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Aspen Properties and Uses

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LAKE STATES ASPEN REPORT NO. 1

ASPEN PROPERTIES AND USES

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FOREWORD

During and since World War II, there has been increasing interest in aspen (Populus tremuloides) in the Lake States, its availability and supply, properties and uses, and management. Aspen is a tree of primary importance in 20 million acres or 40 percent of the total forest area of the three Lake States - Michigan, Minnesota, and Wisconsin.

At an informal meeting at Madison, Wisconsin, in January, 1947, forestry representatives of several federal, state, and industrial groups in the Lake States agreed that it would be desirable to bring up-to-date what is known on aspen and make it available to anyone interested. The job of preparing this information in the form of reports was assigned to each of the groups listed below. The reports will be duplicated as rapidly as completed, and the entire project should be finished by the end of 1947. Each report will concern one aspect of the subject. Copies will be available from the Lake States Forest Experiment Station or from each contributor.

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AGRICULTURE - MADISON

REPORT NO. 1

ASPEN PROPERTIES AND USES

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Because of the large demand for lumber during the last 10 years, and particularly during the war period, aspen has entered many new fields of use. At present there is widespread interest in the possibilities of building new industries and extending the life of old ones by increased use of aspen. Many people are interested in becoming familiar with this wood. This report has been prepared to give general information on the properties and present uses of aspen and also to help in correcting some of the existing erroneous ideas about this wood.

PROPERTIES AND CHARACTERISTICS

Factors such as cost, poor manufacture, poor marketing, and a tendency to underrate the wood have retarded earlier use of aspen and have aided in giving it a somewhat unfavorable reputation. The recent increase in the use of aspen came about largely through its availability rather than recognition of wood properties. The fact that aspen is put to uses for boxes, crates, matches, core stock, excelsior, and wood pulp indicates that it has many characteristics of merit. Although there is a new appreciation of the worth of aspen, lack of knowledge about the wood, prejudice, and poor quality production still continue to hold back its use.

Some of the important characteristics and properties of aspen are reviewed here in brief.

Texture and Working Qualities

The wood of aspen has a fine, uniform texture, with indistinct grain markings. It is soft and is an easy wood to work. Uniform texture and absence of the tendency to raised grain makes aspen fairly easy to finish to a smooth surface. Although aspen dresses to a smooth surface under favorable conditions, the wood, particularly when wet, has a tendency to fuzz when dressed. In ease of working and character of surface obtainable, the clear wood of aspen is somewhat similar to basswood and yellow poplar, which are favorably known for their working qualities. Because of small size and more numerous knots, an average run of aspen lumber may not surface as well as an average run of basswood and yellow poplar lumber. Aspen has possibilities in uses where ease of working is an important requirement. The use of aspen in the manufacture of matches, toys, shoe-pegs, clothespins, core stock, and novelties speaks for its good working qualities.

1/ Maintained by the U. S. Department of Agriculture, Forest Service, in cooperation with the University of Minnesota, University Farm, St. Paul 1, Minnesota.

Color and Odor

As a rule the wood of aspen, both heartwood and sapwood, is practically white. The inner part of aspen logs is frequently discolored to a pale salmon brown. Some of the discoloration is due to the early or brown stain stage of the common aspen heart rot. However, aspen often contains brownish wood that resembles heartwood which does not appear to be due to or associated with decay. The wood around knots is often colored, which contrasts strongly with the white wood and at a casual glance makes knots appear much larger than they are. The source of the dark color of wood around knots and in the center of the tree that is not associated with rot is not known.

The cottonwoods, balsam poplar, and basswood are other light-colored woods with which aspen is occasionally confused. The heartwood of aspen is white, whereas that of the cottonwoods and balsam poplar is pale gray or grayish brown. Basswood has a brownish cast.

Light-colored or white woods are preferred for a number of uses, such as food containers, matches, and excelsior.

Aspen wood is practically tasteless and odorless. It can be used with safety in food containers since it does not impart taste or odor to foodstuffs.

