U. S. DEPARTMENT OF COMMERCE
R. P. LAMONT, Secretary
BUREAU OF STANDARDS
GEORGE K. BURGESS, Director

MISCELLANEOUS PUBLICATION, BUREAU OF STANDARDS, No. 132

PROPERTIES OF FIBER BUILDING BOARDS

By

C. G. WEBER
F. T. CARSON
L. W. SNYDER

December 1, 1931

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1931

For sale by the Superintendent of Documents, Washington, D. C. - - - Price 5 cents

PROPERTIES OF FIBER BUILDING BOARDS

By C. G. Weber, F. T. Carson, and L. W. Snyder

Wall boards and insulating boards, the two principal classes of fiber building boards, have been studied at the bureau to obtain information relative to the properties of these important building materials.

Tests were made on 15 samples of wall boards and 8 samples of insulating boards, representative of the commercial products in common usage. Weight, thickness, density, strength, absorption of moisture, and changes in dimension with changes in moisture content were studied. Special apparatus was developed for determining the strength and for indicating changes in dimension with changes in moisture content. Some discussion of heat insulation, air infiltration, and susceptibility to molds is included.

There was no marked difference in the strength of the different boards studied. The average thickness of wall boards was less than that of insulating boards, but the density of the wall boards was greater and the strength was approximately the same for both classes. There were no marked differences as regards absorption of moisture or changes in dimension with changes in moisture content, except that the crosswise expansion of the laminated or built-up boards was greater than that of homogeneous or 1-piece boards. The difference in thermal conductivity between the various insulating boards has been found by previous work at the bureau to be small, and the average wall boards are so thin and of such density as to be considered of relatively much smaller value as heat insulators.

The results of laboratory tests of the various boards are tabulated, the test methods used are described, and the different properties considered important are discussed in detail.

CONTENTS

I. INTRODUCTION

Fiber building boards have recently assumed a position of importance among the materials used in the building industry, especially in connection with house construction and remodeling.

While such boards are usually thought of as lumber substitutes, they are in reality manufactured lumber designed for specific applications in building construction. There are two classes of boards in general use, namely, wall boards and insulating boards. Wall boards are manufactured for use as wall, ceiling, and partition finish on the interiors of buildings, while insulating boards are made primarily for use as heat insulation within walls, partitions, and roofs of buildings. Insulating boards may have a surface suitable for interior finish and so serve a double purpose, and wall boards may be so constructed as to have good insulating value. The two classes, therefore, apparently overlap to some extent.

Although both classes of fiber building boards are widely used and the manufacture of these products has become a very important industry,[1] little published information on their properties has been available. Both classes of boards have been studied in the paper section of the National Bureau of Standards for the purpose of obtaining definite information as to their properties other than insulating. The tests herein reported were made over a period of years, and some of the information has already been published in an article on fiber wall boards.[2] The fiber building boards are rather recent developments. Wall board found its first extensive use during the late World War when, because of its comparatively low cost and the ease and speed of application possible, it was used very extensively in cantonment and other war-time construction. Fiber insulating board has come into extensive use during the past decade.

II. DESCRIPTION OF FIBER BUILDING BOARDS

1. TYPES IN COMMON USE

There are two definite types of fiber building boards. One type is a laminated product that consists of several sheets of thin fiber board laminated or pasted together with an adhesive. The other type is a homogeneous board which is a 1-piece product. The wall boards are nearly all of the laminated type, and boards manufactured primarily for heat insulation are of the homogeneous type. The laminated boards are generally of much higher density than the homogeneous boards used for insulation and for that reason, are usually of greater strength in proportion to thickness. The homogeneous insulating boards, being of much lower density, contain a proportionally greater number of dead air spaces. By reason of these properties, a large proportion of the boards intended for use as wall boards are of the laminated type and those intended for use for insulating purposes are of the homogeneous type.

2. FIBROUS RAW MATERIALS

Low-grade vegetable fibers are largely used in the manufacture of both wall boards and insulating boards. Such boards were formerly made almost exclusively from ground wood pulp, and some

---

[1] O. R. Sweeney and W. E. Emley, Manufacture of Insulating Board from Cornstalks, B. S. Misc. Pub. No. 112.

