WARTIME STATUS OF SAWDUST, SHAVINGS, AND OTHER WOOD WASTE AS COMMERCIAL RAW MATERIALS

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Since the beginning of the war and especially during the past few months a great deal has been written in trade journals and magazines of general circulation concerning the production of commercial items from wood waste. Some of this publicity has been misleading to the rank and file producer who has been led to believe that since Pearl Harbor a number of new technical processes have created new outlets for waste and greatly expanded consumption.

Actually there has been little increase in the demand for any of the various forms of wood waste in our wartime economy. As a matter of fact, sawdust, shavings, and wood waste generally are currently produced in greater quantity than ever before, and the demand for those items is not keeping pace with their increased production. That situation is resulting in a surplus of waste material that war industries and other outlets can hardly hope to consume under existing economic conditions.

Sawdust, shavings, and other wood wastes have many uses, and the total annual consumption of those materials is large. The greatest single outlet for the above is for fuel at the producing plants. When that requirement has been satisfied there remain large quantities at points of production for which there are usually no adequate markets. As a rule, wood wastes cannot be shipped far because of their low value and relatively high transportation costs. It is necessary, therefore, to search for markets in the vicinity of the producing mills and factories.

Sawdust and shavings are sold chiefly by dealers specializing in these items, and in relatively small amounts spread over a wide variety of uses. The bulk of such sales are in the larger cities, and the original sources of the stock are mainly local or nearby woodworking plants. Sawmills and factories located away from large centers of population must, therefore, depend largely on existing local outlets for disposal of their sawdust and shavings or develop such outlets at their plants. There are industries that can use large quantities of sawdust in their operations, but most of them are currently only potential outlets since the cost of manufacture of and products may be greater than when other more

adaptable raw materials are used. Also some products of wood waste, that can be readily made, currently have limited markets. Most industries that can utilize sawdust, shavings, and other wood waste in large quantities require large investments in plant and facilities. These industries do not offer immediater general solution to the waste wood problem, but may some day be helpful in individual cases.

There are listed and briefly described below industries which under favorable economic conditions can serve as outlets for surplus sawdust, shavings, and other forms of wood waste. The Laboratory will be glad to supply additional information concerning them to anyone interested.

Wood Plastics

During the past few years several concerns have been active in the commercial development of lignocellulose molding materials produced chiefly from hardwood waste. These products are wood plastics but differ from each other in certain important respects. The wood plastic developed at this Laboratory has been named hydroxylin.

Hydroxylin is made in two forms -- molding powder and laminating sheets -- both from hardwood wastes; it is classed as a low-cost plastic and has certain desirable properties, notably high acid resistance. Its future should be influenced by its performance in war material and by production experience gained by war contractors who will apparently be the first to use hydroxylin in quantity.

Made in only one color -- jet, glossy, black -- hydroxylin is in effect a lignin plastic with a cellulose filler. In making the molding powder, sawdust or wood chips -- mill run of either straight hardwoods or softwoods -- is hydrolyzed with a weak acid or aniline to convert parts of the cellulose in the wood to sugars which are removed by washing. This operation increases the percentage of lignin in the residue, which is dried and milled to a fine powder and to which a small amount of any one of a number of plasticizing agents may be added to lower the flow point of the lignin. The cellulose remaining in the molding mixture acts as a filler -- just as wood flour does in many common phenolic molding materials -- to increase the strength. Water resistance of the mixture is dependent on the amount of lignin present. The cellulose-derived sugars referred to as a byproduct of the hydrolysis process could be processed by fermentation to produce ethyl alcohol in operations large enough to guarantee continuous production.

Hydroxylin is relatively hard and strong, has high electrical resistance, and can be cut with machine tools like metal. It is relatively light in weight, and bonds well to metals, such as brass, bronze, and aluminum. The hydrolyzed wood sheet can be laminated under heat and pressure to form, under double curvature if desired, a material that has promise for many uses.

Hydroxylin is one of a class of products for which only a very limited market has been developed.

Wood Sugar for Ethyl Alcohol

The manufacture of ethyl alcohol as a commercial product from sawdust and other mill waste is currently receiving considerable attention. Improved methods of manufacture resulting in increased yield per ton may place wood as a source of raw material for alcohol production on a par with molasses and other materials now used for that purpose.

The yield of wood sugar on a weight basis is about the same whether hardwoods or softwoods are employed. Softwoods, however, are preferable for alcohol manufacture since a much larger proportion of fermentable sugars is produced. Sugar from softwood species yields 50 to 60 gallons of alcohol per ton of dry wood while the yield of alcohol from hardwoods is only about 40 gallons per ton of wood of the same moisture content.

