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E. EGER

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CONSTRUCTION BOARD AND METHOD OF MAKING SAME

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Fig. 1

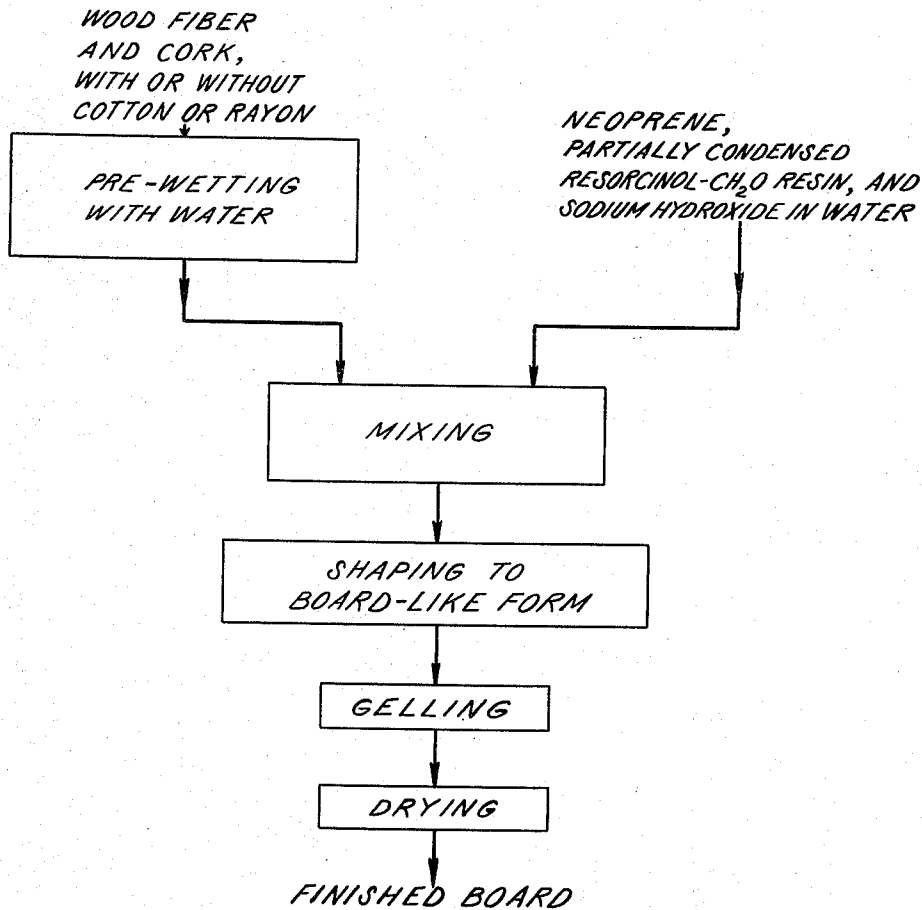


Fig. 2



FIBROUS BOARD MADE FROM
WOOD BARK FIBER AND CORK
BONDED WITH NEOPRENE
AND RESORCINOL-CH₂O RESIN



Fig. 3

CONTAINING COTTON
OR RAYON FIBER

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CONSTRUCTION BOARD AND METHOD OF
MAKING SAMEErnst Eger, Los Angeles, Calif., assignor to United
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1

This invention relates to a composition of matter in the form of a board which is useful for construction purposes and to a method of making same.

The principal object of the present invention is to provide an improved board useful for constructional purposes. Another object is to provide a method of making such a board. Another object is to provide a structural board which is flame-resistant even though a large proportion of combustible fibrous material enters into its composition. Another object is to provide such a board which is cheap to manufacture, strong, light in weight, resistant to water and moisture and which may be produced either in relatively compact form for use as a backing or paneling material useful either in furniture or in the building trade or in a more porous, softer, less compact form having properties particularly adapting it for heat insulation or sound deadening. Another object is to produce a fibrous board of the foregoing type without using high-pressure equipment. Another object is to provide a composition and method yielding a fibrous board without requiring the application of positive mechanical pressure during the setting of the mixture. Numerous other objects of the present invention will more fully hereinafter appear.

In the accompanying drawing:

Fig. 1 is a flow diagram of the process of manufacture of the board of the present invention.

Fig. 2 is an edge view of a relatively compact board made in accordance with my invention. This view portrays the appearance of a cut edge or cross-section of the board.

Fig. 3 is a similar view of a less compact board made in accordance with the present invention and especially useful for thermal insulating and sound absorbing applications.

I have discovered that an improved construction board can be prepared by intimately mixing a fibrous material with an aqueous mixture comprising dispersed polymerized chloroprene and dissolved partially condensed resorcinol-formaldehyde resin, allowing the aqueous mixture to set to a friable solid gel state, and drying to remove the water.

Any fibrous material may be employed in making the board of the present invention but I prefer to use fibrous material a substantial proportion of which is composed of fibers which are relatively elongated, i. e., which are long relative to their thickness, and which are adapted to interlace and form when bonded with the binder of the present invention a homogeneous board-

2

like structure of interlaced fibers in random distribution exhibiting great strength although light in weight. In practice I prefer that at least 40% of the fibrous material employed be of such randomly interlacing fibers. Such interlacing fibrous material is to be distinguished from a granular or powdered fibrous material like sawdust, wood flour or cork which does not interlace and which when used alone does not give a product having the desired great strength.