[2] B. W. Scribner and F. T. Carson, A Study of Fiber Wall Boards for Developing Specification Standards, Paper Trade J., Sept. 26, 1929.

well-known boards are still made principally of this material. Ground wood pulp, as the name implies, is wood (usually spruce or fir) which has been reduced to a pulp by contact with a revolving abrasive stone. Such pulp contains all of the materials present in the original wood. Some boards contain chemical wood pulp in mixture with ground wood, and some boards are made from waste, such as newspapers, composed largely of ground wood and chemical wood fibers. Chemical wood pulp is prepared by cooking wood by a chemical process to remove the noncellulose material, hence the fibers composing the boards made from ground wood pulp, from old papers, and from combinations of these materials are essentially the same. Recently, there has been an increasing use of fibers other than wood, especially fibers from waste plant materials. Among the samples studied were boards composed of fibers from bagasse [3] (extracted sugar cane), straw,[4] cornstalk,[5] licorice roots, and sawmill waste.

3. MANUFACTURE

The two types of boards (laminated and homogeneous) are made by radically different processes. The laminated board is made by pasting together three or more sheets (usually four) that have been made on ordinary cylinder paper board machines, while homogeneous board is formed in one continuous sheet of the desired thickness on a screenlike cylinder or is molded in sheets under pressure in steam-heated platens. Both types are dried in ovenlike dryers on which careful control is maintained to bring the board to a predetermined moisture content. Water resistance is produced in most boards by incorporating rosin size before forming the board, and in addition to this "internal sizing" some boards are given surface treatments with paints, gums, oils, or waxes to further increase the water resistance. Some of the laminated boards have outside plies that have been given special sizing treatments and some have outside plies of better quality than the center plies to improve the appearance and facilitate decorating. In some cases, the boards have a "liner" consisting of a sheet of paper of better quality than the board itself pasted on one or both sides of the board. This is done to improve the appearance and to reduce the air permeability.

4. USES

In addition to the conventional uses as a finishing cover for interior walls, ceilings, and partitions (wall board), and for heat insulation in walls and roofs of buildings (insulating boards), fiber boards, especially the homogeneous type, are used for a variety of purposes, such as a base for inside plaster and outside stucco, for sound deadening, and for the improvement of acoustics in auditoriums, radio broadcasting studios, etc.

---

[3] Hind, Celotex and the Man Behind It, Sugar Central and Planters News, vol. 7, No. 1; 1926.

[4] Gibson, Insulating Board from Straw, Ind. and Eng. Chem., vol. 22, p. 223; March, 1930.

[5] Sweeney and Emley, Manufacture of Insulating Board from Cornstalks, B. S. Misc. Pub. No. 112.

III. PREVIOUS BUREAU RESEARCH

On account of the necessity of purchasing enormous quantities of wall boards for use in temporary structures during the World War, the War Department requested the National Bureau of Standards in 1917 to find what type of wall board was best suited for the purpose and to develop suitable purchase specifications. This led to an extensive study of wall board by Clark and Conley.[6] The following abstract of the article is given, as it contains much valuable information and is no longer available for distribution:

Nine different fiber wall boards and two plaster boards were studied. Tests were made of weight, bursting strength, thickness, ash content, thermal conductivity, and absorption of moisture. The last-named property was tested by immersing a specimen in water and by noting the time of absorption of a drop of water placed on the surface of the board. The conclusions reached were: The relative thermal conductivity of fiber boards is of little importance as the boards studied showed no marked differences; the same is true of combustibility; rosin sizing distributed through the board is considered essential for protection against warping; surface sizing is considered unimportant; sodium silicate is thought to be inferior to starch as the adhesive for laminated boards, for the alkalinity of the former is injurious to rosin sizing; plaster board is deemed superior to fiber board for hospitals, owing to its sanitary and fire-resistant character; fiber wall board is considered superior to plaster board for general use owing to the greater ease of applying it and the small loss due to breakage.

When this pioneer investigation was initiated, it was found that most of the boards on the market were deficient in interior sizing. The incorporation of rosin sizing in the paper stock was not generally practiced at that time. Most of the manufacturers depended on surface sizing only. It was found that nothing but a water-resistant material incorporated throughout the board would give satisfactory moisture resistance. Several manufacturers were induced to increase the degree of sizing in their products. So treated, their products were found by actual usage tests to warp much less than the products made by the procedure then current. The present standard commercial practice of adequate rosin sizing resulted largely from this initial development work.

IV. SAMPLES USED IN STUDIES

Fifteen samples of commercial wall boards and eight samples of commercial insulating boards were obtained from manufacturers. Thirteen of the fifteen wall boards were of the laminated type and all of the insulating boards were of the one piece or homogeneous type. One sample of gypsum board was included for comparative purposes. With the exception of this one sample, all of the boards were vegetable fiber products and the samples were representative of the various types of wall boards and insulating boards in current use.

