TECHAPPLICATION

Microwave Curing of Lumber Adhesives

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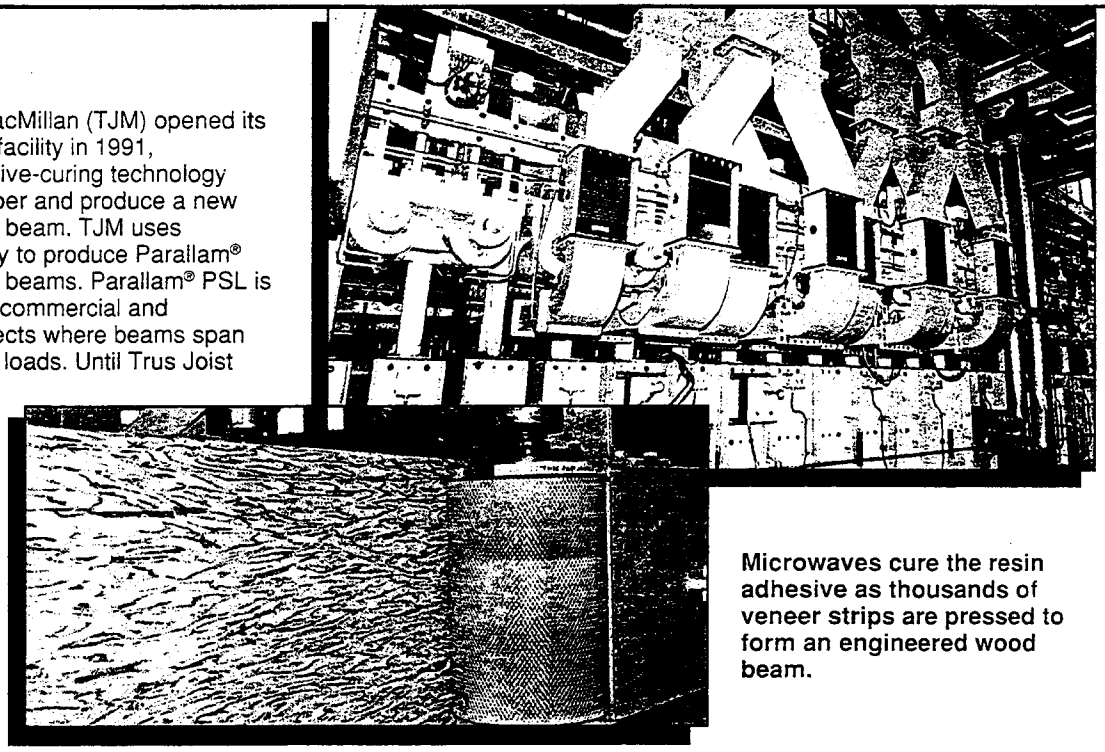
When Trus Joist MacMillan (TJM) opened its Colbert, Georgia facility in 1991, microwave adhesive-curing technology enabled it to "engineer" lumber and produce a new type of wooden construction beam. TJM uses microwave curing technology to produce Parallam® parallel strand lumber (PSL) beams. Parallam® PSL is a specialty product used for commercial and residential construction projects where beams span open areas and carry heavy loads. Until Trus Joist MacMillan developed its innovative method, wood adhesives for plywood and other construction lumber was cured using externally applied heat, limiting the thickness that could be obtained. By using microwaves to cure the adhesive, Trus Joist MacMillan can press beams that are thicker, stronger, and more uniform than those produced by traditional methods.



Microwaves cure the resin adhesive as thousands of veneer strips are pressed to form an engineered wood beam.

In the lumber industry heavy-load carrying wood lengths are commonly produced in standard lengths and later joined with an adhesive or nails to achieve the dimension required. If an adhesive is used, it must be cured. Glued pieces can be clamped together while the glue cures. The clamping method is labor intensive and slow. Alternatively, hot metal plates can be applied to heat through the layers of wood to the center, curing it from the outside in. Because wood is a poor heat conductor, this method limits the thickness of the final product to approximately 3 1/2 inches. The amount of heat required to cure adhesive beyond 3 1/2 inches from the surface would singe or burn the outer layers while not effectively reaching the center glue.

Today, Trus Joist MacMillan produces Parallam® PSL wood beams using microwaves to cure a phenolic resin adhesive. The patented microwave process cures the wood adhesive in beams as thick as 11 1/2 inches without singeing or burning outer layers of the beam. Four 100 kW generators similar to those used for radar and TV transmission produce microwaves at 915 mHz, a standard industrial heating frequency.