Examples of interlacing fibrous materials which are sufficiently cheap and readily available to be employed in making the board of my invention are straw, bagasse, cornstalks, cottonstalks, palmetto fiber, jute fiber, oat hulls, shredded wood fibers such as excelsior, exploded wood fibers, wood bark fiber, etc. I prefer to use organic fiber which is a by-product of the lumber industry or of agriculture and which is available at very low cost and is obtained chiefly as a waste product. The fibrous material is almost always organic although I can use inorganic fibrous materials such as asbestos, glass fiber, slag, rock or mineral wool, etc. provided they are not too costly.

I have obtained unusually good results by the use of a mixture of shredded wood fibers and ground cork, the wood fiber constituting the interlacing fiber component of the mixture and the cork serving as a non-interlacing fibrous component which fills the voids between the elongated wood fibers and giving a strong yet light product. I especially prefer to employ a mixture of wood bark fiber and wood bark cork both of which are found in the barks of evergreens. Use of a mixture consisting of approximately equal proportions of such wood bark fiber and such domestic cork obtained in known manner from evergreen bark is especially satisfactory from the standpoints of low cost and ready availability.

The use of substantial proportions of cork in admixture with the interlacing fibrous material is highly preferred because it produces a board which is much lighter in weight than a similar board in which no cork is employed. At the same time the board made with cork has adequate strength and other characteristics adapting it for structural uses. The use of cork in the form of native wood bark cork is especially advantageous because such cork is much cheaper than the imported cork from the cork oak. I prefer to use cork in amount ranging from 40 to 60% of the fibrous material employed.

In practicing the present invention the fibrous material is intimately mixed with an aqueous mix-

ture comprising dispersed polymerized chloroprene and dissolved partially condensed resorcinol-formaldehyde resin and containing a condensing agent capable of effecting further condensation of the resin from the water-soluble state to a substantially insoluble substantially infusible state. After effecting uniform intermixture of the fibrous material and the aqueous binder, the mixture is shaped to board-like form, as by troweling into place or in any other suitable manner. The resulting mixture is then allowed to stand, taking precautions if necessary to insure that substantial evaporation from the interior of the mass does not occur until the aqueous binding mixture sets to a friable solid gel state. After gelling has taken place, the board-shaped material is dried to remove the water. The drying step completes the resin-forming reaction, carrying the resin to the insoluble infusible stage and effects removal of both water of reaction and water of solution, forming a tough, strong, flexible binder.

It is important that the shaped mixture be held immobilized, i. e. with its various parts stationary with respect to one another, during the gelling and during at least the major portion of the drying. Otherwise a satisfactory bond is not obtained. Preferably the material is maintained in undisturbed condition until at least 90% of the water present has been removed.

In some cases the fibrous material may be wetted with water before intermixing it with the aqueous binding composition. This pre-wetting of the fibrous material causes it to mix more easily and more uniformly with the aqueous binding composition. Preferably the fiber and the pre-wetting water are intimately mixed together in any suitable manner prior to addition of the binding composition. Where a mixture of fibrous materials, such as the mixture of wood bark fiber and domestic cork described above, is employed this preliminary mixing with the pre-wetting water has the additional advantage of facilitating intermixture of the various types of fibrous material with one another so that a better and more uniform product is obtained. The amount of water employed to pre-wet the fibrous material in the manner just described may vary widely depending upon many factors including the water-absorptivity of the fibrous material; it may range from only a small amount up to that required to completely saturate the fibrous material. Usually the pre-wetting water is employed in an amount equal to at least 5% by weight of the fibrous material.

Instead of pre-wetting the fiber with water as just described, it is often more advantageous and practical to add the water for wetting the fiber to the aqueous binding composition, water being added thereto in amount sufficient to dilute it substantially below 30% and usually to not over 25% of elastomer plus partially condensed resin, the dilution, however, being only to such an extent that the elastomer plus resin content of the aqueous binder left after absorption of water therefrom by the fiber is at least 30%. For example the fiber-wetting water may be added to the aqueous binder and the fiber then added to the resulting diluted binder with mixing whereupon the fiber absorbs the excess water rapidly. This mode of operation is preferred since it has the advantage of eliminating one mixing operation, namely the pre-wetting operation, the absorption of the excess water by the fiber aiding in the mixing and readily giving a mixture which

can be troweled into place or otherwise shaped for the production of the board.

Alternatively, a portion of the added water may be used to pre-wet the fiber and the rest may be employed to dilute the aqueous binder.

An important requirement in practicing the present invention is that the water content of the mixture be so adjusted that the content of neoprene (polymerized chloroprene) plus partially condensed resorcinol-formaldehyde resin in the aqueous mixture present on and around the fibers after intermixture be at least 30% by weight of such aqueous mixture. For example, if the fibrous material is completely saturated with water in the preliminary wetting step described above, the aqueous binder admixed therewith should contain at least 30% of neoprene plus resin. If on the other hand the fibers are dry or are incompletely saturated with water, then the aqueous binder commingled therewith can be diluted with water to a neoprene plus resin content below 30% provided the fibrous material is capable of absorbing enough water from the aqueous binder to raise the neoprene plus resin content thereof at least to the 30% level.