V. PROPERTIES STUDIED AND TEST METHODS USED

The properties considered important as regards usage of the boards appear to be strength, moisture absorption, and dimensional changes,

---

[6] F. C. Clark and A. D. Conley, Study of Commercial Wall Boards, Paper, vol. 25, No. 23; Feb. 11, 1920.

and in the case of insulating boards, insulating value. The results of tests to determine the properties of the samples (other than insulation) are given in Table 1 (wall boards) and Table 2 (insulating boards). The tests for the two classes of boards were made at different times and the tests applied were not quite the same in both cases. The preconditioning of the boards listed in Table 2 was accomplished by exposing the specimens for 72 hours in a cabinet at a relative humidity of approximately 32 per cent. Most of the samples listed in Table 1 were preconditioned at a relative humidity of about 25 per cent by exposure to the atmosphere of the laboratory during cool weather. A few, tested during the earlier experiments and during the warmer months, were conditioned at about 50 per cent humidity.

TABLE 1.—*Some properties of fiber wall boards*

Bureau of Standards No.	Density	Weight of 1,000 square feet	Thickness	72 hours in saturated water vapor		30 minutes immersion in water at 75° F.		Time for absorption of 0.1 cm³ water on surface		Flexural [1] strength, rupturing load—		Bursting strength
				Increase in weight	Expansion, crosswise	Increase in weight	Expansion, crosswise	Front	Back	Lengthwise	Crosswise	
	g/cm³	Lbs.	Inch	P. ct.	P. ct.	P. ct.	P. ct.	Hours	Hours	Lbs.	Lbs.	Lbs. [2]
5120	0.75	618	0.16	9	0.70	88	0.65	7+	0.8	9.4	4.9	443
5121	.75	552	.14	10	.75	95	1.00	2.3	2.3	9.4	5.4	392
5122	.60	572	.18	12	.75	92	.65	6.5	6.5	12.0	7.3	357
5123	.55	547	.19	------	------	46	------	7+	6.5	12.2	7.4	291
5124	.60	548	.18	13	.55	46	------	7+	6.5	11.4	7.0	316
5125	.60	587	.18	10	.60	67	.40	6.0	6.0	15.0	9.0	389
5126	.65	529	.16	------	------	40	------	7+	7+	10.2	5.5	345
5127	.55	487	.17	11	.60	27	------	7+	6.8	15.9	8.5	381
5128	.50	477	.18	13	.55	43	.65	7+	7+	11.3	7.4	224
5129	.50	677	.27	14	.50	38	.90	7.0	6.8	25.0	15.4	353
5405	.55	550	.19	------	------	34	------	5.8	5.8	15.3	8.6	342
5406	.55	680	.25	13	.45	46	------	5.8	5.8	26.1	13.0	458
5733	.55	565	.20	13	.65	62	.40	6.5	6.8	15.1	8.3	334
5666	.65	1,112+	.37	------	.30	------	------	6.5	6.5	44.9	35.4	600+
6029	.26	617	.45	------	.36	------	------	6.3	6.3	10.6	10.6	333
XX [3]	.95	1,843	.38	3	.11	------	------	------	------	------	------	------
Average [4]	.57	608	.22	11.8	.56	55.7	.66	6.3	5.8	16.3	10.2	370

[1] Rupturing load at midspan of a specimen 3 inches wide laid flatwise on parallel supports spaced 12 inches apart.
[2] Approximately pounds per square inch.
[3] Gypsum plaster board (nonfibrous).
[4] Exclusive of data for the last board (nonfibrous).

TABLE 2.—*Some properties of fiber insulating boards*

Bureau of Standards No.	Density at 32 per cent R. H.	Weight at 32 per cent R. H. (1,000 square feet)	Thickness at 32 per cent R. H.	72 hours in saturated water vapor: Increase in weight	Expansion: Width of board	Expansion: Thickness of board	Flexural strength: Rupturing load [1]: Lengthwise	Rupturing load [1]: Crosswise	Deflection at rupture: Lengthwise	Deflection at rupture: Crosswise
	g/cm³	*Pounds*	*Inch*	*Per cent*	*Per cent*	*Per cent*	*Pounds*	*Pounds*	*Inch*	*Inch*
311001	0.34	806	0.45	10	0.25	6	13.4	12.2	0.70	0.80
311002	.26	603	.44	14	[2].25	5	9.8	9.5	.65	.80
311003	.29	687	.45	16	.40	7	17.2	13.4	.70	.80
311004	.32	745	.45	12	.55	6	13.3	9.2	.70	.80
311005	.22	595	.44	15	.45	6	12.8	10.0	.60	.70
414031	.27	626	.44	18	.55	--------	14.6	14.2	.50	.60
311006	.37	918	.49	13	.40	6	24.8	24.0	.65	.65
311007	.28	711	.49	14	.50	7	7.0	6.2	.60	.70
Average	.29	711	.46	14	.42	6	14.1	12.3	.64	.73

