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COATED WOODEN FORMS FOR CONCRETE

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This invention relates to a construction material suitable for use in preparing forms for the pouring of concrete or cement, and more particularly to a treated plywood or other fibrous wood or paperboard of increased utility.

Rough wooden forms have long been used to hold concrete in proper position until the characteristic hardening has occurred. For rough work, untreated second or third grade lumber has been quite satisfactory, but where a smooth, highly finished concrete surface is desirable, special treatments have been suggested for surfacing the wood.

Plywood with its smooth, relatively dense grain, its flexibility and strength has recently become popular for the preparation of forms. It has also become common practice to coat the surface of the plywood board with a cheap mineral oil. This procedure is moderately effective but the oil has a strong tendency to sink into the board and/or evaporate, and the disappearance of the surface coating in most cases allows some concrete to adhere to the board when the form is removed, even on its first use. This adhering concrete is generally in an amount sufficient to make cleaning and recoating with the oil difficult and expensive. Also, in most instances, the concrete surface produced by the oiled boards is still too rough for the finer types of work and, in particular, the grain of the wood can be detected in almost every case as an imprint on the concrete. Then, too, on disappearance of the oil, the plywood is subject to cracking and splitting which renders the form objectionable for further use.

Nitrocellulose wood lacquers have been suggested and used as surface coatings to some extent. The initial material cost is high, and the cost of refinishing the boards after each use has made the general application of these lacquers uneconomical. The results produced by lacquers has been quite satisfactory during the useful life of the coatings, but this useful life has to the present been too short.

It is an object of this invention to produce a treated plywood or equivalent fibrous board which can be used repeatedly without recoating. A further object is the production of a suitable board which is highly resistant to warping or swelling during its use, especially when in contact with the wet concrete mixes. A further object is the production of an article having a smooth surface and a surface which in itself is highly water-repellent. A further object is an article which does not need constant cleaning

and refinishing to preserve the initial smoothness of the surface. Another important object is the production of an article, the surface of which will not adhere to the concrete at any stage of the drying. Other objects will appear hereinafter.

We have found it possible to secure all of these objects by the use of a plywood or other fibrous board, the surface of which has been coated with one or more coats of a nitrocellulose lacquer which has present in its composition a moderate amount of at least one water-repelling, adhesion-resisting agent taken from the group of materials consisting of waxes, solid fatty acids, water insoluble metallic soaps and mineral oils.

Example I

	Parts by weight
Nitrocellulose.....	5.5
20 Titanium dioxide.....	1.2
Zinc stearate.....	1.4
Carnauba wax.....	1.0
Dammar resin.....	2.7
Tricresyl phosphate.....	2.7
25 Denatured ethyl alcohol.....	7.5
Methyl ethyl ketone.....	14.0
n-Butyl acetate.....	18.1
n-Butyl alcohol.....	7.6
Toluol.....	33.0
30 High-solveny petroleum naphtha.....	5.3
	100.0

This lacquer has a total solids content of 14.5% by weight of which the adhesion-resisting agents (zinc stearate and the wax) represent 2.4%; or expressed as per cent of the total solids, the adhesion-resisting agents represent 16.5%.

The nitrocellulose used was of a high viscosity type characterized as about 5.5 seconds according to A. S. T. M. method D-301-33 Formula A.

The titanium dioxide pigment was dispersed in the presence of a portion of the nitrocellulose according to the general method of Hucks U. S. Patent 2,052,470. The zinc stearate was ground in a ball mill in a portion of the solvent mixture. The carnauba wax was dispersed in a ball mill in a portion of the denatured ethyl alcohol.

The several dispersions and the remaining single ingredients were finally blended in a mixer and agitated until a homogeneous lacquer was produced.

Two coats sprayed onto one side of a fir plywood panel gave a smooth surface which when used as the form sides for a series of con-

crete mixes had a useful life of twice that of a plywood panel coated with a conventional wood lacquer which did not contain the adhesion-resisting agent. Eventual failure occurred principally because of the expansion and contraction of the plywood which caused minute cracks in the lacquer coating. After a slight cleaning operation the brushing or spraying of an additional coat of the lacquer restored the plywood to full serviceability. Thus, a treated sheet of plywood served for many pourings with the result that a uniformly smooth surface of the set concrete was secured at a lower overall cost for the form materials.