Unless the neoprene plus resin content of the aqueous binder in the mixture after intermixture of fibrous material and binder is at least 30%, the binder will not go through the solid friable gel state and a satisfactory bond will not be obtained.

The aqueous binder composition should contain neoprene and the partially condensed resin in such relative proportions that the resorcinol content of the resin ranges from 3.8 to 16.8 and preferably from 6.75 to 15.0 per cent by weight based on the weight of neoprene. Unless these limits are observed, the material obtained by gelling and drying of the binding composition is not satisfactory as a binder for the fibrous material.

The speed with which the binding composition used in the present invention gels to the requisite solid friable gel state is greatly affected by the temperature, increasing rapidly therewith. Thus at room temperature it may not gel for several hours but as the temperature rises above 90° F. it begins to gel very rapidly and at 120° F. it gels almost immediately. For this reason, gelling may be greatly accelerated by subjecting the shaped mixture to elevated temperature conditions.

The speed of gelling is also greatly affected by the concentration of neoprene plus partially condensed resin in the aqueous binding mixture surrounding the fibers after mixture has been effected. Increase of this concentration by a few or even by a single per cent effects a considerable shortening of the gelling time. This concentration is often at least 35% and it may range as high as 55 or 60 per cent.

For this reason gelling is greatly accelerated by the phenomenon of absorption of water from the binding composition by the fibrous material with which it is mixed. If the fibrous material mixed with the aqueous binding composition is dry or is incompletely saturated with water, it will selectively remove water from the binding composition and thereby concentrate the same so that it will gel or will gel more rapidly.

After intermixture of the fibrous material with the aqueous binding composition and shaping thereof to the desired board-like form, evaporation of volatile material, principally water, from the mixture should be so limited that the requisite gelling takes place before any substantial

surface evaporation occurs. If surface evaporation proceeds too rapidly so that the resin-forming reaction, which takes place in the water phase, is stopped before it can proceed to substantial completion, the product at least on the surface may not have the desired characteristics and may be unsatisfactory. In some cases the shaped mixture of fibrous material and binder may be subjected to non-evaporative conditions, preferably at elevated temperature to accelerate gelling, for example by maintaining same in a heated atmosphere of controlled high humidity until gelling has taken place. After gelling has been effected, the resulting mixture may be dried in any suitable manner. I prefer to employ elevated temperature during the drying step to accelerate the same. For example I may employ a temperature of from 125° F. to 150° F. in the drying step.

I often prefer to place the wet mixture of fibrous material and binder in sheet form between screens or perforated surfaces which may be free to move or may be locked in any suitable manner to prevent separation during setting, the gelling and drying steps being carried out while the material is between such screens or the like.

It is important that the wet shaped mixture be maintained in a relatively undisturbed condition until it has taken its set, i. e. immobilized during the gelling step and during the major portion of the drying step, i. e. until substantially all the water has been removed. The material is usually dried until at least 90% by weight of the water present has been removed before it is subjected to forces which would tend to disturb the relative positions of the various portions thereof. If the material is disturbed before it has taken its final set, i. e. before the major portion of the water has been removed, it will be disintegrated into discrete portions and rendered worthless.

The aqueous composition used to form the binder in accordance with my invention is preferably composed essentially of an aqueous mixture of dispersed polymerized chloroprene, dissolved partially condensed water-soluble resorcinol-formaldehyde resin capable of setting upon removal of water by further condensation to a substantially infusible, substantially insoluble state, and an alkali metal hydroxide capable of effecting such further condensation of said resin. This composition is most conveniently prepared by simply mixing an aqueous dispersion of polymerized chloroprene with an aqueous solution of the partially condensed resorcinol-formaldehyde resin and an aqueous solution of alkali metal hydroxide. The aqueous mixture may embody other ingredients such as suitable proportions of fillers, pigments, anti-oxidants, dyestuffs, suspending agents, dispersing agents, wetting agents, etc. such as agents for holding the polymerized chloroprene and the fillers or pigments in suspension in the aqueous medium. The aqueous mixture may contain ingredients solubilizing or holding in solution the partially condensed resorcinol-formaldehyde resin, a preferred example of such a material being an alkali metal hydroxide, typically sodium hydroxide. The composition will contain excess or unreacted formaldehyde for completing condensation of the resin and effecting hardening such other components of the formulation as casein, glue, etc. It is preferred that the aqueous composition embody a catalyst for effecting completion of the resin-forming condensation, such catalyst pref-

erably being an excess of alkali metal hydroxide such as sodium hydroxide over that required to hold the resin in solution.

The resin is made by reacting resin-forming ingredients consisting of resorcinol and formaldehyde, the molar ratio of formaldehyde to resorcinol being sufficiently great to insure formation of a substantially infusible, substantially insoluble resin upon removal of the water of solution and of condensation, and usually being at least 2:1. The resorcinol-formaldehyde resin solution may be prepared in any manner known to those skilled in the art. The molar proportions of resorcinol and formaldehyde originally employed in formulating the resin may vary widely but usually a molar excess of formaldehyde over resorcinol is employed to give the ultimate formation of an insoluble infusible resin. The resorcinol and formaldehyde are preliminarily reacted together, the reaction being stopped before completion, i. e. before the condensation product has reached the insoluble infusible stage which may also be before all the formaldehyde has reacted. The partially condensed resin is soluble in water and in dilute aqueous alkali metal hydroxide solution. If desired the resorcinol may be reacted with a part only of the formaldehyde and the remainder of the formaldehyde may be added to the formulation at any time prior to use.