[1] Rupturing load at midspan of a specimen 3 inches wide laid flatwise on parallel supports spaced 12 inches apart.
[2] Expansion of this board rather variable, 0.20 to 0.35 per cent.

1. STRENGTH

All structural work involves the question of strength. Although the application of fiber boards adds materially to the rigidity of the structure of which they are component parts, it appears that a board strong enough to permit easy handling of large sheets incident to their erection will have sufficient strength for ordinary structural requirements. Since the resistance to flexural breaking is the property most essential in the economical handling of such boards, the samples were tested for flexural strength.

The flexural-strength test is commonly made by supporting a specimen of material on two parallel knife-edges placed some distance apart and applying a load to the specimen at midspan through a third knife-edge parallel to the other two. In testing fiber boards, it was found that small iron rods or pipes were more satisfactory than knife-edges and three-fourths inch pipes were used. The distance between the supports was 12 inches, the test specimens being 3 by 18 inches. The apparatus is illustrated in Figure 1, clamp *A* being securely fastened in the upper jaw of a breaking-strength tester and clamp *B* in the lower or loading jaw. Clamp *B* must be so adjusted as to be parallel to the line of movement of the lower jaw, and the instrument reading must be corrected for the weight of the device. A point is marked on the specimen equidistant from its ends and the specimen is so placed that this point is under the center of the rod in the lower clamp. The method and rate of loading are the same as outlined in the standard method for determining tensile breaking strength.[7] If a suitable tensile testing machine is not available, the test may be made using the form of apparatus illustrated in Figure 2. In using this apparatus, the load is

[7] Paper-Testing Methods, Lockwood Trade J. Co., 10 East Thirty-ninth Street, New York, N. Y.