Aspen wood should not be confused with that of balm of Gilead. Carelessness at the sawmill resulting in the inclusion of "balm" in shipments of aspen has at times given aspen a bad repute. "Balm" is odorous and when used for food packaging will taint the food. Producers of aspen lumber can seriously injure their own business by carelessness in this regard.

Weight of Aspen

Aspen is one of the hardwoods of light weight. In a thoroughly air-dried condition (12 percent moisture content), aspen weighs on the average 26 pounds per cubic foot. One thousand board feet of nominal size, dry aspen lumber will weigh approximately 2,170 pounds. Similar amounts of other woods weigh as follows: basswood - about 2,170 pounds; eastern cottonwood - 2,330 pounds; sugar (hard) maple - about 3,670 pounds.

The light weight of aspen makes it desirable in containers, toys, excelsior, and furniture. Aspen is well adapted to uses where lightness is more important than strength and where a combination of strength and lightness is desired.

Structure of Aspen

Since aspen belongs to the hardwood, or broad-leaved class of trees, the wood has numerous pores (vessels) scattered among the fibers. The pores are very small, however, being barely visible with the unaided eye under the best of conditions of a smooth transverse cut and good light. They are slightly smaller than in cottonwood, in which they are more readily

visible. The pores are fairly uniform in size throughout the annual ring, although they become slightly smaller toward the end of the growing season; hence, the annual rings are distinctly but not conspicuously defined. The rays are extremely low and narrow, being only one cell wide. The small pores, their uniform distribution, and inconspicuous annual rings and rays all help to make aspen highly uniform in texture and appearance, characteristics which enhance its value for special uses.

Nail-holding Power and Gluing

Although aspen is rated comparatively low in nail-holding power, it has a low tendency to split in nailing. Tests made by the Forest Products Laboratory showed that aspen boxes stood more rough handling than boxes of a number of species with higher nail-holding power. The small tendency of aspen to split at the nails was apparently sufficient to more than compensate for its lower nail-holding power.

Glued joints that are as strong as the wood itself are easily obtained with aspen. Such joints are readily made with any good wood-working glue under good gluing conditions. Tests at the Forest Products Laboratory of joints made with animal, casein, and starch glues resulted in an average joint shear strength of 1,725 pounds per square inch. These tests also showed that aspen is one of the easiest species of wood to glue. The good gluing characteristics of aspen, along with other favorable properties, adapt it to use for core stock and other glued wood products.

Seasoning

Aspen lumber can be seasoned satisfactorily by air-drying and kiln-drying. Recent tests made at the Forest Products Laboratory indicate that the sound white wood of aspen can be dried successfully under severe kiln conditions; however, difficulty has been experienced in the drying of discolored heartwood and the brown areas bordering natural defects without collapse or checking. Kiln-drying of aspen usually is necessary where it goes into factory uses.

Decay Resistance

Both the heartwood and the sapwood of aspen are low in decay resistance. Untreated aspen posts or lumber in contact with the soil may last only two or three years. However, aspen treated with preservatives has given more than 15 years' use under damp conditions. Where aspen is used in contact with the ground it should be treated with a preservative. In treating, some difficulty was experienced in getting it to take a uniform preservative treatment. This is particularly true of posts and other round material and less for aspen lumber, sawn ties, and bridge planking, which appear to treat more satisfactorily.

Painting Qualities

Tests by the Forest Products Laboratory show that aspen holds outside house paint as well as yellow poplar, magnolia, and cottonwood. All of these woods are classed for painting in Group III, together with such

softwoods as ponderosa pine, the spruces, the true firs, and the hemlocks. None of the hardwoods ranks any higher for such painting. Sound knots in aspen, as in other woods, require careful application of good priming paint to keep finish coats from drying without gloss over the knots, but knots do not discolor paint. Brown streaks in aspen can be covered by applying coatings of good paint or enamel in adequate thickness. Aspen can be stained with any of the types of stain commonly used in wood finishing, but the grain of the wood lacks sufficient character to make stain and varnish or stain and lacquer finishes particularly attractive for large surfaces.