In the manufacture of the partially condensed resin capable of setting upon removal of water to the insoluble infusible stage, it is often preferred to employ a molar ratio of total formaldehyde to resorcinol ranging from 2:1 to 3:1. Upon gelling and drying, the incomplete resin-forming reaction proceeds to completion. The free formaldehyde present after the initial reaction is available to carry the reaction to completion during the drying step and also to harden and insolubilize any protein such as casein or glue present in the formulation. The preliminary resin-forming reaction may conveniently be carried out by forming a mixture of resorcinol and water at an elevated temperature, say 130 to 200° F., and adding the formaldehyde, e. g. in the form of commercial 37 to 40% aqueous solution, with stirring. It may be desirable to add the formaldehyde gradually over a considerable period of time in view of the highly exothermic nature of the resin-forming reaction which, if allowed to get out of control, may yield a completely unusable resin. If desired, known catalysts for the resin-forming reaction such as oxalic acid, benzenesulfonic acid, etc. may be employed. Preferably however an alkali metal hydroxide, typically sodium hydroxide, is used as the condensing agent. After the resin-forming reaction has attained the desired stage, aqueous alkali metal hydroxide solution may be added to form a resin solution which may be mixed with the polymerized chloroprene latex and the other ingredients to give the final formulation. There is preferably included in the final composition additional aqueous alkali metal hydroxide solution beyond that necessary to hold the partially condensed resin in solution, such additional alkali metal hydroxide serving to complete the resin-forming reaction as above stated. The resulting mixture is unstable, that is, it gels upon standing for a relatively short time, usually not over 8 hours, the length of time required for gelling to take place depending upon many factors, especially the concentration of neoprene plus resin and the temperature to which the mixture is subjected.

Any desired proportions of pigments, fillers, etc.

may be used in the formulation depending upon the desired consistency of the aqueous mixture and the properties desired in the final gelled and dried binder. The proportions of casein or similar protein will usually not exceed 5%. The proportion of alkali metal hydroxide present in the final formulation will not ordinarily exceed 2% but is usually at least 0.1% of the aqueous mixture used to form the binder. These percentages are by weight of the total binding composition on a water-free basis.

When, as in the preferred practice of my invention, polymerized chloroprene is the sole rubbery or elastomeric material present, the gelling and setting of the aqueous mixture does not depend upon vulcanization and in fact no vulcanizing agents, accelerators or the like ingredients are used in the aqueous mixture. The excellent results of the present invention are obtained without vulcanization merely by allowing such an aqueous composition to gell followed by drying to remove the water.

Where reference is made herein to the proportion of partially condensed resin (as where I refer to the percentage of the sum of polymerized chloroprene and resin), the sum of resorcinol and the total formaldehyde required to set the same to the insoluble infusible state is intended, although all such formaldehyde is not combined in the initial resin-forming condensation. Of course formaldehyde in excess of such requirement is not included although the amount of such excess would ordinarily be so small as to be almost inconsequential.

Instead of using an aqueous dispersion of polymerized chloroprene (neoprene) in the practice of my invention I may less preferably use latices of elastic rubbery or rubber-like sulfur-vulcanizable materials such as GR-S (butadiene-styrene synthetic rubber) latex, Buna N (butadiene-acrylonitrile synthetic rubber) latex, isoprene-styrene synthetic rubber latex, etc. in the same proportions as given above for neoprene latex. I may also use blends of such other rubbery materials in latex form with neoprene latex. However when latices of rubbery material other than neoprene are used it is necessary to include the conventional vulcanizing ingredients in the composition and to cure at a temperature sufficiently elevated to effect vulcanization of such other elastomeric material. Such temperatures are considerably above those required when neoprene is used as the sole rubbery component of the formulation. As explained above simple drying of the neoprene formulations at temperatures only sufficiently elevated to effect removal of the water is all that is required. Neoprene gives a much better product than the other rubbery materials. When a neoprene latex by itself is air-dried it gives a tacky film but the combination with the resorcinol-formaldehyde resin as described herein gives upon air-drying a tack-free film; with latices of other elastomers such as GR-S this reduction of tackiness by the resin is not nearly so pronounced. For these and other reasons, neoprene is by far the preferred elastomer.

While I much prefer to use resorcinol in the practice of my invention, I may use equivalent proportions of pyrogallol which gives a resin-forming reaction substantially the same as that described above for resorcinol. Resorcinol and pyrogallol are similar, both being polyhydric phenols having hydroxyl groups in the 1- and 3-positions on the benzene ring, pyrogallol differ-

ing from resorcinol in having the 2-position also occupied by hydroxyl.

Instead of pure resorcinol, I may with substantially equivalent results use commercial resorcinol which contains related phenolic bodies as impurities and usually contains at least 95% of resorcinol.

