WESTERN FOREST PRODUCTS LABORATORY INDUSTRY SERVICES

F. A. Tayelor
Western Forest Products Laboratory
Vancouver, British Columbia

The Western Forest Products Laboratory is one of two forest products research centers within the forestry service of Environment Canada.

From Vancouver, British Columbia, it serves all of Western Canada, from Manitoba to B. C., including the Yukon and Northwest Territories. In the next 20 minutes, we would like to familiarize you with the laboratory, its functions, and some of its recent research activities.

The laboratories' primary objective is problem-solving, through research, to attain more efficient use of our forest resource. Its work involves developing, testing and demonstrating new and improved forest products and wood processing technology.

Another function is to provide organizations such as The Canadian Standards Association, with data and technical assistance needed to develop codes and standards governing the use of wood in housing and engineering design.

A third function is to provide a technical information service, ranging from telephone inquiries to field investigations, for the forest products industry, wood users, provincial governments, and the general public. Approximately 80 studies covering a wide range of disciplines, are currently in progress. These contribute to our objectives:

Through full resource utilization,
By developing better processing techniques,
By product evaluation and specifications,
By improving product protection,
Through scientific support activities,
And through technology transfer.

In the time available, we can only highlight a few recently completed studies.

Full Forest Harvesting

It is predicted that by the year 2000, world demand for all wood products will exceed the supply from conventional sources by some 200 million cubic meters.

The most promising solution to this projected shortage is through full forest harvesting - a concept of using all harvestable material from an area.

Not only would the "merchantable bole" be used as in common practice today, but also tops, branches and foliage, stumps and roots;

plus dead trees, weed species and small stems not normally utilized. This practice could double the usable biomass from our forests, but also raises many technical questions. To provide some of the required answers, the scientists in our pulping activity have evaluated this additional material for kraft pulp.

Only bark and foliage are of no value in pulping, and methods of segregating these fractions from the usable wood are under investigation.

Efforts at developing new uses for foliage and bark, and technology transfer programs for established uses, are also in progress.

Floating and Flooded Timber

Another aspect of full resource utilization is the conversion of floating and flooded timber to useful products. An estimated 1 billion cubic feet of wood is floating on B. C. reservoirs.

Our studies show that floating spruce and pine from Williston Lake is an excellent fibre source for kraft pulp. Both pulp yield and quality are equivalent to pulp of the same species from other sources.

A related problem is the large volume of timber partially submerged in Ootsa Lake for over 20 years. Tree shears mounted on a barge have opened the way to harvesting this timber. Our investigations show that lumber grade recovery from submerged timber is comparable to fresh-cut spruce and pine. Since even slow kiln drying of this material may result in the development of significant drying defects, air drying is recommended.

In addition, strength tests indicate that the lumber has substantially reduced stiffness, and should not be used for structural applications.

In contrast, pulping tests on flooded spruce and pine show that both pulp yield and pulp strength are at least as good as for normal wood.

Bark Utilization

Bark comprises 10 to 15 percent of the volume of mature trees stems, and is available in vast quantities at primary wood processing plants.

Although half is used as fuel, the remainder is merely disposed of by burning or in landfills. However, the recent energy crisis has stimulated interest in bark as a source of chemicals currently produced from petroleum. Phenolic adhesives derived from petroleum and commonly used in plywood manufacture, are one such group of chemicals.

Our gluing specialists have found that high temperature pressing of ground coniferous bark, without adhesives, produces a waterproof, dimensionally stable board. A paper overlay more than compensates for its marginal bending strength, while internal bond strength is 4 times higher than required.

Two decades ago, the WFPL pioneered the development of adhesives from western hemlock bark extractives. Although a steady decline in

phenol prices rendered it uneconomic, a return to high prices and restricted phenol supplies has prompted us to reassess these adhesives.

Studies evaluating extraction methods, extract stability, and thermal characteristics show that these adhesives can be used in exterior grade particleboard, but further research is needed to adapt them for use in plywood.

Better Processing Techniques

Another major concern of the WFPL is the development of more efficient wood processing techniques.

Improved Tree Shear Blades

Recently, tree shears of a variety of designs have come into common use in the forest industry. A problem which has emerged in the use of these shears is the occurrence of major butt fractures, which are particularly severe in frozen wood. If the logs are subsequently processed in a sawmill or veneer mill, these splits appear in the lumber or veneer, and result in significant losses in produce recovery.

To overcome this problem, a ribbed blade was conceived and designed at the WFPL, which effectively reduces the development of high stresses, with an accompanying reduction in splitting. Field tests on frozen spruce, using double blade shears, indicated that the ribbed blade reduces shearing damage in the dressed dried lumber by 80 percent compared to the standard blade. In the case of single blade shears, the ribbed design resulted in a 30 percent reduction in shearing damage. A British Columbia manufacturer has been licensed to produce the ribbed blade, and over 50 production models are now operating in the field.