It is not necessary to remove the bark from wood waste for use in the production of alcohol, although a high proportion of bark is not desirable. The wood is placed in digesters, and treated with dilute acid at high temperature, converting the cellulose into a solution of fermentable sugars. These sugars are then fermented into alcohol, which is distilled and rectified in the usual manner, making a product that has a quality equal to alcohol produced by any of the other commercial processes, and superior to some.

Plants for the production of alcohol from wood waste are costly to construct and for economical operation require at least 200 tons of raw material (dry basis) daily. Other conditions deemed necessary for the successful operation of alcohol plants using wood waste are that raw material costs and operating expense must be maintained at low levels. A commercial-scale pilot plant is to be constructed near Eugene, Oregon, to make ethyl alcohol from wood. The estimated cost is around 2-1/4 million dollars, and it is expected to consume about 250 tons of wood waste per day. The plant should begin

operations early in 1945, and much will then be learned about its economic practicality and the possibility of its continued operation under normal conditions. The peace-time status of this form of utilization is believed to be partly dependent upon the development of new byproducts that can be made from the residual lignin.

Wood Sugar for Yeast Production

Yeast can be produced from wood sugar derived from softwood or from hardwood with equally good results. The product in dry form contains a high percentage of protein, and when used with other materials, rates high as food for live stock.

Chips for Roofing Felts

The war has brought about a very important change in the manufacture of a product commonly known in the trade as roofing felt. In pre-war times the filler in "felts" was chiefly rags, much of which was imported. A small portion of the filler was wood fiber. With the supply of rags virtually cut off by the war, the volume of wood fiber for filler material was correspondingly increased.

Wood fiber for roofing use is produced from chips made chiefly from sawmill slabs and edgings. The chips are defibered in special machines at the roofing plants, yielding a rather coarse fibrous material. The species preferred at Middle West and eastern plants are reported to be maple, birch, and aspen. Defibered wood is also used for mattress stuffing and similar uses.

Wood Flour

The war has increased the demand for wood flour, primarily in the uses for which it has long been employed. Several species of wood are now used in its manufacture. Very briefly, wood flour is finely ground wood. In pre-war days the bulk of wood flour was made from dry white pine sawdust and shavings. Other woods used in small amounts for wood flour manufacture were a few nonresinous softwoods and light-weight hardwoods. The moisture content of stock for wood flour use should not exceed 10 percent.

The principal uses for wood flour are in the manufacture of linoleum, dynamite, and certain types of plastics. Linoleum and plastics may be expected to remain important outlets for wood flour after the war.

Wood Waste for Fuel

An important commercial use of surplus wood waste is the employment of loose sawdust for domestic furnace fuel. In the Pacific Northwest probably 40,000 homes are heated with sawdust-burning furnaces. These furnaces are equipped with sheet metal hoppers which deliver the sawdust by gravity to special grates where combustion takes place. Sawdust-burning furnaces are also used in large numbers in Maine.

A hopper burner adapted to various forms of wood, that can be readily attached to an ordinary furnace, has been developed by this Laboratory especially for war time use.

Hogged fuel is a standard commercial item at many lumber mills. The hogged stock is transported by barge, truck, and railway car to points of use.

Another method of utilizing wood waste, particularly dry shavings, for commercial fuel is in the form of briquettes. The wood briquetting industry is practically limited to the Pacific Coast States and Idaho. Production is now about 150,000 tons annually. The principal requirements for profitable briquetting operations are a large and continuous supply of suitable dry stock, low operating costs, and a good outlet for the product at fair prices.

Small Waste Wood for Pulp

Sawmill waste, such as slabs, edgings, shavings, and sawdust, is not a particularly desirable form of wood for use in pulp manufacture. However, such types of waste are currently being used at some pulp plants for the manufacture of container board. It is reported that about 25 percent of the digester charge in some cases is sawdust. This is currently an emergency use for sawdust, but with further study it may possibly become more widely accepted practice in the production of some types of paperboard.

The following Forest Products Laboratory waste utilization mimeographs are available on request without cost:

No. R64 Outlets for Wood Waste
No. R565 Wood Flour
No. R842 Briquetting of Wood Waste
No. R944 The Use of Sawdust and Shavings
No. R945 Chemical Utilization of Wood Waste
No. R1209 Wood Plastics as Developed at the Forest Products Laboratory and Their Future Importance
No. 1440 War-Time Model Hopper Unit for Burning Various Forms of Wood in Standard Domestic Furnaces
Unnumbered mimeograph, Wood: Its Heating Value and Importance as Farm Fuel