

Supply of Recovered Wood and Paper Is an Impetus for Recycling

Approximately 37 million metric tons of paper and wood materials were recovered for recycling in 1994, providing a renewable source of inputs to manufacturers. Finding new markets for wastepaper and waste wood is essential to the growth of the recycling industry.

Wood and wood fiber, in the form of discarded paper, wood products, and yard wastes, account for more than half of the municipal solid waste (MSW) by weight in the United States. Mounting concern for long-term environmental, economic, and human health problems associated with landfills and waste incineration has spurred both an expansion in collecting and sorting of recyclables and gains in wood-product-recycling technology.

Besides recycling, wood and paper products can be incinerated both as a means of diverting waste from landfills and as a source of energy. In the United States, most of the incineration of wastepaper and waste wood occurs in MSW facilities. However, such combustion facilities have high operating costs, including expenses to maintain adequate control over air emissions and disposal of the ash residue, which may be regarded as hazardous waste. At the present time, the operating costs of incineration are greater than the revenues from the sale of the energy produced. Facilities make money by charging tipping fees for accepting garbage. As prices for recovered paper continue to increase, as projected by USDA's Forest Products Laboratory, without energy price and tipping fee increases, there will be a greater incentive to sort out wastepaper for sale in the recyclable paper market.

Composting is another alternative for wastepaper and waste-wood disposal. Compost is a relatively inert soil amendment or mulching material, but as an end product, it has little value. Therefore, composting is an economic option for wastepaper and waste wood only if these goods are considered to have little or negative value.

Finding higher value markets for recycled paper and wood is critical to the success of the wastepaper and waste-wood recycling industry. New markets will help raise the demand for recovered paper and wood, which will raise prices for recyclables. In turn, the price increases will provide an economic incentive for sorting and recycling while decreasing the amount of MSW deposited into landfills. Today, many recycled paper and wood products receive a low price because wastepaper and waste wood compete with other low-value materials, such as animal bedding straw and garden mulch, or because they are perceived to be inferior to competing inputs, such as foam or fiberglass for insulation or foam plastics used in lightweight containers. Continued research on products that can benefit from wastepaper and waste wood will help these materials enter higher value markets in the future.

Recycling Has Accelerated

By 1994, the latest year for which data are available, 37 million metric tons of paper and wood materials were recovered for recycling into new products, up from 20.4 million tons in 1986. Domestic paper and paperboard mills, the largest users of recovered fiber, increased their use by nearly 75 percent to 28 million tons in 1994. Use in miscellaneous or industrial products more than doubled between 1986 and 1994 to an estimated 1.5 million tons. Exports of recovered fiber accounted for 7 million tons in 1994, up 75 percent from 1986. Not only has the volume of recovered waste increased, the share of recovered wastepaper and wood also has risen since 1986. Approximately 40 percent of paper and paperboard was recovered for recycling in 1994, compared to only 28 percent in 1986.

In addition to the wastepaper and waste wood component of MSW diverted from landfills, other sources exist for recycled wood fiber. Demolition waste and new-construction waste are two other important sources of waste wood available to recyclers.

Wastepaper and Waste Wood Have Many Industrial Uses

Beside paper and paperboard products, other items made from recycled paper and wood include cellulose insulation, molded-pulp products, animal bedding, paper mulch, packaging cushioning material, and wallboard panels (table 13). According to the American Forest and Paper Association, industrial use of recovered paper (other than for paper and paperboard) is estimated to have more than doubled between 1986 and 1994, but the total quantity is still estimated to be only around 1.5 million metric tons per year.

Cellulose insulation is the second largest category of recycled paper and wood consumption, with 55 reported producers in this enterprise in 1995. The recycled materials, consisting mainly of old newspapers, are pulverized or fiberized and treated with fire retardants (inexpensive inorganic chemicals such as borax). The product is used as a loose fill for insulation of attics and walls, where it is usually poured or blown into place, or it can be mixed with water and adhesives for application as a wet spray. Other insulation products include insulation blocks, barriers, and insulation baffles. Cellulose insulation accounts for only 4 percent of the building insulation market, which is dominated by fiberglass and plastic foam panels.

Molded-pulp products, used mainly for packaging, account for the third largest consumption of recycled paper and wood

Table 13--Approximate quantities of wood and wood-fiber materials recovered for recycling in the United States, 1994

Use category	Approximate quantity Metric tons
Paper and paperboard	28,100,000
Recovered paper for export	7,000,000
Insulation and related products	500,000
Molded-pulp products	300,000
Fiberboard products	275,000
Wooden pallets	250,000
Animal bedding	100,000
Mulch	100,000
Particleboard, hardboard 1/	50,000
Reclaimed lumber 1/	50,000
Roof systems, siding 1/	50,000
"Plastic lumber" and other 1/	10,000

1/ Estimated, not based on actual survey data.

