WOOD PRODUCTS RESEARCH IN OREGON

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The State of Oregon has every reason to be interested in Forest Products Research. Since 1938, Oregon has lead all other States in the production of lumber and forest products. The figure for 1943 -- 7 billion board feet -- was roughly one-fifth of the total production for the United States. The economy of the state is inexorably associated with her forests. Of the total land area of slightly over 61,000,000 acres, approximately 48 percent is classified as being best adapted to timber cropping. Oregon's present estimated total stand of saw-timber -- 360 billion feet, log scale -- is approximately 25 percent of the Nation's total. The leading tree species are Douglas-fir, Western hemlock, and ponderosa pine. Approximately 78 percent of the saw-timber is found in the Douglas-fir forests west of the Cascade Mountains; and the Douglas-fir forests of the West Coast are admittedly the most productive in our country.

According to a recent report by Mr. Burt P. Kirkland of the American Forestry Association. The Douglas-fir Region could produce, without drastic changes in present forest practices, approximately 13 billion feet of lumber annually for the next 20 years and still stay on a sustained yield basis. Re predicts a sustained yield of 20 billion feet when all the forests of the Douglas-fir region are brought up to full growing capacity. Thus it seems apparent that Oregon will be a leader in forest products for many years,

Forest products research is not new to Oregon, although an active State program was not initiated until recently. The School of Forestry, Oregon State College, has been active in research for upwards of twenty years, principally in the fields of wood preservation and the seasoning of lumber. Several of the trade associations and some of the larger lumber companies have also made valuable contributions; as have the various federal agencies located within the State.

Before discussing current accomplishments and future plans for forest products research in Oregon, it seems advisable that I outline, in brief, the facilities that have been established for the purpose. Through the active interest of certain far-seeing individuals at Oregon State College and the help of the more progressive elements of the lumber industry, Oregon passed a law in 1941 which initiated a State-wide research program, aimed primarily at better utilization of waste, or unused forest materials. This project, financed by

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a biennial budget of $25,000, was associated with the State Board of Forestry and the School of Forestry at Oregon State College. The grant was renewed in 1943 and increased to $48,000 in 1945. In order to permit more complete cooperation with industry and to obtain additional funds for special programs, a non-profit corporation, called the Forestry Research Foundation, was formed for the purpose of prosecuting applications for patents, protecting and developing discoveries made by the Laboratory, and having the right to purchase and hold rights to scientific discoveries and to solicit and receive donations for the furtherance of the research program.

State-wide interest in the research program and the success of projects already undertaken has resulted in the approval of a new building to house the facilities of the Laboratory. This building, which will be erected as soon as suitable bids can be obtained, will be of the industrial type, approximately 300' x 60' and costing in the neighborhood of $100,000. Approximately half of the space will be devoted to the pilot-plant experiments of the Chemical Engineering Department of Oregon State College, many of which will consist of commercial adaptations of experimental processes developed in the Oregon Forest Products Laboratory. Industry has generously offered to supply approximately $50,000 to augment existing equipment. It will take time to obtain all of the necessary equipment but eventually we shall have a building fully equipped to conduct experimental work in all types of wood utilization.

At the present time the staff of the Laboratory consists of 3 full-time workers and 5 regularly assigned part-time workers, plus several graduate students. Full-time workers include a wood chemist, a chemical engineer working on carbonization, and a wood technologist. All the staff members of the Wood Products Department of the School of Forestry devote a part of their time to Laboratory research. They include a wood technologist-wood pathologist, a man trained in wood preservation and seasoning, and one in woods waste and sawmill waste problems. The Chemistry Department contributes an additional part-time worker and the Dean of the School of Forestry acts as the Director. In addition, staff members of other Departments on the campus contribute time to certain specialized projects.

The Act of the State Legislature which established the Oregon Forest Products Laboratory is rather specific in directing its activities toward research aimed at better utilization of waste materials resulting from the harvesting of forest crops and the manufacture of lumber and other wood products. However, the policy of the advisory committee has been rather broad and it can be expected that the scope of research will be expanded when the more important problems of better utilization of "bulk" waste, such as sawdust, have been solved. In fact, research to improve the utilization of minor species has already been approved.

It is fitting that the Oregon Forest Products Laboratory should be interested in waste. At the present time, when a tree is cut, roughly one-third is left in the woods as tops, limbs, broken material and partly defective logs. Of the remaining two-thirds of the log, approximately one-half goes out the "wrong" end of the processing equipment -- leaving only 35 percent utilization. Work done by the Oregon Forest Products Laboratory, and later expanded...
by the Forest Service, indicates that 679,744,300 cubic feet of solid wood "waste", weighing 9,653,000 tons, bone dry weight, were developed in the manufacture of about 10,670,000,000 board feet of lumber at primary sawmill operations in Oregon and Washington in 1944. Of this material, about 53 percent was in the form of sawdust and shavings; 47 percent in the form of slabs, edgings, and short wood.

