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CONSTRUCTIONAL MATERIAL

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This invention relates to constructional materials and particularly to a new kind of constructional material suitable for use in the building trade.

The constructional material of the invention comprises particles of wood bonded together by means of a minor proportion of cellulose acetate or other water resistant thermoplastic binder to form a coherent material.

One method of producing the constructional material of the invention is to coat particles of wood, for example in the form of wood-flour, sawdust, chips or shavings, with a dope comprising a water resistant artificial film-forming thermoplastic substance in solution in a volatile solvent, to evaporate the solvent, and form the coated particles into a coherent material by a hot pressure moulding operation. Thus, for example chips, shavings or sawdust of hard wood may be coated with dopes having a basis of cellulose acetate, cellulose acetate stearate or ethyl cellulose and containing a plasticiser for the cellulose derivative, in solution in a volatile solvent.

The coating may be effected by steeping the wood particles in the dope, draining them and drying them, e. g. at about 80° C. The ratio of cellulose acetate or other binder to wood may vary largely, for instance from about 1:5 or even less, e. g. 1:7, up to about 4:5. Very useful products are obtained for example when the ratio is between about 1:4 and about 3:5, e. g., between 1:3 and 1:2. The coated particles may be formed into a coherent sheet or slab of material by a moulding operation carried out at a temperature of about 150° C. and a pressure of 150–500 lbs. per square inch. In this way a material of specific gravity about 1 is obtained. By employing a higher pressure for instance 750 or 1000 to 1500 lbs. per square inch, a denser and stronger material can be obtained, for instance one having a specific gravity between about 1.0 and 1.5. The moulding may be carried out in a multi-platen steam heated press.

Another method of producing the material of the invention is to mix the wood particles with particles of a moulding powder containing the binder together with a plasticiser or mixture of plasticisers therefor, and to subject the mixture to a hot compression-moulding operation as before.

The powder may be mixed dry with the wood particles, or a solvent or potential solvent for the binder may be used to assist mixing. (By a potential solvent for the binder is meant a liquid which is a solvent therefor at elevated temperatures but not at ordinary temperatures.) Thus when cellulose acetate is used as the binder acetone or dioxane or methanol or ethanol, in amount about equal to that of the cellulose acetate may be incorporated in the moulding powder or in the mixture of this powder with the wood particles, and evaporated off before the moulding operation. The mixture may be formed into a coherent material in the same way as the coated particles referred to above, e. g. at pressures of 150 to 1000 or 1500 lbs. per square inch.

The wood employed may be in the form of wood-flour, sawdust, shavings, chips or the like. In general, better results qua water resistance of the product are obtained the smaller the wood particles. Homogeneity in the wood is of considerable advantage from the point of view of obtaining uniformity in the product. Thus it is preferred to work with wood-flour, sawdust, chips or shavings of a single kind of wood. The wood or broad leaved trees may be employed and close grained woods of this kind, for example, oak, teak, birch and beech are very suitable. The wood of coniferous trees, e. g. the various kinds of pine and fir, may also be used. From the point of view of water resistance in the product, the use of resinous woods is of advantage. Valuable results have been obtained with a wood containing ether-soluble matter to the extent of 2% or less and moisture content of 10% or less.

As indicated above, suitable binders include cellulose acetate, cellulose acetate-stearate and ethyl cellulose. Where water resistance in the product is of importance it is preferable to employ a highly water-resistant binder. For this purpose ethyl cellulose, cellulose acetate-stearate and cellulose acetate containing combined acetic acid in excess of about 55%, for instance 56 to 58 or 59%, are even more suitable than the more common cellulose acetate of lower acetic acid content. Other thermoplastic artificial film-forming substances of high water resistance that can be employed include other esters of cellulose, for example cellulose propionate, cellulose butyrate, cellulose acetate-propionate, cellulose acetate-butyrate and cellulose acetate-nitrate and other ethers of cellulose in which the ether radicle contains at least 2 carbon atoms, for example benzyl cellulose and ethyl hexyl cellulose. Water resistant polymerised unsaturated synthetic resins, for example polystyrenes, polyvinyl acetate-chloride, polymethyl methacrylate and other polyvinyl compounds can also be employed.

It is desirable that the material of the invention should contain in addition to the thermo-

plastic substances, a plasticiser or mixture of plasticisers therefor. The plasticiser selected should be water resistant. Complete insolubility in water is not essential. Thus plasticisers such as triacetin and triethyl citrate can be employed in spite of their slight water solubility. It is preferred, however, to employ a more water resistant plasticiser, for example, dimethyl phthalate, diethyl phthalate, tripropionin and especially methyl phthallyl ethyl glycolate, ethyl phthallyl ethyl glycolate and tri-(mono-chlorethyl) phosphate. Aromatic phosphates such as triphenyl phosphate and tricresyl phosphate, although of excellent water-resistance are preferably not employed as the sole plasticiser for cellulose acetate on account of their very limited solvent power therefor. They may, however, be employed in admixture with plasticisers of higher solvent power for cellulose acetate for example, triacetin or dimethyl phthalate.