Size of Aspen

Aspen is a small-sized tree and therefore can produce only a limited amount of wide, clear lumber. Because of the tree size, most of the aspen lumber produced is in 100-inch lengths. This factor permits only a small percentage of long cuttings for factory use and holds little promise for construction lumber users.

UTILIZATION OF ASPEN

Lumber

There are drawbacks which prevent the use of aspen in large manufacturing concerns. Producers are not able to guarantee a large volume of material over a specified time. Most of the aspen lumber produced has been poorly manufactured by small portable mills. There has been almost a complete lack of grading aspen lumber under the standard grading rules. The major portion of aspen lumber is produced in 100-inch lengths. Very little effort has been exerted to market this lumber properly. A correction of these faults will facilitate the further use of aspen.

The following table gives the production of aspen lumber in the Lake States during the last 6 years.

State	1941	1942	1943	1944	1945	1946
			(In million board feet)			
Minnesota	43.7	58.0	53.8	59.9	51.0	68.4
Michigan	8.6	14.6	17.9	28.9	21.3	26.6
Wisconsin	14.6	37.7	25.7	34.9	34.6	57.3
Total	66.9	110.3	97.4	123.7	106.9	152.3
Percent of total Lake States Lumber Production	5.5	8.8	9.8	10.0	10.4	12.0

A review of the 1945 Lake States aspen lumber production data indicates that the lumber produced during that year was used approximately as follows: 80 million board feet or 75 percent for boxes and crating, 15 million board feet or 14 percent for building purposes, mainly on farms and in rural areas, 8 million board feet or 8 percent for core stock material, 2 million board feet or 1.5 percent for furniture, and 2 million board feet or 1.5 percent for novelties, woodenware, venetial blinds, etc.

Building Uses

A recent survey by the Forestry Department of the University of Minnesota shows that aspen lumber as a building material has been used in Minnesota since about 1916. On farms it has been successfully used in barns, granaries, machine sheds, etc., as rafters, stringers, studding, sheathing, shiplap, and flooring. It was also found that aspen lumber has frequently been used in home construction in small villages and has given good service. Properly manufactured and seasoned, aspen lumber is now being used successfully in small home construction and repair. Aspen lumber has some weaknesses which will hinder its use as construction lumber. The small size of aspen logs limits production of lumber in sizes generally demanded by the building industry. Aspen lumber is subject to rapid decay when used in contact with the soil or in damp places where moisture may accumulate in joints. This weakness can be retarded through use of preservative treatment; however, the best precaution is not to use it where it will be subject to moisture or damp conditions. The Minnesota State Highway Department has been using creosoted aspen planking for wearing courses on some of their bridges. It is reported that this planking wears well under highway traffic.

Interior Trim and Finish

Aspen lumber manufactured into molding for interior trim has been used and well accepted by lumber dealers, contractors, and carpenters who have used it. Its resistance to splitting in nailing, lack of resin, ease of working, and suitability to painting and enameling make aspen a desirable wood for interior trim.

Boxes and Crating

The largest present-day use of aspen lumber is in the manufacture of boxes and crating. Here it meets the necessary specifications for container material and often proves to be a relatively low cost wood when compared with other native woods. For a wood of light weight it has good strength and can withstand rough handling. The white wood gives it a clean appearance. It has practically no taste or odor which makes it desirable for containers for meat, fish, butter, cheese, and fruits. Its smooth-wearing qualities make it applicable in re-use boxes where low weight also is a factor, such as beverage cases, bread boxes, and other delivery boxes. Slat crates for shipment of various types of industrial products are made from aspen.

Aspen had an enormous expansion as a box material during the war. Its favorable box-making qualities became known and tested. As a result, many users are now showing a preference for aspen boxes over other woods. The continued large-scale use of aspen for boxes will depend on volume production at a low cost, particularly in competition with good quality western woods.

Core stock

The use of aspen as a core stock for doors, paneling, and furniture has increased rapidly in the past two years. The ability of aspen to take and hold glue, to stay in place, its lack of resin, ease of working, and

light weight contribute to make it a satisfactory core stock material.