Instead of formaldehyde I may use equivalent proportions of other water-soluble aldehydes capable of giving the resin-forming reaction with resorcinol or pyrogallol. Examples are other aliphatic aldehydes such as acetaldehyde, propionaldehyde, butyraldehyde, etc. I may even use furfural although when it is used I prefer to use it only in making the partially condensed water-soluble resin and to use an aliphatic aldehyde such as formaldehyde or a homolog thereof in the formulation to complete the resin-forming reaction. I may use one aliphatic aldehyde in the initial resin-forming reaction and use another in the formulation to carry this reaction to completion; thus I may employ formaldehyde in making the partially condensed resin and then a homolog such as acetaldehyde or propionaldehyde to complete the reaction; or acetaldehyde first and then formaldehyde to complete the reaction; or propionaldehyde first and then formaldehyde or acetaldehyde.

I prefer to use resorcinol in conjunction with formaldehyde both for the partial condensation and to complete the resin-forming reaction or in conjunction with furfural for the initial condensation and formaldehyde to complete the condensation.

The mixture of the fibrous material and the aqueous binding mixture must be given its final shape prior to the occurrence of gelling because material shaped from the mixture after gelling has begun or is completed will not have enough strength to be useful.

The relative proportions of fibrous material and aqueous binding composition employed in manufacturing a fibrous board in accordance with my invention may vary widely depending upon many factors including physical characteristics desired in the board, type of fibrous material used, etc. The amount of binder should be sufficient to produce a strong, coherent board capable of standing up during handling, installation and use. I have successfully used the binding composition in a proportion such that the amount of elastomer plus partially condensed resin ranges from 20 to 70 parts by weight per 100 parts of the fibrous material such as wood fiber and ground cork. Use of from 20 to 40 parts of elastomer plus resin per 100 parts of wood fiber and ground cork gives a mixture which can be troweled and thus easily shaped into the desired board-like form.

I have found that formulation of a mixture consisting of approximately equal parts of wood bark fiber and ground wood bark cork and an aqueous elastomer-partially condensed resin binding composition in relative proportions corresponding to from 20 to 40 parts of elastomer plus resin per 100 parts of the fibrous material, the relative proportions of elastomer and resin being such that the polyhydric phenol content of the resin ranges from 3.8 to 16.8 per cent by weight based on the weight of elastomer and the concentration of elastomer plus resin in the aqueous mixture surrounding the fibrous material following intermixture being at least 30 per cent by weight of said aqueous mixture, gives a composition which when shaped, allowed to go

through the gel stage and dried, yields a compact board which lends itself as a backing material or paneling material and which can be utilized in furniture or in the building trade. I believe that the great shrinkage of the aqueous binding material, when it is employed in such proportions, effects compaction of the fibrous material during the drying step. I have observed that there is about 10 to 11% linear shrinkage of the mixture during drying and that this shrinkage compacts the fiber. This great shrinkage enables me to obtain a compact board without the necessity of using expensive high pressure platen presses. Thus I can simply place the wet intermixture of fibrous material and binder between screens or like perforated surfaces allowing escape of water and hold it there until gelling and drying are accomplished. In making such a hard, compact board, it is desirable to leave the top and bottom of the form as well as the sides free so as to enable these to follow the shrinkage of the material.

The technique described in the preceding paragraph requires only very simple and inexpensive equipment and the application of no positive external mechanical pressure. Although the shrinkage upon gelling and drying of the aqueous neoprene-partially condensed resorcinol-formaldehyde composition by itself or with the ordinary fillers and pigments but without intermixture of a large proportion of fibrous material is often so excessive as to preclude the production therefrom of useful articles thicker than one-fourth of an inch, nevertheless the present invention takes advantage of this great shrinkage to obtain an unexpected result: namely the production of a compacting action which eliminates the need of high pressure equipment and yields a useful product even when made in great thickness say up to three-fourths of an inch or even greater. In other words shrinkage imposes no limitation on thickness of the board produced by my invention, the only limitations on thickness of my boards being that imposed by the difficulty of drying extremely thick boards. For a thin board the particle size of the fiber limits the thinness of the board.

I have further found that by incorporation of a minor proportion of cotton or rayon fiber into the composition described above, a much less compact board is obtained. This embodiment of my invention is especially valuable where a board having a rather low weight per square foot characteristic and a rather porous and loosely connected structure for the purpose of sound deadening and temperature insulation is desired. For this purpose I may incorporate into the formulation from 5 to 20% by weight based on the weight of other fibrous material, such as a mixture of wood fiber and cork, of ground waste cellulose fibers, preferably the fibers that are reclaimed from old tire carcasses made from cotton or rayon by cracking or grinding tires to about $\frac{1}{2}$ to $\frac{1}{4}$ inch particle size, then passing this ground material through a mechanical device that beats the fiber free from the rubber and separates it by air suction. Such fibers may be described as cotton and/or viscose rayon fiber composed of a mixture of twisted cord and shredded single strands both spun and unspun in various lengths, the fiber length varying from $\frac{1}{4}$ to 1 inch with the bulk around $\frac{1}{4}$ inch. The use of such a minor proportion of short-length (length generally averaging $\frac{1}{4}$ of an inch) cellulose textile fibers produces unusual results,

yielding a more porous, much less compact board than the same composition from which such fibers are omitted. At the same time the lighter board so obtained has sufficient strength and other characteristics adapting it to use as a constructional material. The resulting board can be laminated with various materials such as a resinous sheet for producing a wall panel that can be directly applied to the studding of a building and become part of the building. This board, like the more compact board obtained without the cotton or rayon, is flame-resistant.