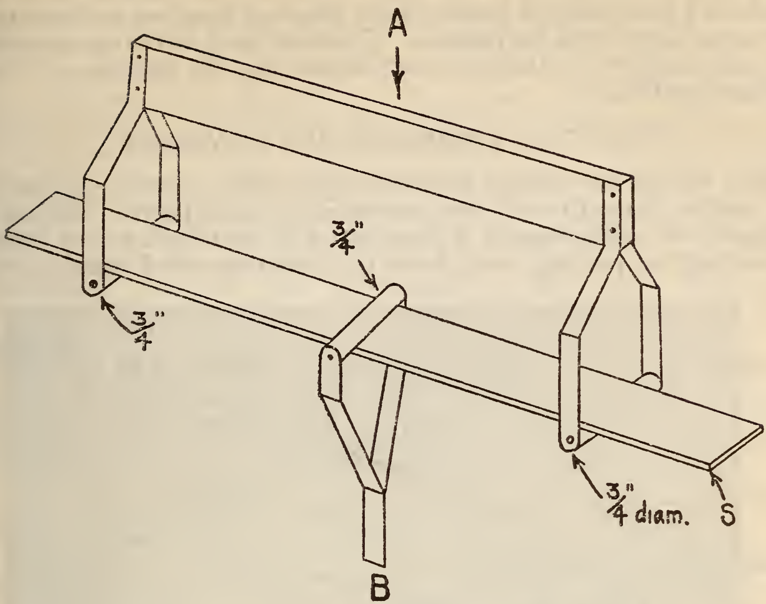

FIGURE 1.—*Flexural strength apparatus for use with tensile test machine*

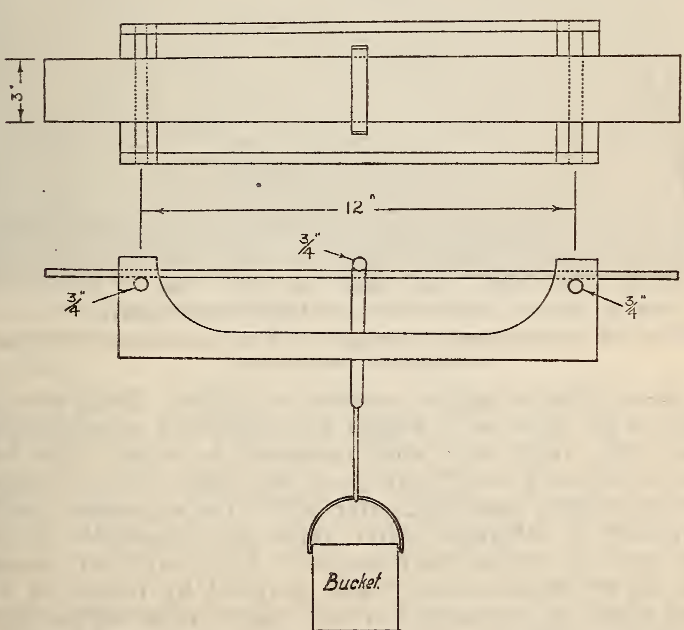

FIGURE 2.—*Flexural strength apparatus for using shot bucket*

applied by adding shot to the bucket at a slow, uniform rate of speed until the specimen breaks, when the load required to break the specimen is recorded in pounds. Thickness and bursting strength were obtained with standard instruments and in accordance with standard methods.[7]

2. MOISTURE ABSORPTION AND EXPANSION

Fiber boards are subject to dimensional changes with changes in the relative humidity of the surrounding atmosphere. Excessive expansion or contraction of a board after its installation may result in buckling or pulling away from its fastenings, and consequently

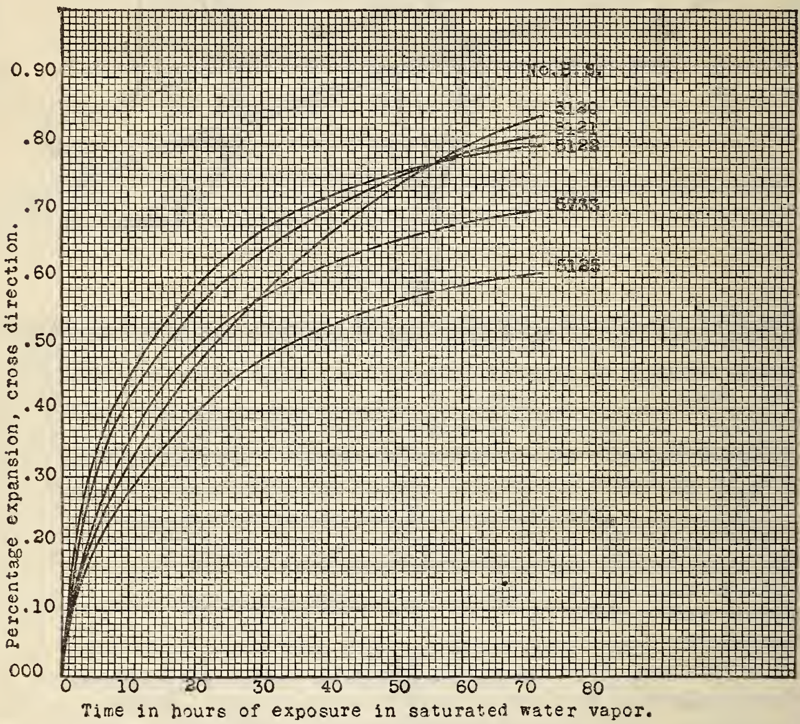

FIGURE 3.—*Some typical curves showing the rate of expansion of wall boards in saturated water vapor*

the boards are sized to impart moisture resistance. Tests were made to determine the increase in weight and expansion when exposed to saturated water vapor and when immersed in water. The boards were first conditioned for 72 hours in an atmosphere of approximately 30 per cent relative humidity, after which the expansion resulting from exposure to saturated water vapor and immersion in water for given periods of time was measured. For preliminary measurements, a set of extensometers[8] was designed by means of which expansion could be determined at any time without disturbing the specimens. (See fig. 4.) A separate unit was provided for each

[7] Paper-Testing Methods, Lockwood Trade J. Co., 10 East Thirty-ninth Street, New York, N. Y.
[8] Suggested by P. W. Codwise, Beaver Products Co.

specimen, B, and several units were placed side by side, each specimen resting on one long edge. Each extensometer served not only its primary purpose of indicating the expansion of a specimen, but also as a spacer and guide for the next specimen. The extensometer consisted of a metal frame, F, at one end of which was a pointed lever L. The shorter arm of the lever bore against one end of the specimen and the longer arm served as a pointer as it moved along the scale, S. The scale was graduated directly in percentage of a definite length to which the specimen was cut. By means of a second lever, K, at the opposite end of the specimen, the reading could be made zero at the start of a test. After the procedure was established, expansion was determined by the simpler method of measuring the distance between reference marks before and after exposure.