One large manufacturing concern in Wisconsin is now using large volumes of aspen as a core stock for doors and paneling. A concern in Minnesota operates a sawmill and wood-working plant for the production of core stock. Furniture companies in Michigan and Wisconsin are using aspen core stock successfully in their production.

Furniture

Furniture manufacturers have used aspen in their industry for shelving, backs, dust separators, and juvenile and painted furniture. A few sawmill operators have been sorting out their good grade aspen lumber to supply the demand of a few manufacturers. Further use of aspen in this field will depend on producers guaranteeing a large volume over a speci fied time, and on manufacturers getting acquainted with and learning to use this wood.

Venetian Blinds

Venetian blind and porch shade manufacturers have used aspen successfully as rails and headers. A few have worked it into venetian blind and porch shade slats. Further use in this field will depend on the amount of high grade and long lengths of aspen which will be available.

Pulp and Paper

The best possibilities for large-scale aspen utilization are in the pulpwood field. The prospect of a serious shortage of wood pulp during the war years gave aspen its greatest impetus for this market. The large amount of aspen in the Lake States offers a possible solution to the raw material problem for some of the mills in this area.

Aspen can be readily pulped by any of the standard chemical or mechanical processes. In the sulphite process it is readily pulped alone or mixed with softwoods. Here the pulp yield varies from 48 to 54 percent by weight or from about 720 to 1,170 pounds per cord. The unbleached aspen pulp is of excellent color and can be bleached readily to a high white color. It is not as strong as pulp made from softwoods but it has characteristics such as opacity, bulk, and softness which are responsible for its use in book, tissue, and specialty papers.

The sulphate and soda processes produce an easily bleached aspen pulp and give yields of from 45 to 55 percent by weight or from about 675 to 825 pounds per cord. These processes, however, are applicable to all North American hardwoods, as well as corn stalks and other material. Mills producing soda pulp are located largely outside the Lake States.

The ground-wood process was first employed with aspen. Spruce, however, has largely supplanted aspen in the production of ground wood pulp because it gives a pulp of greater strength and better felting properties for a given expenditure of energy per ton. Aspen ground-wood pulp is light-colored.

The paper manufacturing industry has made great progress in improving the strength of papers made from short-fibered pulp from aspen and other hardwoods through variations in processing and the use of adhesives and resins. These developments indicate the possibilities for increased aspen utilization in the paper and pulp industry. One of the main drawbacks in the use of aspen for the higher grade pulps is that it is required to be peeled before delivery. This is almost universally a hand job and seasonal, though there has been some recent progress in developing power peeling machines.

The mills in northern Minnesota manufacturing insulation and other building boards are using aspen as the main ingredient in their product. Recent expansion at one of these mills and the present need for housing assure a good demand for aspen pulpwood in Minnesota.

Aspen wood fiber is now being prepared in the Lake States by a mechanical defiberizing process. This product is being used as part of the fibrous composition of saturating felt for impregnation with asphalt, for roofing, siding, and similar building products. Several additional installations of defiberizing equipment are planned which indicate a probable increase in demand for aspen.

The volume of aspen used for pulping purposes in the Lake States during the past 25 years and the percentage this represents of all the woods used is shown in the following table:

Year	Aspen Used (Thousands of cords)	Proportion of all species used (Percent)
1920	3	0.2
1925	19	1.0
1930	67	4.0
1935	63	4.0
1940	174	9.0
1941	281	13.0
1942	401	17.0
1943	417	18.0
1944	439	18.4

Excelsior

Aspen, because of its toughness, light color, light weight, and freedom from odor, makes an excellent excelsior wood. In years past, basswood was the principal species used for this purpose, but because of scarcity and high prices aspen is rapidly replacing it.

In 1944, about 70,000 cords of wood were used in the manufacture of excelsior in the Lake States, the bulk of which was aspen.

Excelsior is an excellent outlet for the utilization of aspen as it can make use of relatively small-size material.

Railroad Ties

Aspen railroad tie production in the Lake States during 1944 amounted to 300,000 ties. This was 7.3 percent of the total production in this area.

