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GLUING MATERIALS TOGETHER

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It has long been customary to glue materials together by means of an isolated or substantially pure protein, as for instance casein, by initially treating to bring into a dispersed condition such as to then involve a liquid form of adhesive. By dispersion is meant that colloidal system in which dilution can be carried to a high degree without apparent loss of homogeneity in the system. Various chemical agents have been necessary in order to reduce casein or the like to this condition, and a corresponding rather elaborate technique has been required in the initial preparation and conditioning of the glue, so that it will have the right conditions of viscosity, spreadability, lack of deterioration before spreading or while standing before pressing, etc. Moreover, it has commonly been considered necessary to dissolve or disperse proteinous substances before their action as adhesives was utilized. Again it has been considered that in order to secure water-resistant results lime had to be incorporated and it is well known that casein glues heretofore which do not contain lime are non-water resistant. In accordance with the present invention, however, I am enabled to employ such a non-dispersed material and correspondingly all the disadvantages and difficulties characteristic of the old practice are avoided. Moreover, with the absence of such extreme water solubility, I am enabled to attain superior water-resistant results and without the undesirable use of lime at all. Furthermore, the invention provides a procedure where the penetration of the adhesive is limited to a desirable point, particularly in the presence of a quantity of water at the glue line which would act to carry a dispersed glue unnecessarily and undesirably into the wood.

As adhesive base material, I may employ segregated proteins, such as casein, gluten, segregated or isolated protein from oil seed flours, such as soya bean, hempseed, castor, etc., or I may employ a vegetable proteinous material in the form of a ground seed flour, for instance the residue of oleaginous seeds from which the oil has been removed being particularly advantageous. Examples of this are flour or meal made from cake or residue from soya bean, peanuts, cottonseed, flaxseed, perillaseed, hempseed, rapeseed, copra, tung nuts, castor beans, etc. The adhesive base is supplied to a surface to be glued in discrete particle form.

In the case of a surface already carrying moisture, as for instance a wood ply coming from a veneer cutting machine, the casein or the like in powdered or other discrete particle form may be applied by dusting or sprinkling. Preferably, the proteinous material, such as casein, isolated vegetable proteins, oil seed flour, or the like, is applied to a wet surface in relatively dry powdered form, and, after an assembly is formed, subjected to pressure and heat. Such material is capable of absorbing water to a certain extent, as from a wet wood ply, but since it does not yield a solution of the adhesive ingredients in hot or cold water, i. e., the adhesive ingredients remain in a substantially undissolved form therein, it is not at any time dispersed to a point where excessive penetration can occur. Water does act, however, to promote conditions which assist in the formation of a satisfactory bond. In some cases the amount of water carried by a wet veneer sheet, for instance, may be in fact in excess of desirable conditions. In such event I may preliminarily eliminate surplus moisture by mechanical or drying means. In dealing with dry surfaces, on the other hand, such as a dry veneer ply, I may supply moisture in any convenient manner before, with or after the application of the casein or the like, such as by brushing, spraying or atomizing, etc. Since the casein or the like is non-dispersed and not directly water soluble, I may in fact, if desired, provide moisture along with it and may even apply it in the form of a suspension of discrete particles in water in some instances. However applied, the protein is thus fundamentally in different condition from that characteristic of the old wet gluing practice in which the adhesive was dispersed in the water.

The amount of moisture thus required is seen to be different from that involved where the adhesive was reduced to a dispersed or fluid condition, and in my process the mois-

ture need be only sufficient to soften the protein, and adhesion is developed in the subsequent procedure. The amount of moisture may in some instances be as low as 1½ times the weight of the casein or the like, or even somewhat lower.

With the surfaces concerned suitably supplied with the casein or the like and assembled, the assemblage is then subjected to pressure and heat. The pressure may be adapted to the characteristics of the materials assembled, for instance, a green cottonwood being treated satisfactorily with pressures on the order of 40 pounds per square inch, while with a dense material, such as a dry yellow birch, pressures up to about 300 pounds are satisfactory. The invention finds a particularly advantageous application of such desirable adhesives as casein, isolated vegetable proteins, and oil seed flours, in the gluing of green or wet woods.