The rate of absorption was determined in two different ways—by increase in weight after immersion in water for a definite period of time and by the time required for complete absorption of a measured quantity of water on each side of the board. The time required for

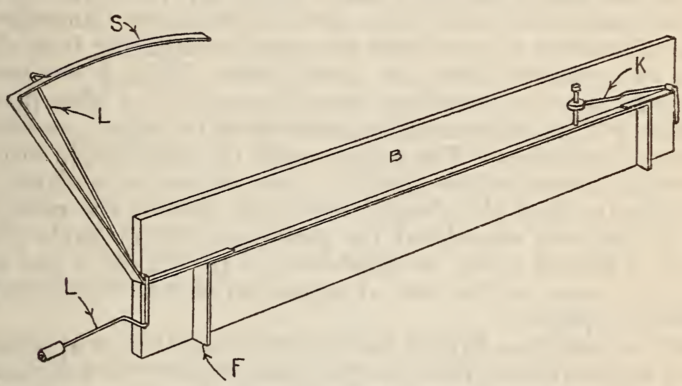

FIGURE 4.—*Extensometer*

absorption of a measured quantity of water was obtained by measuring onto the surface of the board 0.1 ml of water and noting the time required for complete absorption of the water as indicated by no further reflection of light from it. The side designated in the tables as "front" is the side apparently designed to be exposed on erection.

The connection between change in moisture content and change in dimensions is a complex one, depending upon such factors as density of the board, structural arrangement of the fibers, the nature of the fibers, modification of characteristics by treatment in fabrication and by sizing materials, bonding strength of fibers, etc. But in the attempts to remedy the evil of undue dimensional changes attention has been largely confined to the rather obvious factor, the proper sizing of the material. Because of the presumption that the moisture absorption is governed by the sizing of the board and because sizing is added to paper, in general, in order to impart water resistance, the test long used for judging the moisture absorption of building boards and likelihood of warping has been the rate of absorption of water by a specimen immersed in water. But, since most of the trouble resulting from dimensional changes comes from moisture absorbed from or given up to the atmosphere, some experiments were made upon both laminated wall boards and homogeneous insulating boards to find out if there was a relation between the rate of absorption of water and the expansion in a humid atmosphere. The results are shown in the two tables. The tests made upon the laminated boards were made several years ago, and those upon the insulating boards more recently.

In Table 1 are shown the percentage increase in weight as a result of immersing the boards in water for a definite period of time, the percentage expansion under the same conditions, the time required for the absorption of a measured quantity of water placed on the surface, the gain in weight by absorption of moisture for a period of 72 hours from an atmosphere containing saturated water vapor, and the percentage expansion under the last-named condition. The absorption by immersion in water was found to be extremely variable in boards from the same source and presumably alike. There is observable a slight correlation between the absorption by immersion and the expansion in saturated water vapor, but there are too many gross discrepancies to justify the use of the simpler immersion test to replace the direct measurement of expansion resulting from the absorption of moisture from the atmosphere. Making comparisons likewise of expansion resulting from immersion, or absorption on the surface, with the expansion in saturated water vapor, one observes no definite correlations. The measurement of expansion in saturated water vapor, although objectionably time consuming and requiring more apparatus than the simpler tests, was deemed the most trustworthy of the tests considered for predicting the probable relative tendency of boards to be unsatisfactory. In Figure 3 are shown some typical curves of the rate of expansion of wall boards in saturated water vapor.

As may be seen from Figure 3 most of the boards were approaching a state of equilibrium at the end of 72 hours exposure to the saturated water vapor, and the relative grading of the boards would probably not be much different for a longer period of exposure. Subsequent tests were therefore made after exposure of the boards for 72 hours in saturated water vapor.

There are certain facts which point to the desirability of further investigating the optimum conditions for making the expansion tests of boards. When saturated water vapor is used there is danger of condensation of water on the specimens resulting from a temporary lowering of the temperature such as might occur during the night when the test has to be run continuously for a 3-day period. Wall boards used indoors are seldom subjected to such an extreme condition as immersion in saturated water vapor. As may be seen from Figure 3 the time of exposure is very arbitrary. It might be that an investigation of the average limits of relative humidity fluctuation and the period of time during which boards are subjected to extremes of relative humidity in actual use would suggest testing conditions more in line with the conditions under which building boards are used. In some respects it appears that air conditioned by a saturated solution of sodium chloride, which gives a relative humidity of about 75 per cent for the laboratory range of temperatures, might have been a wiser choice.