Example II

	Parts by weight
Nitrocellulose (low viscosity)-----	9.00
Stearic acid modified alkyd resin-----	13.50
Zinc stearate-----	.90
Denatured ethyl alcohol-----	10.50
n-Butyl acetate-----	14.40
Methyl ethyl ketone-----	14.90
n-Butyl alcohol-----	3.00
High solvency petroleum naphtha-----	33.80
	100.00

This lacquer has a total solids content of 23.4% of which the adhesion-resisting zinc stearate represents 3.8% of the total solids. The use of a stearic acid modified alkyd resin assists in part, as the stearic acid imparts a waxy character to the resin and some free stearic acid may be present. The particular resin used contained in combined form 16.6 parts of glycerol, 26.7 parts by weight of phthalic anhydride, 25.1 parts by weight of stearic acid and 31.6 parts by weight of rosin.

The nitrocellulose was of the low viscosity type having a viscosity characteristic of about 3 seconds when measured in Formula C of A. S. T. M. test method D-301-33.

The zinc stearate was incorporated by first grinding it in a ball mill with a portion of the solvent mixture. Blending of all ingredients was accomplished in a conventional agitation type mixer.

Two coats of this lacquer applied by spraying to one side of a Douglas fir plywood board gave a built-up finish having a smoothness satisfactory for use. Selection of the type of lacquer used is, therefore, dependent upon a number of factors including its cost, the build secured for each coat applied and the degree of expansion and contraction occurring during the actual use of the plywood form as well as its resistance to water and alkali.

The useful life of a board coated to a given smoothness with the lacquer of Example II was also somewhat in proportion to the effective agent. The lacquer of Example II gave an increased useful life of about 50% as compared with a conventional wood lacquer.

The lacquer coating may be applied by any convenient method including spraying, brushing, dipping or roller coating. The volatile liquid components of the lacquer will in any case be formulated to give the best possible results in line with the method of application chosen.

The nitrocellulose may be of any suitable viscosity type. Normally the so-called low viscosity nitrocellulose of commerce will be most satisfactory, in that higher solids compositions can be produced at application viscosity. In certain cases, the use of the somewhat stronger, tougher,

high viscosity nitrocellulose may prove most valuable. Compositions based upon water insoluble cellulose esters and ethers and containing adhesion-resisting agents provide efficient coatings for our purpose. Cellulose acetate and ethyl cellulose provide examples of commercially available products suitable for our purpose.

Natural or synthetic resins may be used and these contribute greatly to the adhesion between the board and the lacquer coating. It is essential, however, that these resins be resistant to the alkali present in the concrete mixes and compatible with the cellulose derivative used. Of the natural resins, dammar is the most satisfactory for use with nitrocellulose. Synthetic resins such as ester gum, the oil and/or resin modified alkyd condensation products, the phenol formaldehyde and the urea-formaldehyde resins can often be used with advantage. Other synthetic resins such as those represented by the vinyl or methacrylate classes and which show sufficient compatibility with nitrocellulose and alkali-resistance may also be present. In all cases the resin should be resistant to softening by the resinous oils of the wood.

As in practically all lacquer compositions, plasticizers may be used to impart flexibility. Here again alkali and resin oil-resistance are important, and tricresyl phosphate has been found to be very efficient and its use is preferred. Many other plasticizers for nitrocellulose can be used alone or in combination with the tricresyl phosphate.

The usual white pigmentation of lacquers is designed to produce opacity or hiding. This is normally accomplished by the use of pigments having high hiding power. Zinc oxide and titanium oxide are commonly used for this purpose. In order to secure the required hiding power, pigment concentrations of 15 to 30% of the total solids are normally required, but these high concentrations of pigment tend to embrittle the film. In the surface coating of plywood for our purpose it is necessary to make use of strong flexible films, and it is important to minimize the quantity of pigment to that amount which shows a real benefit in partially obscuring any staining from resin oils in the wood and identifying the treated surface when only one side is lacquered. Normally it has been found that zinc oxide and titanium oxide in amounts of less than 10% of the total solids are the most effective for this purpose and their use is preferred, although a great variety of pigments can be used.

Many suitable water-repelling, adhesion-resisting agents are materials difficultly soluble or insoluble in organic solvents and must be introduced into the lacquer by special dispersion means. In the case of the use of highly insoluble waxes such as carnauba, and also in the use of the difficultly soluble metallic soaps, a grinding or dispersion process in a non-solvent has been found to be satisfactory; for example, carnauba wax or zinc stearate may be ground in denatured ethyl alcohol by means of a ball mill. The more soluble waxes may, in certain cases, be incorporated by dissolving in a warm or hot solvent and added to the lacquer solution. The waxes in this instance will normally be thrown out of solution on cooling and will form a fine particle suspension in the lacquer. The fatty acids are not completely satisfactory when used alone but are often effective in combinations.