Veneer Peeling

In the manufacture of plywood, only half of each veneer log ends up as usable veneer, the remaining half consists of core, shrinkage, round-up and waste. The objective of our veneer peeling research is to recover more usable veneer, with an accompanying reduction in waste. Much of our effort has been directed toward reducing veneer losses due to varying thickness, roughness, and deep lathe checks.

Our recently published lathe operators' manual outlines the many facets of operating, maintaining, and setting up a veneer lathe for best performance, using instruments developed at the WFPL and other forest products laboratories. These instruments, used to measure knife pitch, horizontal gap, vertical gap, and knife height are now available commercially. In recent mill studies, these lathe instruments and our recommended lathe settings were used to set up well maintained industrial lathes. The results were yield improvements of 5 to 11 percent, more uniform panel thickness, and a 50 percent reduction in spinouts, with consequent increases in financial return to the mills.

Drying Northern Aspen

Our lumber seasoning group is periodically called upon to develop kiln drying schedules for species coming into more common use.

Poplar species, which comprise roughly 10 percent of Canada's timber supply but are virtually unused, have recently attracted much attention. The two main species, trembling aspen and balsam poplar can be processed and sold as framing lumber, but drying them has proven a major problem. Our drying experts have developed experimentally a high-temperature schedule suitable for use in steam kilns.

A subsequent semi-commercial kiln trial confirmed that 2 x 4 northern aspen lumber can be dried to the required 19 percent moisture content level in 4 days with a minimum of degrade.

A second set of schedules have also been developed for direct-fired kilns, with expected commercial drying times of 4 to 4.5 days. Although these schedules minimize degrade, crook is the single most degrading factor in dried aspen. A method of straightening crooked studs has been investigated.

Small-log Sawmills

Modern sawmill designers have the task of fitting log supply and lumber requirements with an efficient combination of equipment and mill layouts.

To rationalize the design process, our sawmilling specialists have studied 72 mills cutting small logs. Production data were gathered on almost every type of small-log headrig in Western Canada, from quad bands to chipping headrigs. The information obtained on lumber yields, log through-put, and delay times is now available for use in assessing headrig alternatives.

The second major step has been to develop a flexible and comprehensive sawmill simulation program. This program assists sawmill designers to study mill lay-out decisions before the mill is built. By using available data on machine processing characteristics, coupled with a scheduling routine that transfers logs, cants, or boards between machines, a realistic picture of material flow through the mill can be obtained. We are now in the process of testing this new design took in cooperation with mills planning new investment.

Product Evaluation and Specifications

Another major WFPL activity, "Product Evaluation and Specifications," is concerned largely with determining strength values of western wood species, for use in structural design.

The basic data developed in our timber engineering laboratory form the basis for the allowable stresses assigned to various wood products through the Canadian Standards Association.

We also undertake timber engineering studies to develop new engineered uses for wood, or to extend and improve the structural use of wood. A recent example is the application of machine grading of lumber to the manufacture of laminated beams.

Machine Grading

The glued-laminated timber industry in Canada has traditionally used Douglas-fir, largely due to its high strength and stiffness values under the current visual grading system. However, the diminishing supply and increasing cost of Douglas-fir is fast creating a need for suitable alternative species. But when alternate species are employed, larger and usually more costly beams are needed to satisfy the same engineering requirements. Machine grading, which categorizes lumber by stiffness and strength classes, offers a promising solution to this dilemma.

We have applied this technique to assess the practicality of selecting high strength laminating material from alternative species, and the placing it on the top and bottom of beams, where stresses are the greatest. Test beams constructed from machine-graded western spruce and lodgepole pine resulted in strength and stiffness design values only slightly lower than for beams made from visually graded Douglas-fir.

Beams fabricated from machine-rated western hemlock and Amabilis fir were found equivalent in strength to those made from visually graded Douglas-fir. The basic information developed in these tests has opened up the opportunity to efficiently use alternative species in the laminating industry.

Wood Protection

Wood protection, another major area of WFPL activity, is concerned with the protection of wood products from deterioration by fungi and other micro-organisms.

Activities range from studying deterioration of pulp chips in outside storate to evaluating new preservatives and the treatability of various wood species.

Recent tests have shown a newly formulated water repellent to be effective in controlling moisture uptake and sap stain and mould in kiln-dried packaged lumber.

