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PROCESS FOR PREPARATION OF LEATHER-LIKE FLEXIBLE AND PLIABLE MATERIAL FROM WOOD SHEETS

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The invention concerns a leatherlike, flexible and pliable material from wood sheets or rods with retention of the natural wood structure and of the characteristic wood grain, as well as a process for its production and manufacture.

The sphere of application of such products lies preeminently in the preparation of non-splitting veneers, wall coverings, furniture upholsterings, roll shutters, fancy goods and various containers. In all of these cases it is necessary to have completely plane working pieces, which may be coated and glued. By the following process it is possible to manufacture a material which satisfies these requirements in all respects. The method consists in a chemical softening, a treatment for the stabilization of this softened condition, a treatment with film-building colloids and possibly a mechanical treatment.

I. Chemical softening

It is possible to transform thin wood sheets or woods into a soft, flexible condition by all processes for cellulose production, so long as the treatment is not extended too far. Especially good results may be obtained by the alkali softening, which results in a thorough swelling and loosening of the wood structure. The soft flexible structure, however, only lasts as long as the wood contains enough water. It gradually loses these properties by air-drying, and the dry product finally again becomes hard and brittle.

II. Preservation of flexibility

In order to cause wood, which has been softened, to be permanently soft and flexible, it must be impregnated with materials of low vapor pressure which are suited to stabilize the condition of loosening and swelling. Experiments have shown that two groups of substances come into consideration for such an impregnation. The first group contains substances of low vapor pressure which are water soluble and perhaps water attracting, such as glycerol, monoacetin and lactates. These substances act themselves as swelling and softening preservatives. Since it is necessary to introduce large quantities of these materials into the wood in order to retain it in a sufficiently soft condition, this sort of impregnation is rather expensive. The second group contains water insoluble but emulsifiable substances, such as liquid, dissolved or emulsified hydrocarbons, fats, oils and soaps, known emulsifying agents, such as sulpho- and oxyfatty acids and their derivatives (Turkey red oil, or similar products such as alkali salts of sulfonated castor oil). To be sure, the substances of the second group work as retainers or softeners on the softened wood, still their effectiveness is largely dependent on moisture content of the material. Thus, a softened board, treated with wool fat soon becomes hard and brittle when put in warm, dry air. It was, however, found that very good results might be obtained by using plastifiers of both groups, as then even in dry air the plastifying action of both groups, which in each case has a different cause (group I acts mostly through swelling, group II through lubrification) work together. An instance of such impregnation, which makes possible an important reduction of manufacturing costs and at the same time an improvement in the product, will be given later under sample applications.

It was further settled by experiment that for the production of products which are plane and at the same time suitable for gluing and lacquering, it is necessary to avoid transformation of the cellulose into cellulose hydrate, both during the alkali softening (which will usually come into question) and during the following impregnation. X-ray tests of the wood samples serve as criterion. Only the cellulose interferences should appear, not those of cellulose hydrate. The transformation of native cellulose into cellulose hydrate involves a shrinkage of 10% in the fiber direction, and this is a substantial ground why the originally flat veneers or slats warp, and the wood grain shows in relief, owing to the inhomogeneity of the material. If solutions of strongly hygroscopic materials, such as zinc chloride (which itself brings about the transformation of the native wood cellulose into cellulose hydrate) are used, the inequalities of the wood disappear somewhat. Still, such a product, by reason of its high moisture content, may be neither glued nor lacquered, and is besides unstable because of its acid reaction. Therefore it is not usable for the above purposes.

For the production of working material of the above named properties it is not only necessary that, by preventing formation of cellulose hydrate, no shrinkage in the fiber direction occurs, but that the shrinkage perpendicular to the fiber direction be reduced as much as possible, which may be obtained by suitable composition of the impregnating liquid. For many purposes it is sufficient to use an impregnation with a suitable concentration of a solution of a plastifier of the first class, e. g., impregnation with a 35 vol. percent glycerol solution. (If the concentration is much below 35%, there results

shrinkage and insufficient plastifying action; if much above, the material is unsuited for further work because of its hygroscopicity.)

Very suitable, however, is an impregnation with a combination of plastifiers of both groups, for example, with glycerol and soap (see sample application). In this case shrinkage is entirely avoided and 40%–50% of the glycerol which otherwise would be required is saved. In general, it was made evident that shrinkage in the direction perpendicular to the fiber direction and a, though small, saving in glycerol would be obtained if non-volatile fillers were added to the glycerol-water mixture, even if these fillers had in themselves no softening action. Thereby the vapor pressure of the solution is reduced, and a greater weight of the mixture is in equilibrium with the surrounding atmosphere than in the case of pure glycerol impregnation of the above concentration. It follows therefrom that a part of the glycerol may be spared. Starch sugar, invert sugar, and organic combinations, etc. can be used as fillers. What is here said for glycerol applies equally well for the other usable plastifiers. The following operations, gluing of a support and lacquering, are made easier if the impregnating bath contains additions of colloidal lyophile substances such as starch, dextrine, pectin, gelatine, etc.