The results in Tables 1 and 2, however, for the expansion of building boards as a result of absorbing moisture from the atmosphere were obtained by the following procedure: Specimens 3 by 12 inches were cut from the samples with the longer dimension crosswise of the board as it is usually obtained and erected. At points approximately 10 inches apart heavy marks were made with a glass-marking pencil. Within each of these marks a fine line was engraved with a razor blade, these fine lines serving as the reference marks between which the expansion was measured. The length of the specimens preconditioned at 32 per cent relative humidity, maintained by a solution of magnesium chloride, was measured between the two engraved lines on each specimen and the result recorded to the nearest 0.005 inch. The magnesium chloride solution was then replaced with water and the boards exposed for 72 hours to saturated water vapor circulated through the cabinet. At the end of this 72-hour period the distance between the two engraved lines was again measured. A steel scale graduated in hundredths of an inch and a magnifying lens were used in making the measurements. The results obtained in this manner were reported as percentage expansion over the length at 32 per cent relative humidity. The dimensional changes of building boards as depicted in the tables are representative of practically all types of commercial fiber building boards. The last board in Table 1 is not, strictly speaking, a fiber board, although it is faced on both sides with thin fiber boards. The body of this board is gypsum and it was included as a matter of general interest because such boards are widely used in the same manner as the fiber building boards.

An important determining factor in the dimensional changes in fiber building boards is the density of the boards. Other things being equal a dense board may be expected to expand and contract more than a porous, bulky board. It is interesting to observe in Figure 5 that there is a rough proportionality between density and expansion in saturated water vapor. Figure 5 is a plot of the pertinent data of both tables. The nonfibrous board of great density and low expansion is of course most out of line. Of the fiber boards, certain of the insulating boards which have a relatively high ratio of expansion to density are considerably out of line. The influence of density upon dimensional changes in building boards is probably to be explained structurally. When a vegetable fiber absorbs moisture from the atmosphere it is taken into the walls of the fiber and causes swelling. The fiber increases in diameter but changes little or not at all in length. If the structure is of an open nature with many voids and if the contact bonds between the fibers is not too unyielding, most of the expansion of the fibers can take place into the voids with relatively little effect upon the gross dimensions of the board. A board, on the other hand, in which the fibers are closely packed must suffer dimensional changes in order to accommodate the lateral expansion of the fibers. Incidentally, the expansion of fibers in the lateral and not in the longitudinal direction is the reason why the laminated boards undergo a greater percentage dimensional change in the crosswise than in the lengthwise direction, for, as a result of the conditions of fabrication, more fibers are laid lengthwise than crosswise of the boards. This is one of the two principal reasons that measurement of dimensional changes has been confined to the crosswise direction of the boards, the other reason being that the ends of the boards are usually covered by baseboards or molding and the materials there are not abutted in such a manner as to result in warping when expansion takes place.

3. INSULATING VALUES

The heat-insulating properties of boards were not studied in this investigation. Thermal conductivities of different fibrous materials

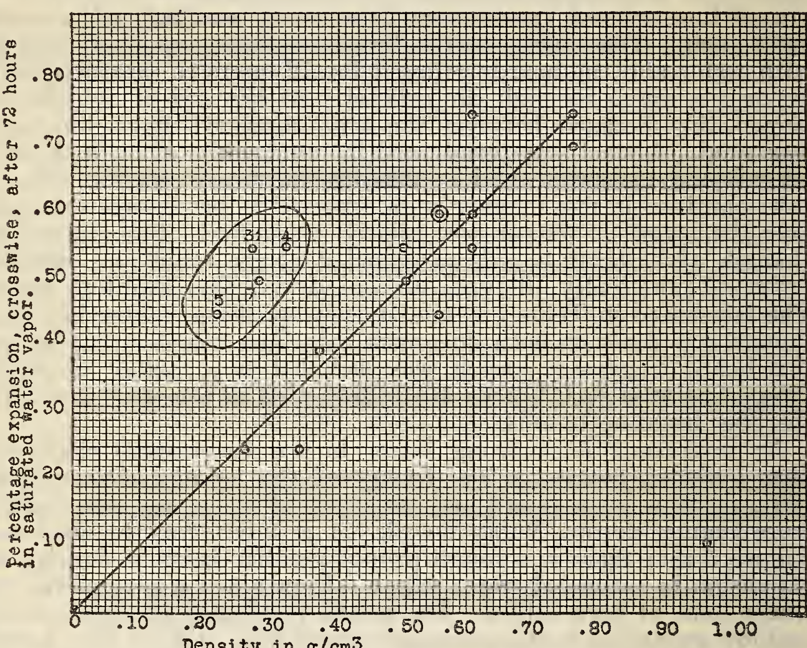

FIGURE 5.—*Relation of density to expansion caused by absorption of moisture from the atmosphere*