In applying pressure, the materials to be glued are subjected to conditions such as to provide a sufficient contact-film of the softened discrete protein particles whereby to form good contact with the surfaces to be glued. Heat being applied the heat and pressure act to eliminate excess water and to cause a limited degree of penetration of the proteinous material into the ply surfaces and thereupon to transfer it into a rigid, particle-united, water-resistant form uniting the plies. In this connection, it is to be noted that the term "particle-united" does not exclude a condition wherein certain of the particles retain their individuality. The protein may further be rendered additionally water-resistant through the coagulating action of the heat. Temperatures up to about 350 degrees F. may be applied, as desired in any particular instance. With low temperatures or a range only slightly above 212 degrees F., the casein retains its original color, but with higher temperatures around 275–350 degrees F., the casein is changed to deep orange color and its water resistance is greatly increased.

As illustrative of results obtained where gluing plywood in accordance with this invention, the following may be noted:

Wood	Binder	Dry strength	Wet strength
		Pounds	*Pounds*
Cottonwood	Casein	258	128
Southern gumwood	Casein	225	202
Yellow birch	Casein	420	270

Among the advantages of my process, in contrast with the customary practice employing a dispersed casein or the like, are the avoidance of all the troubles involved in making up a dispersed glue. No limitations relative to narrow requirements of viscosity, spreadability, etc., are concerned. Again, since I do not have to apply a fluid glue and set panels aside while accumulating a sufficient number for a pressfull, whereby some must stand longer than others before pressing, and with consequent variable changes in viscosity and amount of loss on the glue line by excessive penetration, I avoid the degree of non-uniformity inevitable with the old practice and all articles in accordance with my process develop adhesion under substantially the same conditions with the resultant high uniformity of quality. Again, since I start with a substance which is not dissolved in water and render it still more water-resistant by the process, I can obtain a superior water-resistance as well as uniform adhesion. Again, whereas fluid casein glues introduce a large surplus of water to be eliminated before the product is finished, by my process all such useless water may be avoided, with resultant lessening of warpage and checking of the product and acceleration of the gluing process itself. Wood and other materials as well, which are capable of being bound together by an adhesive, may thus be readily glued; with corresponding absence of the obstacles characteristic of the old methods in which a large surplus of water had to be introduced and eliminated. Nor is it necessary that the materials glued together be of definite geometrical shape. It will be understood that the term "dispersing agent" as used in the appended claims refers to materials such as have been used in conjunction with water to cause an aqueous dispersion of the adhesive base to be formed, but does not include water alone.

This application is a continuation in part of my application Serial No. 335,998, filed January 29, 1929.

The following applications are continuations in part of the present application: Serial No. 565,929, filed September 29, 1931; Serial No. 565,930, filed September 29, 1931, and Serial No. 596,070, filed March 1, 1932.

Reference is likewise made to the following applications which are also continuations in part of said application Serial No. 335,998; Serial No. 454,832, filed May 22, 1930; Serial No. 455,978, filed May 26, 1930; Serial No. 456,813, filed May 28, 1930; Serial No. 456,814, filed May 28, 1930; Serial No. 518,944, filed February 28, 1931; and Serial No. 538,983, filed May 21, 1931.

Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims, or the equivalent of such, be employed.

I therefore particularly point out and distinctly claim as my invention:—

1. A process of gluing, which comprises supplying in discrete particle form to a surface to be incorporated an undispersed proteinous material adhesive base of a character which does not yield a solution of the adhe-

sive ingredients in hot or cold water and which undergoes transformation in the presence of heat and pressure into a rigid, particle-united, water-resistant form in discrete particle form without presence of a dispersing agent, assembling, and applying pressure and heating the adhesive at a temperature above the boiling point of water.

2. A process of gluing, which comprises supplying to a surface to be incorporated a non-dispersed casein in discrete particle form and without presence of an alkaline reagent, assembling, and applying pressure and heat.

3. A process of gluing, which comprises supplying to a surface to be incorporated a non-dispersed casein in discrete particle form and without presence of an alkaline reagent, assembling, and applying pressure and heat to water-resistant condition.

4. A process of gluing, which comprises supplying to a surface to be incorporated a non-dispersed casein in discrete particle form and without presence of an alkaline reagent, assembling, and applying pressure and heat to at least 275° F.