Example methods

1. Linden wood veneers one millimeter thick are treated, 6 hours with cold 4% caustic soda, washed, bleached by the usual methods (oxidative and reductive) to the original lightness, thoroughly washed, impregnated with a 35% by vol. solution of glycerol in water until saturated, then dried in the air. Each kilogramme original weight of wood takes up about 600 grammes glycerol.

2. Maple, oak and pine and other woods which are difficult to soften are treated three hours cold and 12–16 hours with boiling 4–8% caustic soda and then further as in (1).

3. Colored wood, such as walnut, mahogany, etc. of 0.5 mm. thickness, is softened as in (1), bleached with 2% oxalic or sulphuric acid, and further treated as in (1).

4. Linden veneers are softened as in (1), and bleached, then treated in a shaking machine 24 hours with a solution containing 20% by vol. glycerol and 80% by vol. of a mixture of an alkali salt of sulfonated castor oil and water in the ratio of 1:2, then air dried.

5. Linden veneers are softened as in (1), and impregnated with a solution of 20% glycerol, 25% glucose syrup (43 Bé.), and 25% water. A small quantity of antiseptic is added to the bath.

6. Linden veneers are softened as in (1), bleached and impregnated with a solution of 35% glycerol and 10% dextrine in water. A little antiseptic must be added to the bath.

III. Treatment with film forming colloids

The products manufactured by the above process are flexible and pliable, are the same in appearance as natural wood and are completely flat. However, they have only a small strength in the direction perpendicular to the fiber, and on folding parallel to the grain the wood splits more or less readily, depending on the sort of wood.

We have found that this failing can be avoided by treatment with elastic film forming colloids. These substances hold the wood structure together and so prevent splitting, breaking and splintering. Rubber, polyvinyl acetate, polyacrylic acid, glue, gelatine, cellulose esters and physically similar substances are suited for elastic film building colloids. The treatment with these substances may occur either through impregnation or on the surface.

Polyvinyl acetate and polyacrylic acid have a great advantage over the physically similar cellulose esters, in that they are more hydrophile, whereby for example an adherent coating may be made on relatively moist wood fibers.

The impregnation may be either performed by the usual methods with a solution of the colloid (with or without the addition of plastifiers), or else polymerizable substances, such as vinyl acetate, acrylic acid, etc. (with or without addition of plastifiers) may be soaked up in the wood and there polymerized in the known manner, for example with catalyzers.

The impregnation with film forming colloids can in certain instances occur in connection with the plastifying stage described under II.

It is possible in some cases to replace the expensive and difficult impregnation with film building colloids by brushing, dipping or spraying so that only a surface coating is formed.

At the same time, this coating acts as a lacquer, whose thickness is chosen to correspond with the awaited conditions of service, and, for the sake of convenience, we shall claim the above-mentioned substances as lacquers. In certain cases, where severe mechanical forces do not have to be withstood, as in wall coverings, this coating serves only the purpose of a varnish.

IV. Mechanical working

It is advantageous at some time before, after or during the above described process to give the wood sheets a mechanical working in calenders or perhaps presses, whereby the pliability of the material is considerably increased.

Example methods

7. The sheets softened and impregnated according to Examples 1–6 are worked mechanically by calenders or presses. Then they are given a coating of highly elastic nitrocellulose lacquer by brushing, dipping or spraying. The thickness of this depends upon the mechanical requirements, and therefore the process is repeated until the coating is thick enough.

8. The sheets impregnated according to Examples 1–6 and mechanically worked are first given a coating of polyvinyl acetate lacquer by brushing, dipping or spraying on one or both sides and then a coating of nitrocellulose lacquer is put on. Highly polymerized vinylacetate is especially suitable for brushing or dipping, while the lower polymerization grades are better adaptable for spraying.

9. The softened sheets are (possibly after washing out the water with methanol) impregnated at 80° under a pressure of 5–20 atmospheres with a solution of 120–150 g. gelatine or glue, 350 g. glycerine and 600–700 cc. water. After this the gelatine or glue is hardened and the surface in the usual way with formaldehyde or alum solution. After thorough drying the sheets are given a thin lacquer coating.

10. The sheets softened and impregnated according to Examples 1–6 are laid for a short while in a solution of 120–150 g. gelatine, 250 to 450 g. glycerine and 600–700 g. water heated on the water bath, hardened and further treated as under (7).

V. Gluing of a support

There is a large field of application for soft and pliable wood sheets, when they are united to a textile base according to our invention. The material worked by the method described has comparatively little tensile strength perpendicular to the fiber direction. For certain purposes it is therefore desirable to glue it by a further process (usually after the impregnation with softening agents) to a flexible support. Such a compound sheet consists of an upper layer of pliable wood and an under layer of felted fibers, films or fabric of any sort. In some circumstances a metal cloth or sheet can serve as under layer. Also, pliable wood itself can be used for the support, the grain of the upper and lower layers being either parallel to one another, or at an angle to each other.