For the sake of more tangible comparisons, the Forest Service has expressed the significance of this volume of waste materials in the following form: "Total wood by-products weighing 9,653,000 tons bone dry weight are the equivalent of 579,180,000 gallons of alcohol at 60 gallons per ton of wood waste plus 2,413,250 tons of lignin at 500 pounds per ton plus another 579,180 tons of fodder yeasts at 120 pounds per ton." Putting it another way, 4,538,000 tons of coarse waste, bone dry, would yield about 2,000,000 tons of well-screened pulp at 45 percent recovery; or at 90 percent recovery, over 4,000,000 tons of fiber for the production of insulating and wall boards. Four million tons of fiber would yield nearly 4,000,000 sq. ft. of two-inch insulating board weighing 13 pounds per cubic foot of board.

Since the material listed above is now largely unused in the milling centers outside of Portland, other than for fuel, the efforts of the Laboratory have been directed toward more complete, and more profitable, utilization of present waste by-products of the lumber industry. Time does not permit a complete description of the accomplishments of the Laboratory to date but the following examples are illustrative of the work being done.

The production of charcoal from sawdust or hogged wood, for use as domestic fuel or even metallurgical fuel, offered one possibility for the utilization of sizable amounts of sawmill waste. A pilot-plant in operation at the Laboratory for over a year has produced encouraging results. It has shown that a good quality of charcoal can be made from Douglas-fir sawdust, and that satisfactory briquette can be formed by mixing charcoal with water and using some of the derived tars as a binder. Preliminary calculations indicate that the briquettes can be produced at a cost that will be competitive with other fuels and steps are being taken to determine the changes required to convert from pilot-plant to commercial operation. Preliminary calculations have not included the possible value of the resultant tars and distillates obtained as by-products. With proper auxiliary equipment, as much as 1 pound of settled tar has been obtained to 4 pounds of charcoal. Yields of up to 14.5 percent of tar acids and phenols have been obtained from distillation of the settled tar. It is too early to make predictions but it is possible that improved utilization of wood tars may make tar the most important product of wood distillation, thereby reducing the cost of charcoal and providing a profitable use for sawmill waste. Studies are now in progress to determine the physical properties of the acids, as well as their chemical identification.

Another use for sawdust that has shown some promise is the compounding of a finishing plaster made from wood flour. This project, which was halted during the war for lack of manpower, is to be reopened in the near future. At the time the project was dropped the plaster showed possibilities of
being applied to plywood surfaces with ordinary spray equipment at a cost comparing favorably with that of building plaster. It is indicated that this product may be satisfactory for the interior finish of prefabricated housing units.

The ethyl alcohol plant nearing completion at Springfield, Oregon has opened up a number of research possibilities. The production of the primary product is, in itself, based on the utilization of sawmill waste. Originally designed to produce approximately 10,000 gallons of industrial ethyl alcohol per 24-hour day from 220 tons of wood waste, dry weight, improved techniques, developed largely through the pilot-plant experiments conducted at the Madison Laboratory, indicate that production can be increased to approximately 15,000 gallons per day, using upwards of 350 tons of wood waste. Not only has plant efficiency been improved, but yields have been increased from approximately 50 gallons of alcohol per ton of dry wood to over 60 gallons. In addition to the 1200–1500 pounds of wood sugar produced for each ton of dry wood, there will be a total daily accumulation of "waste" by-products from this utilization of waste wood amounting to about 70 tons of lignin, 18 tons of calcium sulphate sludge, and over 5,000,000 gallons of residual liquor which contains about 1–1/2 percent reducing sugars.

These by-products present disposal problems at the present time but also offer challenging opportunities for research and development. Whereas research on the alcohol phases of the program have been conducted under the direction of the Madison Laboratory, the Oregon Forest Products Laboratory has played a major part in examining the possibilities for utilizing the waste by-products. Only a meager start has been made on some of these problems, due primarily to lack of funds and personnel during the war years, but increased activity is now anticipated.

The operating plan for the alcohol plant calls for the lignin to be dried and burned in the boilers; a return of 0.01 cent per pound. It is indicated that a market for lignin at even one cent per pound would reduce the alcohol cost by ten cents per gallon. Therefore, we have been intensely interested in this phase of the problem. Preliminary studies have indicated that the waste lignin can be carbonized by controlled pyrolysis for the production of charcoal and the manufacture of briquettes. The tars and extractives from this process are being studied and some of them appear to be of sufficient interest to warrant further investigation. Work on the analysis of the pyroligneous acid for dissolved tar, acetic acid, and methanol is in progress.

Possible use as a plant fertilizer and soil stabilizer also offered good prospects for the extensive use of rather large quantities of waste lignin, Results have not been very encouraging but the experiments will be continued until all aspects of the problem have been explored. Results of experiments dealing with the use of ground lignin as an extender for insecticidal dusts appear to offer more promise, but the work has not passed the preliminary stages of investigation. Our studies of the possibilities offered by lignin as a plastic moulding compound and as an extender for synthetic resin glues are in the same category. The recent return of qualified personnel will permit resumption of work on several aspects of lignin research which were temporarily abandoned during the war.