Source: USDA, Forest Service, Forest Products Laboratory.

products. By the early 1990's, there were 13 producers of molded-pulp products, which accounted for 300,000 metric tons of recycled paper. These products include protective packaging in shipping containers, food packaging, such as food service trays and egg cartons, and horticulture plant pots. Currently, molded-pulp products are overshadowed by polystyrene and other plastic foam packaging materials in the packaging market.

Waste paper can also be used as a feedstock in the manufacture of fiberboard products. For example, Gridcore Systems International Corporation in Long Beach, California, is manufacturing Gridcore panels, a strong, lightweight, molded-fiber panel developed and patented by USDA's Forest Products Laboratory. A Gridcore board consists of two subpanels of molded fiber, each with one smooth surface and one waffle-textured surface, bonded together on the waffled sides, so the smooth surfaces face outward. The panels are made primarily from waste corrugated cardboard, which provides the long fibers necessary to maintain structural integrity, and from recycled newsprint and office paper. Fibers from other sources, such as wood waste from construction and demolition debris, rice hulls, kenaf, jute, and bagasse, can also be used. The panels are produced by mixing waste cardboard or cellulosic fibers with water and pouring them into a compressible rubber mold. The water component is vacuumed out of the pulp, and the newly formed panel is transferred to a hot press (1). Gridcore panels are currently being marketed for theater and television stage sets, exhibit or trade-show displays, and office partitions. Future applications of Gridcore will capitalize on its light weight and strength, and include shipping containers and wall, floor, and roof panels.

Particleboard and hardboard is another market for recycled paper and wood products. The annual quantity of recycled wood used is estimated to be about 50,000 metric tons or 1 percent of the industry's total wood use. For instance, Evanite Fiber Corporation in Corvallis, Oregon, is recycling urban waste wood to make a hardboard product

for use as paneling and pegboard. Evanite's hardboard is constructed of 48 percent urban wood waste; 45 percent scrap pallets, shakes, and utility spools; and 5 percent virgin wood. Currently, Evanite produces approximately 1.5 million cubic feet of hardboard per year, using nearly 37,000 metric tons of waste wood fibers (1).

Waste paper and wood can also be combined with concrete, plastics, or other materials to form composite products, which can combine the best properties of each input. For example, Insul Holz-Beton International, Inc. (IHBi) of Windsor, South Carolina, licenses the manufacture of wood-cement building products and insulating wall forms. IHBi developed a process to impregnate wood with a nontoxic mineral emulsion to preserve the wood cellulose and protect the chips against rot and decay. The wood aggregate is mixed with portland cement to form lighter weight, fireproof building materials and components. The organic fiber makes up 91 percent (by volume) of the total composition. Using the same process, IHBi also licenses, under the tradename Faswall, permanent insulating wall forms for reinforced concrete structures. The wall forms have a 4-hour fire rating and a R-value of 11 to 24, depending on configuration.

Recycled newspaper is combined with soybean flour to form a decorative surface product that looks like granite but handles like wood. Phenix Biocomposites, Inc., of St. Peter, Minnesota, currently produces Environ for use in furniture, store fixtures, and plaques. Products may be developed in the future for use in the structural building materials market.

Recycling Research Continues

Additional recycling technologies are under research and development. Emphasis is on finding markets for currently unusable recyclable fiber, such as magazines, food-packaging containers, and urban waste wood. One example of new research has shown that urban wood waste can be mixed with fiberglass waste from sheet molding to produce subflooring panels. The result is a stronger, less expensive panel, and new uses for two products that would otherwise fill valuable landfill space.

Improving the recycling value of juice boxes, milk cartons, and other food-packaging containers is another area of investigation in recycling research. Recyclers tend to like these low-cost, high-quality fiber containers but separating the fiber from the plastic film (low-density polyethylene) used to coat them creates wet film waste. Up to 50 percent of the paper fiber is lost in the waxy slurry during the separation process. The Forest Products Laboratory, in collaboration with university and private industry, has developed technology that thickens the film waste and creates pellets that can be used in typical plastic-molding equipment. [Jacqueline Salsgiver, ERS, (202) 501-7107, jsalsgiv@econ.ag.gov, and Peter Ince, Forest Service, Forest Products Laboratory, (608) 231-9364, pjince@fac-staff.wisc.edu.]

1. Lorenz, David. *A New Industry Emerges: Making Construction Materials From Cellulosic Waste*. Institute for Local Self-Reliance, Minneapolis, MN, 1995.