The pliable wood and the textile base are combined by means of an adhesive. It may be advantageous in case of some varieties of impregnating material to provide a protecting coating impervious to water and to impregnate before gluing. Also, the protective coating and the adhesive can be one and the same material, such as polyvinyl acetate, cellulose esters (such as celluloid-like glues) and physically similar substances.

The glued material may be folded and rolled up. It can be made in practically endless bands. It shows the growth anisotropy of the wood, which can be more or less emphasized by use of fabric supports with the warp and filler made of threads of differing strengths.

Because of these properties, the material may be advantageously used for many purposes. Such compound sheets are especially suitable for roll curtains on windows, doors or cupboards, in place of the usual curtains of wood slats, as the latter have many disadvantages. The division into many slats not only increases the weight, but also causes a noisy operation and is unsatisfactory on aesthetic grounds, because the grain peculiar to the wood and especially desired in furniture is not properly brought out. These disadvantages are not observed when using the new material. Indeed, it offers new advantages, if the roller axis is perpendicular to the grain. Thereby the growth characteristics of the wood are used in the best manner, as then the direction of greatest strength falls in the direction of the hardest requirements, and even by repeated alternating loads plastic deformation is avoided and the wood is not deformed in fiber direction.

The material is in this regard better than artificial leather, which is plastically deformable in every direction when alternately loaded and unloaded.

The wood layer may be provided with openings of any desired form, in order, for example, to let air through for heating or ventilating purposes. This is not hindered by the cloth support. Such openings also make the material suitable for coverings for musical instruments, loud speakers, etc.

Our veneer after softening and mounting on a support, possesses the advantage over the known plywood of thin veneers of a greater resistance to separation of the layers, especially after repeated bending and folding strains, and it is incomparably more pliable. As a result, the material is suitable for floor-carpets, stair-carpets and the like; covering for flat or curved surfaces, for example, as wall covering, non-splintering veneer and chair upholstery. In the latter case it is better to take advantage of the anisotropy of the material and have the grain go from front to back.

The material has especial interest when cut into strips and used for basketwork. In this case it is advantageous to cut the strips along the grain.

Compound sheets may also be made in which one or both sides have been covered with films (e. g. Cellon films). Such materials are suitable, for example, for unbreakable phonograph records.

As already mentioned, the wood sheets after softening and being made pliable are suitable either alone or in combination with a textile base as covering for plane or curved surfaces. The compound sheets are very suitable for wall coverings, as they may be made in rolls of any desired length and width and applied to the wall in the same manner as wall-paper. Still, correspondingly large pliable veneer sheets without support can find use. In some cases the unlacquered material may be mounted and then varnished.

The new material has the advantage for wall coverings that it is insensitive to blows, tension and pressure, because of its plasticity and elasticity. Therefore cracks in the wall are not transmitted through the covering and remain invisible. In this respect the material is different from all previously known rolled-up wall-paper. It must be remarked that ordinary veneer has not been until yet used for wall coverings because of its brittleness and of the difficulty of applying it to the wall.

What we claim is:

1. The process of making a thin piece of wood soft and permanently flexible which comprises subjecting it to the action of an alkali solution of such a strength and for such a time that the natural wood structure is swollen and loosened without being destroyed and without destruction of the characteristic wood grain thereof, washing, and then saturating with a water-soluble substance such as glycerol, likewise of such a strength and for such a time as to avoid destruction of the natural wood structure and characteristic grain thereof.

2. The process of making a thin piece of wood soft and permanently flexible which comprises subjecting it to the action of an alkali solution of such a strength and for such a time that the natural wood structure is swollen and loosened without being destroyed and without destruction of the characteristic wood grain thereof, washing, and then saturating with a water-soluble substance such as glycerol, monoacetin or a lactate, in combination with an emulsified water-insoluble substance such as a hydrocarbon, fat, oil, or soap, likewise of such a strength and for such a time as to avoid destruction of the natural wood structure and characteristic grain thereof.

3. The process of making a thin piece of wood soft and permanently flexible which comprises subjecting it to the action of an alkali solution of such a strength and for such a time that the natural wood structure is swollen and loosened without being destroyed and without destruction of the characteristic wood grain thereof, washing, then saturating with a water-soluble substance such as glycerol, likewise of such a strength and for such a time as to avoid destruction of the natural wood structure and characteristic grain thereof, and submitting the product to pressure.

4. The process of making a thin piece of wood soft and permanently flexible which comprises subjecting it to the action of an alkali solution of such a strength and for such a time that the natural wood structure is swollen and loosened without being destroyed and without destruction of the characteristic wood grain thereof, washing, then saturating with a water-soluble substance such as glycerol, likewise of such a strength and for such a time as to avoid destruction of the natural wood structure and characteristic grain thereof, and impregnating the product with a lacquer.

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