Suitable solvents for cellulose acetate when employing a dope with which to coat the wood particles include in addition to the solvents mentioned above, methylene ethylene ether, mixtures of methylene chloride or ethylene chloride with methanol or ethanol and of acetone, ethanol and benzene.

The following examples in which all the parts are by weight illustrate the invention:

Example 1

A moulding powder is made of the following composition:

	Parts
Cellulose acetate of acetyl value about 53% (calculated as acetic acid)	63
Dimethylphthalate	28
Tri-phenylphosphate	9

This powder is mixed in a Werner-Pfleiderer mixer with three times its weight of a Columbian pine sawdust which passes a sieve of 20 meshes to the inch and is retained by one of 40 meshes to the inch.

The mixture is pressed in a multi-platen press for 30 minutes under a pressure of 1,000 to 1,500 lbs. per square inch, to form sheets about ½ of an inch in thickness.

In this way a sheet material of specific gravity of about 1.2, suitable for use as a building board and capable of being sawed, drilled or nailed can be obtained.

Example 2

A moulding powder of the following composition is made:

	Parts
Cellulose acetate as specified in Example 1	1
Di-methoxyphthalate	1

This powder is mixed with 5 times its weight of the saw-dust specified in Example 1 and boards are moulded from the mix as described in that example.

The boards formed are of higher tenacity and extension than those of the previous example and of slightly higher specific gravity.

Example 3

A moulding powder is made of the following composition:

	Parts
Ethyl cellulose of ethoxy content about 29%	5
Di-ethylphthalate	1

This powder is mixed with twice its weight of wood sawdust and moulded as described in Example 1. The boards formed are of higher water-resistance than those of Examples 1 and 2.

Example 4

The process is carried out as described in Example 3 but substituting for the ethyl cellulose a cellulose acetate-stearate of acetyl value 39.9 and stearoyl value 29 (both calculated as percentages of the fatty acid concerned). Somewhat lower pressures can be employed in moulding the mix of this example owing to the greater plasticity of the acetate-stearate compared with the cellulose derivatives of the previous examples. Thus a good compact board can be obtained by moulding for 30 minutes at 500 to 1,000 lbs. per square inch. The method of this example enables products of still higher water-resistance than those of the preceding examples to be obtained.

Example 5

A dope of the following composition is formed:

	Parts
Cellulose acetate as specified in Example 1	10
Tri-acetin	10
Acetone	25
Ethanol	10
Benzene	15

Sixty parts of wood sawdust are mixed into this dope in a Werner-Pfleiderer mixer. The composition is then dried free from volatile solvent and moulded into boards as described in Example 1.

Example 6

The process is carried out as in Example 5 except that a dope of the following composition is employed:

	Parts
Cellulose acetate of acetyl value 56–59% (calculated as acetic acid)	10
Dimethyl phthalate or diallyl phthalate	2 to 5
Methyl acetate	100

In this way a product of higher water-resistance than that of Example 5 can be obtained.

Example 7

The process is carried out as in Examples 5 or 6 but substituting for the sawdust an equal weight of wood shavings. In this way boards are formed having a pleasant pattern-effect. The products of this example are in general less water-resistant and of lower tenacity than those of the previous examples in which sawdust is employed.

Example 8

The process is carried out as in Examples 5 or 7 but employing a dope of the following composition:

	Parts
Cellulose acetate-stearate as specified in Example 4	15
Di-ethylphthalate	6
Acetone	160

Example 9

The process is carried out as in Example 5 or 7 but using a dope of the following composition:

	Parts
Cellulose acetate-stearate of acetyl value 24.1 and stearoyl value 54.5 (calculated as percentages of the fatty acid)	9
Di-ethylphthalate	2
Acetone	70
Benzene	8

Example 10

A moulding powder is made of the following composition:

	Parts
Cellulose acetate	20
Di-ethylphthalate	9
Ethanol	20

50 to 60 parts of sawdust are mixed with this powder and the powder is then dried free from ethanol and moulded into boards as described in Example 1.

Although the best results have been obtained using a cellulose derivative binder, thermoplastic synthetic resins may be employed in place of the cellulose derivatives of the above examples. Thus dopes or moulding powders having a basis of polymethyl methacrylate can be employed. The products obtained, however, are in general of considerably lower impact strength than when cellulose derivatives are employed. Polyvinyl acetate may also be employed instead of the cellulose derivatives, but in this case the products are softer and less resistant to heat.

