Chapter 41
Wood-Based Composites

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ABSTRACT

Wood composites are made from various wood or ligno-cellulosic non-wood materials (shape and origin) that are bonded together using either natural bonding or synthetic resin (e.g. thermoplastic or duroplastic polymers), or organic- (e.g. plastics)/inorganic-binder (e.g. cement). This product mix ranges from panel products (e.g., plywood, particleboard, strandboard, or fiberboard) to engineered timber substitutes (e.g., laminated veneer lumber or structural composite lumber). These composites are used for a number of structural and nonstructural applications in product lines ranging from interior to exterior applications (e.g. furniture and architectural trim in buildings). Wood composite materials can be engineered to meet a range of specific properties. When wood materials and processing variables are properly selected, the result can provide high performance and reliable service. Laminated composites consist of wood veneers bonded with a resin-binder and fabricated with either parallel- (e.g. Laminated Veneer Lumber with higher performance properties parallel to grain) or cross-banded veneers (e.g. plywood, homogenous and with higher dimensional stability). Particle-, strand-, or fiberboard composites are normally classified by density (high, medium, low) and element size. Each is made with a dry woody element, except for fiberboard, which can be made by either dry or wet processes. Hybrid composites based on wood wool, particles, and floor mixed with cement or gypsum are used in construction proving high weathering and fire resistance in construction. The mixture with plastics (PP or PE) and wood floor open a new generation of injected or molded Wood Plastic Composites (WPC), which are able to substitute plastics for some utilizations. In addition, sandwich panels with light core made from plastic foams or honeycomb papers are used in the furniture industry.

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GENERALITIES AND HISTORY OF WOOD-BASED COMPOSITES

The terms wood-based composites are intended to apply to a family of lignocellulosic panel materials specially manufactured for use industrially as components (core, facing, or panels) of furniture, cabinets, and the like, and in building construction as siding, sheathing, partitions, door cores and paneling, acoustical treatments, and as structural components there and elsewhere where the combination of thickness, panel size, and properties satisfy a particular need.

Wood-based composites (veneer, particle and fiber panel products) have an impressive range of engineering properties. While some panel types are relatively new on the market, others have been developed and successfully introduced hundred years ago. However, even those panel types having a long history of continuous optimization are still a long way from being fully developed and they probably never will be. Technological developments on the one hand and new market and regulative requirements, combined with a steadily changing raw material situation, drive continuous improvements of wood-based panels and their manufacturing processes.

The manufacture of wood-based panel products has been brought about by the ever increasing cost of logs and decreasing diameters and lumber, which in turn, has caused in the early last century the specialists for forest resource to investigate ways and means of using trees more efficiently. Many wood composite processes can superior utilize low grade logs such as thinning, bowed and twisted logs. They can also use wood waste material coming from urban areas as recycled residues which became a valuable raw material for the particleboard production (Irle, 2005).

All sawmills produce large quantities of residues, called secondary products (or by-products) in the form of chips, sawdust, and slabs (more than 40% from the log volume in the case of softwood) (Figure 1). Worldwide the amount of sawn softwood reached by 2010 approx. 300 mil. m^3, a 1/3 of it is processed in Europe, another 1/3 in North America (Pöyry, 2005; Eurostat, 2011).

These residues can be used to manufacture cellulose, paper, fiberboard in wet and dry process, particleboard and other wood-based composites (Figure 1).

Figure 1. The family of wood-based products (www.pfleiderer.com)