5. A composite structure glued by casein supplied in discrete particle form and substantially free from alkaline reagents and being rendered water-resistant by heat.

6. Plywood glued by casein material supplied in discrete particle form and substantially free from alkaline reagents and being rendered water-resistant by heat.

7. A process of gluing which comprises supplying in discrete particle form to a surface to be incorporated an undispersed proteinous adhesive base of a character which does not yield a solution of the adhesive ingredients in hot or cold water and which undergoes transformation in the presence of heat and pressure into a rigid, particle-united, water-resistant form, assembling, and subjecting to pressure and heat, in the absence of a dispersing agent.

8. A process of gluing which comprises supplying in discrete particle form to a surface to be incorporated an undispersed proteinous adhesive base of a character which does not yield a solution of the adhesive ingredients in hot or cold water and which undergoes transformation in the presence of heat and pressure into a rigid, particle-united, water-resistant form, assembling, and subjecting to pressure and a temperature of at least 275° F., in the absence of a dispersing agent.

9. A process of gluing which comprises supplying in discrete particle form to a surface to be incorporated an undispersed proteinous adhesive base of a character which does not yield a solution of the adhesive ingredients in hot or cold water, and which undergoes transformation in the presence of heat and pressure into a rigid, particle-united, water-resistant form, assembling, and subjecting to heat and pressure, said operations being conducted in the absence of an alkaline re-agent.

10. A process of gluing which comprises supplying to a surface to be incorporated undispersed casein in discrete particle form, assembling, and subjecting to pressure and heat in the absence of a dispersing agent.

11. A process of gluing which comprises supplying casein in discrete-particle form to a surface to be incorporated, assembling, and applying sufficient heat to transform the casein to a water-resistant condition where it has a deep orangy color.

12. A composite structure formed under bonding conditions in the absence of a dispersing agent by members between which there is supplied in identifiable discrete particle form an identifiable undispersed proteinous adhesive base of a character which does not yield a solution of the adhesive ingredients in hot or cold water and which has been transformed in the presence of heat and pressure into a rigid, particle-united, water-resistant form.

13. A composite structure formed under bonding conditions in the absence of alkaline re-agents by members between which there is supplied in identifiable discrete particle form an identifiable undispersed proteinous adhesive base of a character which does not yield a solution of the adhesive ingredients in hot or cold water and which has been transformed in the presence of heat and pressure into a rigid, particle-united, water-resistant form.

14. Plywood, glued by an inherently water insoluble proteinous material substantially free from alkaline dispersing agents and being in agglutinated solid form.

15. A composite structure comprising members joined by a bond embodying a casein binder supplied in discrete-particle form having a deep orangy color.

16. A process of gluing which comprises supplying to a surface to be incorporated an undispersed vegetable proteinous adhesive base in discrete particle form, assembling and subjecting to pressure and heat, in the absence of an alkaline re-agent.

17. A process of gluing which comprises supplying to a surface to be incorporated undispersed soya bean flour in discrete particle form, assembling and subjecting to pressure and heat, in the absence of an alkaline re-agent.

18. A process of gluing which comprises supplying to a surface to be incorporated an undispersed vegetable proteinous adhesive base in discrete particle form, assembling and subjecting to pressure and heat, in the absence of a dispersing agent.

19. A process of gluing which comprises supplying to a surface to be incorporated undispersed soya bean flour in discrete particle form, assembling and subjecting to pressure

and heat, in the absence of a dispersing agent.

20. A composite structure glued by a vegetable proteinous seed flour in the absence of a chemical dispersing agent.

21. A composite structure glued by soya bean flour in the absence of a chemical dispersing agent.

22. A plywood comprising wood plies bonded by a vegetable proteinous seed flour in the absence of a chemical dispersing agent.

23. A plywood comprising wood plies bonded by soya bean flour in the absence of a chemical dispersing agent.

24. A process of gluing which comprises supplying in discrete-particle form to a surface to be incorporated an oil seed flour, assembling and subjecting to pressure and heat, in the absence of a dispersing agent.

25. A process of gluing which comprises supplying in discrete-particle form to a surface to be incorporated an oil seed flour, assembling and subjecting to pressure and a temperature of at least 275° F., in the absence of a dispersing agent.

Signed by me, this 12th day of May, 1930.

THEODORE WILLIAMS DIKE.