Instead of reclaimed tire cord, I may use cotton or rayon flock or any other form of short-length substantially pure cellulose fiber, such as cotton or regenerated cellulose textile fiber, uniformly distributed throughout the mixture from which the board is made. However from the standpoint of cheapness I prefer to use the waste tire fabric.

I am not certain as to how the intermixture of the minor proportion of cotton or rayon fiber brings about the result described. Nevertheless such intermixture results in a substantial diminishing of the compacting effect of the binder without preventing formation of a strong, useful board. It may be that the cotton or rayon fibers have a tendency to filter out the elastomer and resin constituents of the aqueous mixture and thus prevent the penetration thereof into the wood fiber and cork so that after drying the resulting assembly is interlocked through surface adhesion of coated cotton or rayon fibers with the wood fiber and cork but due to the lack of binder adjacent the latter sufficient voids are left therebetween to give a softer and more porous material lending itself to use as a heat insulating and sound absorbing material. It may be that the cotton or rayon fiber, being substantially pure cellulose highly swellable by aqueous media is highly swollen by the aqueous mixture and upon drying shrinks back to its original size, leaving voids and holding sufficiently some of the wood fibers apart preventing the binder from contracting upon drying, thus forming a porous board. The alkali metal hydroxide condensing agent in the binding material would accentuate such swelling. The other fibers present such as wood fiber and cork, being very impure, woody lignin-containing cellulose which is relatively non-swellable by aqueous media, as compared to pure cellulose such as cotton and rayon, would not undergo such great swelling and subsequent shrinkage leaving voids.

In the preferred practice of my invention, no positive external mechanical pressure is applied to the shaped mixture during the gelling and drying steps, sole reliance being placed upon the self-compacting nature of the mixture to effect the production of the desired board having excellent strength and other physical properties adapting it to structural uses and having the desired degree of compactness.

In the accompanying drawing which is largely self-explanatory, Fig. 1 is a flow diagram of the process of making the board, Fig. 2 portrays a compact board made as described in Example 1 below and Fig. 3 portrays a relatively porous board made in identical manner to the board of Fig. 2 except with the incorporation of 10% by weight of ground cellulose textile fiber obtained from reclaimed tire carcasses as described in Example 2 below. The looser, more porous texture of the board as a result of the intermixture

of the cotton or rayon fibers will be apparent from inspection of Fig. 3.

EXAMPLE 1

To approximately equal parts of wood fiber and of ground domestic cork, both derived from the bark of native evergreens, was added about 5% by weight thereof of water and the materials were mixed until a uniform mixture was obtained. There was then added an aqueous mixture freshly made as described below. The relative proportions were such that for each 100 parts of wood fiber and cork there was employed 100 parts of said aqueous mixture. Since the aqueous mixture contained 28.2% neoprene and 5.05% of resorcinol-formaldehyde resin, there were employed 33.25 parts of neoprene plus resin per 100 parts of the fibrous material. The resulting materials were mixed to a uniform condition and the mixture which had a troweling consistency was placed in sheet form between screens, allowed to stand for 30 minutes and then dried at 125-150° F. A strong, compact fibrous board illustrated in Fig. 2 was obtained.

The aqueous composition used to form the binder was prepared from four separate recipes, identified as A, B, C and D which were admixed together, just prior to use, in the following proportions by weight.

	Parts by weight
Recipe A.....	200
Recipe B.....	40
Recipe C.....	6
Recipe D.....	110
	356

Recipes A, B, C and D had the following compositions:

Recipe A

This was an aqueous neoprene latex containing 50% of dispersed polymerized chloroprene.

Recipe B

	Per cent by weight
Zinc oxide.....	12.50
Casein.....	1.25
Conc. NH_4OH (29.4% NH_3).....	1.25
Phenyl beta naphthylamine.....	5.00
Lithopone.....	30.00
Sodium salt of short chain alkyl naphthalene sulfonic acid.....	1.25
Water.....	48.75

Recipe B was prepared as follows: The casein and ammonia were added to 20 parts of water. The mixture was ball-milled one hour. The remaining ingredients were then added and the mixture ball-milled for a minimum of 8 hours. The resulting dispersion was stored in such a way as to permit agitation sufficient to prevent settling out.

Recipe C

	Per cent by weight
Dry caustic soda (76% commercial).....	10
Water.....	90

Recipe D

Resorcinol.....	40 lbs.
Water.....	120 lbs.
Formaldehyde (37% aqueous solution).....	84 lbs.
Recipe C.....	9 lbs. 10 oz.
Crushed ice.....	188 lbs.

441 lbs. 10 oz.

Recipe D was prepared as follows: The resorcinol was placed in the water which was at a temperature of approximately 150° F. After mixing, the formaldehyde was added and the batch stirred until the resorcinol was dissolved. During this operation the temperature was maintained at from 115 to 120° F. by either heating or by adding small amounts of crushed ice. Thereafter the indicated portion of Recipe C was gradually added while the composition was agitated. Finally the remaining ice was added.

Using a slow speed agitator, to the Recipe D was added Recipes B, C and A in the order listed.