The material of the invention may usefully be produced in the form of sheets from ¼" or less up to ½" or more in thickness and having sides several feet in length. Such sheets may, for example, be used, mounted on suitable frames, in forming the walls and roofs of huts, barns and like buildings. They may also be used for interior panelling and as ceiling boards, black-out screens and the like. They may be formed with plane perpendicular edges or with edges bevelled, rabbeted, tongued and grooved or otherwise shaped so that adjacent sheets interlock. The material of the invention may also, by the use of suitably shaped moulds, be produced in forms suitable for use as frame members for windows or doors, picture rails, hand-rails, skirting boards, cornices and other interior fittings commonly made of wood. Furniture components can also be formed of the material. The material can further be produced in the form of thick sheets, slabs or blocks from which short scantlings, planks and boards can be cut. Where ornamental materials are required, patterned dies may be used in the moulding operation.

The material of the invention can be sawn, drilled and nailed in a similar way to wood, it can also be remoulded under heat and pressure. The water-resistance of the material may be enhanced by an overall coating with paint, varnish or lacquer. Thus, for example, paints containing linseed oil or other drying oils, or lacquers or varnishes having a basis of natural or synthetic resins or water-resistant cellulose derivatives can be applied, for example by brushing or spraying methods; or the materials may be given a coating of a partially polymerised thermosetting synthetic resin which may then be further polymerised to the insoluble condition on the material. The material for example, may be coated with a solution of an intermediate condensation product of formaldehyde with urea, a phenol, or like polyfunctional monomer and may then be baked to insolubilise the condensation product. The material can also be given a metallic coating, for example by spraying methods.

Laminated materials may be built up by uniting two or more sheets of the material of the invention by means of a suitable adhesive, e. g. cellulose acetate or other thermoplastic film-forming polymer or a thermosetting synthetic resin. The adhesive may be applied in solution in a volatile solvent or in powder form, union being then effected by a hot pressing operation.

Having described our invention, what we desire to secure by Letters Patent is:

1. A molded structural material having a specific gravity between about 0.1 and 0.5 and being suitable for use in paneling, said material consisting of wood chips closely bonded together into a coherent mass by means of a binder consisting solely of a substantially solvent-free plasticized substance selected from the class consisting of water-insoluble organic esters and ethers of cellulose, at most 4 parts of said substance being present per 5 parts of wood chips, the parts being by weight.

2. A molded structural material having a specific gravity between about 0.1 and 0.5 and being suitable for use in paneling, said materials consisting of wood chips closely bonded together into a coherent mass by means of a binder consisting solely of a substantially solvent-free plasticized cellulose acetate, at most 4 parts of said substance being present per 5 parts of wood chips, the parts being by weight.

3. A molded structural material having a specific gravity between about 0.1 and 0.5 and being suitable for use in paneling, said material consisting of wood chips closely bonded together into a coherent mass by means of a binder consisting solely of a substantially solvent-free plasticized ethyl cellulose, at most 4 parts of said substance being present per 5 parts of wood chips, the parts being by weight.

4. A molded structural material having a specific gravity between about 0.1 and 0.5 and being suitable for use in paneling, said material consisting of wood chips closely bonded together into a coherent mass by means of a binder consisting solely of a substantially solvent-free plasticized cellulose acetate stearate, at most 4 parts of said substance being present per 5 parts of wood chips, the parts being by weight.

5. Process for the production of a structural material suitable for use in paneling, which comprises closely bonding together into a coherent mass having a specific gravity of 1.0 to 1.5, at a temperature of about 150° C. and a pressure of 150 to 1500 lbs. per square inch, and in the substantial absence of a solvent, wood chips coated with a binder consisting solely of a plasticized substance selected from the class consisting of water-insoluble organic esters and ethers of cellulose, at most 4 parts of said substance being present per 5 parts of wood chips, the parts being by weight.

6. Process for the production of a structural material suitable for use in paneling, which comprises closely bonding together into a coherent mass having a specific gravity of 1.0 to 1.5, at a temperature of about 150° C. and a pressure of 150 to 1500 lbs. per square inch, and in the substantial absence of a solvent, wood chips coated with a binder consisting solely of a plasticized cellulose acetate, at most 4 parts of said substance being present per 5 parts of wood chips, the parts being by weight.

7. Process for the production of a structural material suitable for use in paneling, which comprises closely bonding together into a coherent mass having a specific gravity of 1.0 to 1.5, at a temperature of about 150° C. and a pressure of 150 to 1500 lbs. per square inch, and in the substantial absence of a solvent, wood chips coated with a binder consisting solely of a plasticized ethyl cellulose, at most 4 parts of said substance

being present per 5 parts of wood chips, the parts being by weight.

8. Process for the production of a structural material suitable for use in paneling, which comprises closely bonding together into a coherent mass having a specific gravity of 1.0 to 1.5, at a temperature of about 150° C. and a pressure of 150 to 1500 lbs. per square inch, and in the substantial absence of a solvent, wood chips coated with a binder consisting solely of a plasticized cellulose acetate stearate, at most 4 parts of said substance being present per 5 parts of wood chips, the parts being by weight.

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