Protecting Shingle and Shake Roofs

Studies aimed at increasing the decay resistance of western red cedar shingles and shakes are currently in progress. Although red cedar has high natural decay resistance due to its heartwood extractives, these are present in varying amounts and may be leached out in high rainfall zones. In mild wet regions, we have found decay organisms in shake roofs within 10 to 16 years after installation. Preservative treatment is recommended in such "high decay hazard" areas.

We are currently assessing seven different preservatives for single and shake roofs. Analysis of rain water collected from the test roofs, has suggested that the preservative level drops during the first 8 months, and then remains constant for the next year. Sufficient preservative was retained in all cases to prevent biological deterioration. More studies are planned to assess longer-term effectiveness of these and other potentially effective preservatives.

Scientific Support

Basic scientific support activities are often essential ingredients in deriving solutions to practical problems.

Wood Chemistry

Studies in wood chemistry have contributed in many practical ways to our understanding of wood. Those chemicals removable by water and neutral solvents, known as extractives, have been studied intensively at the WFPL.

Western red cedar extractives, which are responsible for the colour, odor, and natural decay-resistance of this species, play an important role in its use. Although cedar extractives can be beneficial by providing natural decay resistance to cedar products, they are also responsible for such problems as corrosion in pulp digesters, and dark stains due to contact of iron-based metals with moist cedar.

Our chemists have also shown that brown stain on western hemlock, which caused concern for hemlock lumber exporters, was a harmless chemical stain due to hemlock extractives reacting with air. This stain can be completely removed by planing.

With increased use of alpine fir, it has become necessary to distinguish between this species and Amabilis fir. This is very difficult to do, even using microscopic techniques. However, Ehrlich's reagent reacts with extractives in alpine fir to give a positive colour separation.

Extractive chemistry even promises a means of combating insect infestations. Our chemists have isolated insect juvenile hormone analogues from several conifers which can control insect populations by retarding insect development, and preventing sexual maturity.

Wood Anatomy

The quality of wood for lumber, paper and other products depends largely on its physical structure, or anatomy. Microscopic examination of wood cell structure is frequently useful in explaining the behavior of wood under various conditions.

Dendrochronology, a division of wood anatomy, is concerned with annual ring formation in trees and how these relate to environmental influences. Ring width and specific gravity are particularly important.

An X-ray scanning machine, developed at the WFPL, produces radiographs of wood samples, which in turn are scanned by a computerized densitometer to produce ring width and ring density information. These density and ring width profiles are used to related tree growth to such things as silvicultural treatments, air pollution and climate; and even to date archaeological and geological events. We have recently used this technique to assess changes in radial growth and specific gravity resulting from fertilizing and thinning Douglas-fir stands.

Technology Transfer

No research is complete until the results have been implemented, so the WFPL Technology Transfer program, spearheaded by the Liaison

and Research Development group, has been given high priority.

Our technical enquiries service to the forest industry, provincial governments, wood users, and the general public, draws on the collective knowledge and experience of all WFPL staff, and the extensive collection of forest products literature in our library.

Specialized courses, demonstrations and lectures are held for groups from educational, research and industrial establishments. The kiln course for lumber dry kiln operators has been held since 1928.

Seminars are also held to inform specific clientele of research findings, and developments of current interest; and proceedings of these seminars are normally published.

Publications are an important means of communication, with about 35,000 distributed in 1975. Wood Research Notes summarizes our activities and lists recent publications. Distributed quarterly to a mailing list of 2500 people, it includes a simple system for ordering publications of interest. We will be glad to include your name on this mailing list upon request.

Some WFPL developments, such as the ribbed shears, slope of grain indicator, and borax veneer treatment, are patented in order to protect the Canadian taxpayer and to facilitate commercial development.

WFPL scientists also participate on 13 committees of the Canadian Standards Association, and 15 committees of the American Society for Testing and Materials. This gives us direct input into codes and standards governing the use of wood products for construction, housing and engineering purposes.

This function has been extended into participation in joint industry-government programs, such as membership on the Canada and Japan Housing Committee, intended to increase markets for Canadian lumber and plywood in Japan.

Conclusion

To maintain a relevant research program, we have worked closely with our clients, and have set up research program committees representative of the forest industry, wood users, and provincial governments, to advise us to research needs and priorities.

These RPCs cover six specific areas:

(1) Lumber and Shingles
(2) Panel Products
(3) Wood Preservation
(4) Wood Engineering
(5) Fibre Products
(6) Housing and Light Construction

Research problems you have identified can be brought forward for consideration either through your RPC representative, or by contacting us directly. Your participation, and the advice of these committees is

essential for a meaningful and problem-oriented approach to our program development. Through this co-operative approach to forest products research, we hope to achieve more efficient and effective use of our forest resource.