In a continuous process, Southern Pine logs are soaked, peeled, cut into veneer strips, and thoroughly dried. The veneer is sorted ultrasonically according to its quality with low grade veneer sold for paper production and the highest grades used for plywood facing. The middle quality veneer is chopped into 5/8 inch strips and coated with a phenolic resin adhesive. The coated strips are randomly layered in a 19 inch wide production conveyor trough and pressed from 30 inches to an 11 1/2 inch billet. Microwaves applied to the billet produce heat from the inside out, curing the adhesive. The microwave energy generates temperatures greater than 100°C. At these temperatures the adhesive cures nearly instantly and no time is lost in the curing process.

The resultant beam, which TJM can press up to 11 1/2 inches thick, is available in lengths up to 66 feet, but is usually cut into standard construction lengths. Parallam® PSL's superior strength makes it ideal for markets with strict building codes and space restraints that dictate that buildings be built up instead of out. Because the beams are natural wood, standard carpentry tools and methods can be used.

Engineered lumber uses natural resources efficiently: strips of veneer can be cut from portions of the tree that previously have gone unused. The process uses up to 60% more of the tree than traditional processes. Trus Joist MacMillan can use faster growing, smaller diameter trees, weaker wood, and wood not suitable for plywood. Because the process can make stronger, heavier beams from second and third growth forests. engineered lumber plays a major role in preserving first growth forests.

The Results: Superior Lumber for Specialty Applications

Through microwave technology and its unique manufacturing process, TJM produces construction beams that are

- **Thicker and structurally stronger** — The beam that is produced using microwave technology can be made 2 to 3 times thicker than standard timbers affording it the additional strength that comes with thickness.
- **Able to be cut to optimum dimensions requested by contractors** — TJM's continuous process does not rely on one single length of wood from a tree and therefore the beam can be cut to any desired length up to 66 feet.
- **Uniform from piece to piece** — Because TJM produces Parallam® PSL at a precise density, the product is consistent, is free of knots and defects, and has a high strength value.
- **More easily treated** — Due to its low moisture content and inherent structure, Parallam® PSL beams are more easily treated to prevent insect and weathering damage.

With Parallam® PSL, TJM is exploiting specialty niches in the lumber industry such as with its Silent Floor System. Because Parallam® PSL beams have a low moisture content, they do not shrink over time preventing annoying squeaking.

What Did It All Cost?

• TJM invested approximately 3.5 million dollars in 1989 to install its four 100 kW microwave generators. Safety features were installed to monitor for microwave leaks, and employees were trained in working with the system. The monetary rewards or energy savings cannot be determined since conventional methods cannot be used. TJM estimates that if conventional methods could be used, substantially more energy would be expended to penetrate the same thickness.

The Bottom Line: Stronger Products and Better Use of Timber

Microwave technology enables TJM to produce Parallam® PSL engineered lumber which exceeds typical beams in thickness, weight load capacity, and uniformity. In addition, Trus Joist MacMillan is able to make better use of its natural resources by using more of the tree and eliminating much of the waste associated with traditional methods.

All the advantages afforded by microwave technology are enhanced by the safety of the system. Every four hours TJM monitors the microwave system for leaks. The system is very tight and poses less of a safety hazard than a home microwave oven with a leaking door seal.

Other Applications

Because they are a clean, efficient source of energy, numerous applications exist for microwave technology including home and commercial food applications (microwave ovens), rubber vulcanization, and telecommunications. New applications using microwave technology are continuously being developed and include, among others, innovations in ceramics and microwave disinfection systems.

For more information on microwave technology see EPRI Process Industry Office's *TechApplication* Vol. 2, No. 1, or EPRI CMF's *TechCommentary* Vol. 4, No. 3.

Company Profile

Trus Joist MacMillan is a joint venture subsidiary of TJ International (Boise, Idaho) and MacMillan Bloedel (Vancouver, Canada) with 16 plants throughout North America.

President and CEO— Thomas H. Denig

TJM's Colbert, Georgia location started production in October, 1991 and employs approximately 200 people. The company also employs approximately 200 technical sales representatives throughout North America.

Trus Joist MacMillan produces specialty engineered lumber products for the residential housing and millwork industries including Parallam® PSL, Microllam™, Silent Floor® I-beams, open web trusses, and other industrial products.

Len Komori of TJM, and Scott Orr of Georgia Power examine construction which uses engineered lumber. The 7" x 7" Parallam® PSL beam can support approximately 60 tons.

Len Komori of TJM, Scott Orr of Georgia Power, and Ed Smith of the EPRI Pulp and Paper Office made valuable contributions to this issue.

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