EXAMPLE 2

Example 1 was duplicated exactly except that there was included with the wood bark fiber and ground cork 10% by weight thereof of ground cotton and viscose rayon cellulose fiber obtained from tire carcasses in the rubber reclaiming operation. The resulting board had the looser, more porous structure indicated in Fig. 3 of the drawing and was eminently suited for sound absorption and thermal insulation use.

From the foregoing, many advantages of the present invention will be apparent to those skilled in the art. The principal advantage is that a flame-resistant building board having good strength is produced in a simple and economical manner. Another advantage is that the mixture is self-compacting during setting so that a compact board in the case where the cotton or rayon fiber is not used and a somewhat less compact board, though still sufficiently compact for the purposes required where such cellulose fiber is used, are obtained while subjecting the mixture to substantially no external pressure during its formation, i. e. after shaping and during the gelling and drying steps. This elimination of the necessity of subjecting the mixture to external mechanical pressure while it is taking its set is highly advantageous because the manufacture is thereby greatly simplified and accelerated and the equipment investment is much lower since mere placement of the sheeted material between foraminous surfaces such as screens is all that is required in contrast to the complexity and expense of using high pressure platen presses. Another advantage of the present invention is that the mixing of the aqueous binder mixture with the fibrous material to obtain a uniform homogeneous mixture is greatly facilitated by the form of the aqueous mixture used to form the binder, in comparison to prior art methods of making wall-board or the like using a powdered binder which is extremely difficult to distribute uniformly around each fiber and throughout the fibrous mass. Numerous other advantages of my invention will be obvious from the foregoing description.

All parts and percentages referred to herein are by weight.

Having thus described my invention, what I claim and desire to protect by Letters Patent is:

1. A fibrous board comprising a mass of fibrous material comprising randomly interlaced fibers bonded together by a bonding medium comprising the dried gelled residue of an aqueous mixture comprising dispersed polymerized chloroprene and dissolved partially condensed resorcinol-formaldehyde resin capable of setting upon removal of water to a substantially infusible, substantially insoluble state, said mixture containing said polymerized chloroprene and said resin in such relative proportions that the resorcinol con-

tent of said resin ranges from 3.8 to 16.8 per cent by weight based on the weight of said polymerized chloroprene and containing at least 30 per cent by weight of said polymerized chloroprene and said resin.

2. A fibrous board composed essentially of a mass of shredded wood fiber and ground cork bonded together by a bonding medium comprising the dried gelled residue of an aqueous mixture comprising dispersed polymerized chloroprene and dissolved partially condensed resorcinol-formaldehyde resin capable of setting upon removal of water to a substantially infusible, substantially insoluble state, said mixture containing said polymerized chloroprene and said resin in such relative proportions that the resorcinol content of said resin ranges from 3.8 to 16.8 per cent by weight based on the weight of said polymerized chloroprene and containing at least 30 per cent by weight of said polymerized chloroprene and said resin, the weight of said polymerized chloroprene and said resin ranging from 20 to 70 parts per 100 parts of said wood fiber and ground cork.

3. A fibrous board comprising a mass of fibrous material comprising shredded wood fiber and ground cork having uniformly distributed there-through a minor proportion of short-length cellulose textile fiber, said fibrous material being bonded together by a bonding medium comprising the dried gelled residue of an aqueous mixture comprising dispersed polymerized chloroprene and dissolved partially condensed resorcinol-formaldehyde resin capable of setting upon removal of water to a substantially infusible, substantially insoluble state, said mixture containing said polymerized chloroprene and said resin in such relative proportions that the resorcinol content of said resin ranges from 3.8 to 16.8 per cent by weight based on the weight of said polymerized chloroprene and containing at least 30 per cent by weight of said polymerized chloroprene and said resin, the weight of said polymerized chloroprene and said resin in said composition ranging from 20 to 70 parts per 100 parts of said wood fiber and ground cork, said board being substantially more porous, less compact and less dense than the same board from which said short-length cellulose textile fiber is omitted.

4. A process of making a fibrous board comprising intimately mixing a mass of fibrous material comprising randomly interlaced fibers with an aqueous mixture comprising dispersed polymerized chloroprene and dissolved partially condensed resorcinol-formaldehyde resin capable of setting upon removal of water to a substantially infusible, substantially insoluble state, said mixture containing said polymerized chloroprene and said resin in such relative proportions that the resorcinol content of said resin ranges from 3.8 to 16.8 per cent by weight based on the weight of said polymerized chloroprene, said aqueous mixture containing after said mixing has been accomplished at least 30 per cent by weight of said polymerized chloroprene and said resin, shaping the resulting mixture to board-like form, allowing the shaped mixture to stand until said aqueous mixture has set to a friable solid gel state, and drying the resulting mixture to remove the water.

5. The process of claim 4 wherein said fibrous material is wetted with water prior to completion of admixture with said aqueous mixture.

6. A process of making a fibrous board com-

prising intimately mixing a mass of shredded wood fiber and ground cork with an aqueous mixture comprising dispersed polymerized chloroprene and dissolved partially condensed resorcinol-formaldehyde resin capable of setting upon removal of water to a substantially infusible, substantially insoluble state, said mixture containing said polymerized chloroprene and said resin in such relative proportions that the resorcinol content of said resin ranges from 3.8 to 16.8 per cent by weight based on the weight of said polymerized chloroprene, said aqueous mixture containing after said mixing has been accomplished at least 30 per cent by weight of said polymerized chloroprene and said resin ranging from 20 to 70 parts per 100 parts of said wood fiber and ground cork, shaping the resulting mixture to board-like form, allowing the shaped mixture to stand until said aqueous mixture has set to a friable solid gel state, and drying the resulting mixture to remove the water.