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Going to the next major by-product of the alcohol plant, it has been found that Scholler gypsum, that is, the calcium sulphate residue, is equal to agricultural landplaster for use on soils. Green house and sample plot tests have been completed. Large scale field tests are planned with the actual product from the Springfield plant when sufficient supplies are available. With an available annual market in Oregon of about 9,000 tons at $14.00 to $15.00 per ton, profitable disposition seem assured.

The 5,000,000 gallons of still bottom liquor produced daily presents a serious disposal problem. The problem is being attacked in two ways: first, the possibility of growing feeding yeast on the pentose sugars, thereby removing sonic of the materials that contribute to stream pollution and, second, in cooperation with the Bacteriological Department at Oregon State College, methods for creating suitable sewage disposal facilities. Since the exact nature of the still bottom liquors will not be known until the plant is in operation, it is difficult to predict the exact type of biological community that will be required to effect the desired decomposition. Nevertheless, cultures of many types are being tested on samples of still bottom liquor obtained from the pilot-plant at Madison to determine their efficacy in this connection. The feasibility of producing furfural and acetic acids are being examined rather critically, as are other forms of fermentation for the production of acetone, butyl alcohol, lactic acid, butylene glycol and citric acid.

Leaving the alcohol plant, our projects deal with more direct applications of wood waste utilization. Interest in the manufacture of fiber boards from mechanically-produced fiber, from either chips or slabwood, is gaining considerable impetus. In one cooperative project we have assisted in working out the details for forming resin impregnated shells, or cabinets, for home freezing units, made entirely from mechanical fiber produced from waste wood. The reduction in supplies of high-grade peeler logs has also focused attention on the use of fiber overlays of several different types to replace costly face veneers. In order to be in a position to supply information on this subject, we have recently inaugurated a rather extensive project to determine the best means of refining mechanical fiber. This type of use offers prospects of utilizing large amounts of waste.

The better use of Oregon hardwoods and minor coniferous species has also come under consideration. The present heavy demand for poles has created an active interest in lodgepole pine. While the Forest Service is working on the forest management and transportation problems which attend the utilization of this species, the Oregon Forest Products Laboratory is cooperating with several industries in matters of improved methods of preservation, as well as examining the possibility of producing pulp and mechanical fiber. Other minor coniferous species will be considered as time permits. Oregon has approximately 4 billion feet of hardwoods, principally red alder, oaks, and bigleaf maple. Virtually nothing is known concerning the management of these species and mill, grade, and seasoning studies are badly needed. In cooperation with several mill operators, initial steps have been taken for a study to determine optimum drying procedures for Oregon white oak, tan oak, and California black oak. Grade studies will follow. There is no doubt that the utilization of Oregon hardwoods can be materially expanded and it is possible that new industries can be developed.
In cooperation with the West Coast Lumbermen's Association we have also embarked on an ambitious program of determining optimum kiln-drying conditions for Douglas-fir, hemlock, and the other more important species. Schedules are pretty well worked out. More detailed studies are needed to perfect refinements, improve product quality, and reduce drying costs. Our current project deals with the air velocities required to dry 2-inch common Douglas-fir and 1-inch hemlock to determine the point at which power costs for high velocities reach the point of diminishing returns.

While the primary function of the Laboratory deals with the increased utilization of waste resulting from manufacturing processes, experience has shown that the problem of better utilization of woods waste cannot be entirely divorced from the more immediate problems confronting the Laboratory. In view of this a certain amount of time has been devoted, in cooperation with several lumber and pulp companies, in attempting to recover more values from logging operations and to devise equipment and methods for doing so.

To date, lack of space and equipment have prevented research in the fields of pulp and paper, plywood, laminates, adhesives and bonding, wood preservation, wood stabilization, and other projects. Completion of a new building in the very near future will permit expansion into a number of these fields if the demands of local industries justify increased activity along these lines.

The keynote of the entire Oregon Forest Products Laboratory research program has been cooperation. Because of limited funds it has been necessary to marshall all available forces into a full cooperative effort and wherever possible, to avoid duplication of research; particularly that being pursued by other public agencies. On the Oregon State Campus the Departments of Wood Products, Chemistry, Chemical Engineering, Mechanical Engineering, and Agricultural Engineering have all contributed. Graduate students have been used when available, under supervision of members of the College and Laboratory Staffs. The Bonneville Power Administration, The Pacific Northwest Forest and Range Experiment Station, the Madison Laboratory, The West Coast Lumbermen's Association, the Portland Gas and Coke Company, The Willamette Valley Wood Chemical Company, and the lumber industry have all made definite contributions in certain studies, and plans for more intensive cooperation with industry are shaping up rapidly.

The Oregon Forest Products Laboratory is committed to a policy of concentrating on practical research designed to solve the immediate problems of Oregon's forest products industries. This does not preclude the advisability of engaging in some basic research but, for the most part, the Federal agencies, with their greater resources are in a better position to sponsor long-term and costly projects.

Because of the vast amount of work that remains to be done it seems to me essential that full cooperation between public agencies, and, in so far as possible, the elimination of duplication of effort should be stressed to the limit. It is my hope that from this meeting will come a concrete plan for the interchange of information between public research agencies, and a conscientious effort on the part of all concerned to avoid duplicating work which can be accomplished more efficiently by another organization having specialized equipment and personnel,