have been studied in the heat transfer section of the bureau and the results obtained were reported by J. L. Finck.[9] It was found that the insulating value of a fibrous product depends more on such factors as the density of packing and arrangement of fibers than on the choice of raw material. Density is an important factor since, above a certain minimum not attained in any boards studied, thermal conductivity increases with the density at an approximately uniform rate. The results of experiments on fiber arrangement indicated that the orientation of the fibers has much effect on conductivity. Boards having fibers for the most part parallel to the sur-

[9] J. L. Finck, Mechanism of Heat Flow in Fibrous Materials, B. S. Research Paper No. 243.

faces of the board, and therefore perpendicular to the line of heat flow, have conductivities definitely lower than boards having no definite orientation of fibers. The present methods of manufacture of fiber boards tend to orient the fibers so that they are most effective for insulation. At densities found in homogeneous fiber insulating boards, 30 to 50 per cent of the heat transferred through the boards is by conduction in the fibers, and the remainder by conduction through the inclosed air. At such densities convection and radiation are unimportant.

4. DIMENSIONS

The boards are commonly made 32, 48, and 64 inches wide and 6 to 16 in length, all intermediate lengths being in even feet. Thickness varies widely. Laminated wall boards are made in standard thicknesses of $\frac{1}{8}$, $\frac{3}{16}$, and $\frac{1}{4}$ inches and are made quite accurately to those thicknesses. The homogeneous boards are usually of greater thickness, and, while there is no standard practice, such boards are usually made slightly less than one-half inch in thickness. The processes used in making homogeneous boards do not permit accurate control of thickness.

5. AIR INFILTRATION

Since infiltration of air does not appear to be an important factor in ordinary usage, no tests of air permeability of fiber building board were made. Such boards are not, except in unusual cases, installed exposed and unprotected. Even when used as external sheathing, fiber boards must be protected against the weather, and any coating suitable for that purpose would be fairly impervious to air. Such data on the air permeability of fiber boards as are available indicate that heat transfer by air infiltration through any of them under the usual conditions is of little consequence compared to the transfer by conduction. There are insulating boards through which air passes readily; however, such boards are not intended for use where they will be the sole protective covering, but are normally covered by other protective structural components.

6. SUSCEPTIBILITY TO MOLDING

In common with other materials composed of vegetable fibers, the fiber boards are subject to attack by molds under certain conditions. It does not appear, however, that these products are less resistant to the growth of fungi than other components of structures, such as wood and wall papers. Conditions of moisture and temperature that will permit the growth of molds in the fiber boards will also permit the growth of rot-forming fungi in untreated wood. If necessary or advisable for special uses, means of preventing the formation of molds in fiber boards by the use of preservatives can doubtless be developed, but such measures do not appear necessary for use under usual conditions.

VI. RELATIVE PROPERTIES OF WALL AND INSULATING BOARDS

The relative properties of the two classes of boards are illustrated to some extent by a comparison of the average values for wall boards given in Table 1 with the average values for insulating boards given in Table 2. The values for the average density, thickness, and breaking strength are significant for comparative purposes. The average density for wall boards is twice that for insulating boards, the average thickness of wall boards is slightly less than one-half that of insulating boards, and the average flexural breaking strength is practically the same for both classes of boards. There is no marked difference as regards increase in weight or expansion of the two classes of boards in saturated water vapor. The crosswise expansion of laminated boards was slightly higher than that of the homogeneous boards, as might be expected when the relative densities are considered. The surface of a hard, dense board is best adapted to decorative finishes; therefore, the wall boards which are intended for interior finish are made of sufficient density to obtain the desired surface finish. The insulating boards designed primarily for heat insulation must be of low density in order to have optimum insulating properties; therefore, the surface finish on boards of this kind does not usually equal the finish obtained on wall boards.

Washington, June 6, 1931.