longer needed, and spray booth exhaust is now filtered and directed back into the plant. Combined, these greatly reduce utility requirements. In addition, removing ovens and exhaust stacks has freed up roughly 600 square feet of floor space and allowed easier layout changes.

The new system has many benefits. Haworth realized an 88 percent reduction in VOC emissions and a 33 percent reduction in adhesive use. Utility savings are estimated at $16,000 per year. Quality improvements result in approximately $18,000 in savings per year.

Source: "Solvent-Free Switch Yields Savings," Upholstery Design & Manufacturing, July 1996.

Benefits

- reduced wood and glue wastes
- improved yield

Cautions

- The shelf life and pot life of glues vary. Be sure to know the shelf life before purchasing or catalyzing large quantities as they could end up as waste.
- PVA is more expensive than urea, however it is better suited for certain applications.
- Urea formaldehyde resins are sources of formaldehyde emissions; discuss with suppliers to obtain the lowest emitting resin that can do the job.
- Federal air regulations regulate emissions for contact adhesives, that is, adhesives that bond without requiring clamping, pressure or airing. Glues used to aid in holding a structural piece of furniture together (e.g. table legs to a table top) are not regulated by this rule. Check with your governing regulatory agency for details.

Hussey Seating Case Study
North Berwick, Maine

Hussey uses adhesives to aid in attaching fabric to chair seats and backs during the upholstery operation. Hussey also makes wood seats and backs by gluing several thin pieces of wood together. Traditionally, all of the adhesives used at the facility were solvent-based. These contributed to Hussey's air emissions, as well as potential air quality problems with the plant.

In 1995, Hussey switched all of the adhesives used at the plant to PVA glues. No air emission or safety concerns are associated with the new adhesives. In addition, the glue manufacturer takes back all the waste glue and cleanup rinse water to use in their production process. Therefore, Hussey no longer has any glue or rinse wastewater disposal issues or costs.

Source: "Wood Furniture: The Clean Air Act Amendments of 1990 and Pollution Prevention Opportunities," The Northeast Waste Management Officials' Association, Sept. 1997.