The paraffin waxes cannot be used unless provision is made to dry the lacquer coatings at

temperatures well above the melting point of the wax. Ordinarily the presence of only traces of a paraffin wax will prevent the satisfactory drying of a nitrocellulose lacquer at normal temperatures. A further disadvantage of paraffin lies in the fact that recoating is impractical. Therefore, such waxes alone are not suitable for the purpose of the invention.

The quantity of adhesion-resisting agent required will vary. We prefer to have these agents present to an amount of about 15% of the total solids content of the lacquers. In some cases as much as $\frac{1}{3}$ of the total solids may represent adhesion-resisting agents, but in general these high concentrations tend to make the film pudgy and with poor resistance to abrasion. The lower limit will seldom be below about 3.0% of the total solids.

Water-repelling, adhesion-resisting agents applicable to our invention include the hard natural waxes but not paraffin. Some of the common hard waxes are carnauba wax, Japan wax, candellilla wax, beeswax and palm wax. Oxidized montan waxes, hydrogenated castor oil, and similar synthetic waxes are very effective. In the claims the term hard wax includes these but excludes paraffins notwithstanding the hardness of some types of paraffins. The metallic stearates such as zinc, magnesium, aluminum, calcium and lead stearate are quite effective. The solid fatty acids such as stearic and palmitic acid can be used but normally should be combined with a wax, metallic stearate or mineral oil. It has been found that combinations of adhesion-resisting agents are often superior to the use of single agents, and in general we prefer combinations. In the claims the term wax-like, water-repelling adhesion-resisting agent refers to the materials just described.

In all cases where these agents are used, it will be found that the resistance to wetting by water, when the water is applied to the surface of the dry lacquer film, will approximate the water-repellency of the adhesion-resisting agent itself. Water, therefore, does not effectively wet these lacquer films and, therefore, they tend to shed water and to prevent adhesion of the wet concrete mix.

The laminated wood sheeting commonly designated as plywood represents our preferred basic material, and the resin bonded or waterproof grade is superior to the glue or casein bonded grades commonly used for interior construction. Other types of synthetic board may be used, but in case of the more porous types, a filler for surfacing prior to the application of our preferred compositions may be necessary. The lacquer can also be advantageously applied to almost any type of wood provided the surface is planed or otherwise treated to form a moderately smooth surface initially so as to permit formation of a

smooth lacquered surface with a minimum of lacquer. Dense paperboard can also be advantageously treated and will give excellent materials for our purpose but, in general, must be lacquered on both sides and the edges to prevent disintegration.

The principal advantages of our product include the final formation of a concrete surface of excellent smoothness and freedom from designs or markings of the surface of the form. A further advantage lies in the longer serviceable life of the form, in its resistance to expansion and contraction in the presence of the wet concrete, and the ease with which it can be removed when the concrete has set, due to the complete lack of adhesion between the lacquered surface of the plywood and the hardened concrete. A further advantage lies in the fact that further coats of lacquer can be applied to repair minor surface defects or to completely recoat the surface without difficulty.

It is apparent that many widely different embodiments of the invention may be made without departing from the spirit and scope thereof; and, therefore, it is not intended to be limited except as indicated in the appended claims.

We claim:

1. A concrete form comprising a wooden member coated at least on the molding surface with a lacquer containing a cellulose derivative and at least one wax-like, water-repelling, adhesion-resisting agent.
2. The article of claim 1 wherein the total water-repelling, adhesion-resisting agent represents from about 3 to 33 per cent of the solids content of said lacquer.
3. A concrete form comprising a wooden member coated at least on the molding surface with a lacquer containing nitrocellulose and a water-insoluble metallic soap, said metallic soap being present in an amount between about 3 and 33 per cent of the solids content of said lacquer.
4. A concrete form comprising a wooden member coated at least on the molding surface with a lacquer containing nitrocellulose and a hard wax, said wax being present in an amount between about 3 and 33 per cent of the solids content of said lacquer.
5. The article of claim 1 in which the said wax-like agent is a salt of stearic acid and is present in the amount of about 15% of the composition.
6. The article of claim 1 in which the wax-like agent is a salt of palmitic acid and is present in the amount of about 15% of the composition.
7. The article of claim 1 in which the said wax-like agent is a hard wax and is present in the amount of about 15% of the composition.

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