7. The process of claim 6 wherein said fibrous material is wetted with water prior to completion of admixture with said aqueous mixture.

8. The process of claim 6 wherein said mixture is subjected to substantially no external pressure during said gelling and drying steps and the mixture is compacted through the sole agency of shrinkage which occurs during said drying.

9. A process of making a fibrous board comprising forming an intimate uniform mixture of a fibrous material comprising a mass of shredded wood fiber and ground cork and a minor proportion of short-length cellulose textile fiber with an aqueous mixture comprising dispersed polymerized chloroprene and dissolved partially condensed resorcinol-formaldehyde resin capable of setting upon removal of water to a substantially infusible, substantially insoluble state, said mixture containing said polymerized chloroprene and said resin in such relative proportions that the resorcinol content of said resin ranges from 3.8 to 16.8 per cent by weight based on the weight of said polymerized chloroprene, said aqueous mixture containing after said mixing has been accomplished at least 30 per cent by weight of said polymerized chloroprene and said resin, the weight of said polymerized chloroprene and said resin ranging from 20 to 70 parts per 100 parts of said wood fiber and ground cork, shaping the resulting mixture to board-like form, allowing the shaped mixture to stand until said aqueous mixture has set to a friable solid gel state, and drying the resulting mixture to remove the water and yield a board which is substantially less compact than the same board from which said cellulose fiber is omitted.

10. The process of claim 9 wherein said fibrous material is wetted with water prior to completion of admixture with said aqueous mixture.

11. The process of claim 9 wherein said mixture is subjected to substantially no external pressure during said gelling and drying steps and the mixture is compacted through the sole agency of shrinkage which occurs during said drying.

12. A process of making a fibrous board comprising intimately mixing a mass of water-absorbent fibrous material comprising randomly interlaced fibers with an aqueous mixture comprising dispersed polymerized chloroprene and dissolved partially condensed resorcinol-formaldehyde resin capable of setting upon removal of water to a substantially infusible, substantially insoluble state, said mixture containing

said polymerized chloroprene and said resin in such relative proportions that the resorcinol content of said resin ranges from 3.8 to 16.8 per cent by weight based on the weight of said polymerized chloroprene, said aqueous mixture containing not over 25% by weight of said polymerized chloroprene and said resin, causing said fibrous material to absorb sufficient water from said aqueous mixture during said mixing step that the aqueous mixture present on and around the fibers after intermixture contains at least 30 per cent by weight of said polymerized chloroprene and said resin, shaping the resulting mixture to board-like form, allowing the shaped mixture to stand until said aqueous mixture has set to a friable solid gel state, and drying the resulting mixture to remove the water.

13. A fibrous board comprising a mass of randomly and initially loosely interlaced fibers bonded firmly together by a bonding medium comprising the dried gelled residue of a hardenable aqueous mixture comprising dispersed elastic rubbery composition selected from the group consisting of rubbery copolymer of butadiene and styrene in admixture with vulcanizing ingredients, rubbery copolymer of butadiene and acrylonitrile in admixture with vulcanizing ingredients, rubbery copolymer of isoprene and styrene in admixture with vulcanizing ingredients, and rubbery polymerized chloroprene, and dissolved partially condensed resin obtained by the partial condensation of a polyhydric phenol having hydroxyl groups in the 1- and 3-positions and an aldehyde and capable of setting in the aqueous condition to a friable solid gel and capable of being converted upon removal of water to a substantially infusible, substantially insoluble state, said mixture containing said rubbery polymer and said resin in such relative proportions that the polyhydric phenol content of said resin ranges from 3.8 to 16.8% by weight based on the weight of said rubbery polymer and containing at least 30% by weight of said rubbery polymer and said resin.

14. The process of making a fibrous board com-

prising intimately mixing a mass of randomly loosely interlaced fibers with an aqueous mixture comprising dispersed elastic rubbery composition selected from the group consisting of rubbery copolymer of butadiene and styrene in admixture with vulcanizing ingredients, rubbery copolymer of butadiene and acrylonitrile in admixture with vulcanizing ingredients, rubbery copolymer of isoprene and styrene in admixture with vulcanizing ingredients, and rubbery polymerized chloroprene, and dissolved partially condensed resin obtained by the partial condensation of a polyhydric phenol having hydroxyl groups in the 1- and 3-positions with an aldehyde and capable of setting in the aqueous condition to a friable solid gel and capable of being converted upon removal of water to a substantially infusible, substantially insoluble state, said mixture containing said rubbery polymer and said resin in such relative proportions that the polyhydric phenol content of said resin ranges from 3.8 to 16.8 per cent by weight based on the weight of said rubbery polymer, said aqueous mixture containing after said mixing has been accomplished at least 30% by weight of said rubbery polymer and said resin, shaping the resulting mixture to board-like form, allowing the shaped mixture to stand until said aqueous mixture has set to a friable solid gel state, and thereafter drying the resulting gelled mixture and converting the same to a substantially infusible, substantially insoluble state.

ERNST EGER.

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