Railroads have been testing treated aspen ties in spur lines for more than 15 years. Reports indicate that they have given good service. However, it is unlikely that aspen will become a major tie species. The amount of aspen that grows to tie size is limited and is in demand for other uses. In treating, some difficulty was experienced in getting aspen to take a uniform preservative treatment even under pressure. One plant indicated that under normal tie handling aspen deteriorated rapidly while in storage for seasoning.

Veneer

Aspen veneer has been cut on a commercial basis for some time. One factory in Minnesota uses aspen veneer in the manufacture of matches. Other factories in the Lake States use it in egg cases, cheese boxes, and other veneer containers. In general, aspen has cutting qualities for veneer similar to those of basswood and cottonwood.

Aspen veneer requires the larger size aspen trees which are found on the good sites. Occasional large aspen logs have been known to be accepted by conventional veneer mills for the same purpose as basswood.

Toys and Novelties

Location of markets and wood supply determine the use of aspen in the manufacture of toys and novelties as well as the technical properties of the wood. At present, aspen is used to some extent in such items as clothespins, swab sticks, spools, skewers, etc. The properties of aspen such as light weight, ease of working, white color, and smooth finish make it a desirable wood for this use.

Fence Posts, Cabin Logs

Aspen in the round or log form has been used where it grows for such items as cabin logs and fence posts. The average life of untreated fence posts is from 2 to 6 years, depending upon locality, soil condition, and size of timber. Aspen treated with preservative put to these uses can give good service.

Pressure treated aspen fence posts in test plots put out by the Forest Products Laboratory in cooperation with the University of Wisconsin, were in good condition after more than 15 years of service. Several less expensive methods of treating aspen fence posts are being tested by both the Forest Products Laboratory and the University of Minnesota. One concern in Minnesota is now exploring the possibilities of large-scale production of pressure-treated aspen fence posts.

Many log cabins of aspen, both of round and split log style, have been built in the recreation areas of the Lake States. Those who constructed

these cabins so that the untreated logs are not placed in contact with the soil or allowed to accumulate moisture in joints or cracks reported very good structures. Small shrinkage and lack of checking are favorable characteristics of aspen for log cabin construction.

Fuelwood

Aspen is used as fuelwood only when the more desirable hardwood species are not available. In heat value aspen rates below such woods as birch, maple, oak, and jack pine. Many of the residents in the forest areas who use wood in the summer for cook stoves prefer seasoned aspen to the other hardwoods because it is a fast-burning fuel and produces a good cooking fire without heating up the home too much.

FUTURE RESEARCH NEED ON ASPEN WOOD

To encourage its use, cooperative efforts are necessary to develop low-cost and profitable production methods. This includes the logging, transporting, and milling phases. The drain on the aspen forest will most likely continue to be heaviest on the limited quantity of high-grade material. More consideration must be given to the potential use of the large acreage of medium and low-quality stands.

Aspen will have to be graded and handled as carefully as other hardwoods to get the proper utilization of this species. The preservative treating qualities of aspen should be further investigated to overcome the difficulties that have been experienced in obtaining uniform penetration, which is necessary to insure long service life.

It is known that aspen is an easy wood to work, yet the machining of aspen to a smooth surface is not always possible. Studies to determine the conditions under which aspen machines best are desirable.

Aspen has characteristics that make it suitable for many uses, but certain of these properties need further study before the wood can be adapted to some of the more exacting and profitable uses. A variability survey is desirable to determine the variations in size, taper, knottiness, straightness of trunks and grain, decay infection, and specific gravity of the wood as influenced by site, stand density, and age to facilitate selection of material for other tests and special uses, and as a guide in forest management.

The wood-using industries can contribute substantially to the utilization of aspen by trying small shipments of aspen in products for which aspen might be suitable. New markets for little-used woods such as aspen would be advantageous to the lumber consumers, to the lumber producers, and to the forest owners.

Research agencies and educational institutions can participate and cooperate in trade extension activities by analyzing the problem confronting the wood-using industries and interpreting their needs in the light of known facts concerning the properties of various woods.