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MOLDING PULP AND IMPREGNATING
THE PRODUCT

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This invention relates to molded pulp. More particularly, the invention relates to the use of synthetic resins in pulp molding process, and product obtained therefrom.

It is an object of this invention to provide a new process for pulp molding. It is a further object of this invention to provide pulp preforms having the surface fibers thereof suitable for direct finishing. Another object of this invention is to provide molded pulp articles having excellent finishes. A still further object of the invention is to provide a process for producing improved pulp preforms and molded articles therefrom.

The foregoing and other objects and advantages of my invention are obtained by the combination of steps comprising the application of a gelled polyester resin to the surface of a pulp preform impregnated with a polyester resin from fibers which preferably are bound by a thermosetting acid colloid synthetic resin applied as beater addition to the fibers. The individual steps and combinations thereof form subcombinations of the invention.

The history of molded pulp is mainly a story of impregnants and advances in their development toward improved products and simplified technics. The impregnants used in the industry have ranged from water glass to varnishes of the phenolic and urea-melamine-alkyd types. A brief list of the impregnants that have contributed to the advancement of the molded pulp industry would have to include the following, many of which are still widely used: asphalt, water glass, natural and synthetic gum varnishes, cellulose acetate and nitrate lacquers, alkyd varnishes, phenolic varnishes, urea-melamine-alkyd varnishes, and oxidizing type varnishes.

The impregnant most widely used in the past and in wide use today is the oxidizing type varnish. This impregnant, while giving fairly good results, requires a process that at the best is somewhat cumbersome and has certain disadvantages both processwise and in the finished piece. When used as a pulp impregnant, the varnish is usually diluted with naphthenic solvents which are lost during curing. The die dried pulp preform after being dipped into this solution requires an air dry period of at least one-half hour and a bake of at least one and one-half hours starting at 200° F. and finishing at 275° F. The disadvantages of this type impregnant are: (a) Relatively poor water resistance and only minor improvements in other physical properties over those of the untreated molded pulp, (b) after curing, the treated article presents a surface that

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requires considerable sanding and base coat spraying to obtain a satisfactory finish. To eliminate some of the sanding and base coat application, the majority of manufacturers of molded pulp products have resorted to the use of wrinkle and crackle finishes. This last factor cannot be taken lightly because it results in limiting the range of molded pulp application, in that it is relatively costly to develop a satisfactory smooth finish.

The fibers generally used in the past, many of which are in wide use today, consist of semi-chemical, chemical and macerated wood and cellulosic materials, the most important of which are northern kraft, unbleached sulphite, shredded wood, ground wood, cotton linters, and rag pulp. The principal pulp fibers used for alloying properties are caroa, manila, jute and bagasse. The majority of pulp formulations used, contain large proportions of kraft or sulphate, or combination of kraft and sulphite. These two pulps are considered the base materials for almost all the formulations.

There are three satisfactory processes, to wit: (1) The process employing the steps leading to die drying, then impregnating the dye drying and oven curing, followed by finishing the cured surface; (2) the process employing the steps resulting in die drying, and impregnating the die dried preform, surfacing the impregnated preform with a special gel polyester resin, followed by evacuation of the solvent from the gel, and subsequently molding both of the impregnated sections and surface finishing simultaneously in a single step of surface finishing and, (3) the process involving the steps leading up to felting and followed by oven drying, impregnating, air drying and then die molding.

GENERAL PROCESS STEPS

The process steps used in the manufacture of die dried, impregnated and oven dried, press-squeezed and oven dried, or press molded articles according to the teachings of this invention, are substantially as follows:

A. Pulp preparation

The fibers are prepared by beating for periods of 1 to 1½ hours, depending upon the type fibers used. The fibers are preferably beaten at a 3% consistency, in water at room temperature. Alum, rosin and starch size can be added, if desired, during the beating cycle. Where the article is to be treated with a polyester type resin, however, it is recommended that the above mentioned sizes not be used, but that the pulp be

treated with a resin acid-colloid wet strength resin, such as trimethylol melamine colloid, dispersed in acidified water. This resin is added during the last 15 minutes of the beating cycle in amounts up to 4% of the dry fiber weight. After completion of the beating phase, the pulp is allowed to stand for at least three hours, to insure attachment of the melamine resin-acid colloid to the fibers. The addition of this resin-acid colloid serves three important purposes. (a) It improves wet strength, (b) it assists in improvement of the water resistance of the finished article, (c) its use results in a laying down of the surface fibers during die drying. This last is of considerable importance, as in the spray finishing of molding articles, any loose fibers at the surface will tend to rise under the air blast from the spray gun. When this occurs, hand sanding between coats of spray finish is absolutely necessary, if a satisfactory final finish is to be obtained. Such hand sanding (machine sanding is precluded in many cases because of contour), invariably adds considerably to the production cost. In fact, the most effective attack on production costs of molded pulp products can be made in the realm of surface finishing.

B. Felting

After beating, the pulp is transferred to the felting tank where its consistency is reduced from 3% to between .01% to .25% by the addition of water.

Felting consists of the deposition of the fibers on a contoured screen. This is obtained by the application of vacuum to the screen, which serves to pull water through it and deposits the fiber by a filtering action. The felt weight is usually controlled both by time and consistency. Where fine definition is demanded in the preform, the type of fiber and low consistency exert considerable influence.

C. Presqueezing

This very important and simple step in the process consists simply of a cold pressing of the wet felt immediately after felting. This can be done either on the felting platform or in a press. The presqueeze serves to remove water prior to die drying, thus reducing the die drying time. Reductions in die drying time of 65% have been obtained. This results in the use of fewer B. t. u.'s for die drying thus effecting a saving not only in time but also in fuel cost. It also serves to densify the wet felt and bring it closer to the dimensions of the finished piece, thus facilitating entry into the drying die.

Where the article is to be felted, dried, and subsequently compression molded, the presqueeze reduces the oven drying period. Further, it influences the subsequent resin absorption when impregnated.

D. Die drying

The operation, while simple in itself, requires considerable control in order to insure consistent and satisfactory results. The operation consists of drying of the felted preform under pressure and heat. The drying die is invariably composed of a screen covered member and a solid member. The screened member is slotted to allow for water drainage which is facilitated by the application of vacuum. The wet preform of proper weight is placed between the two die members, and dried at pressures ranging from 40 p. s. i. to 500 p. s. i., being dependent upon the requirements of the article. Normal die drying tem-

peratures are of the order of 370° F. The dies are usually gas heated, although Dowtherm has been successfully used. As mentioned previously, the presqueezing of the wet preform can effect a saving in die drying time and also in cost, as the B. t. u. requirement for water removal is less due to the lower water content in the piece. Presqueezing also aids in die entry, as it conforms very closely to the final form because of pre-densification.

E. Impregnation

Impregnation consists simply of a dip into the resin solution. This step is the same whether the piece has been die dried, presqueezed and oven dried, or felted and oven dried. Resin absorption is controlled by the density of the preform, the solution resin solids, the time of immersion, the resin viscosity, moisture in preform, and type of pulp used.

F. Oven curing

When the piece is impregnated with a polyester type resin, the oven curing takes place after a diffusion period of usually not more than 15 minutes, and is accomplished by placing the piece either in an infra-red or hot air oven at 275° F. At this temperature, oven curing can be completed in from 10 minutes to 30 minutes, with the infra-red giving the quicker result. Other resins invariably require a longer air dry and oven time.

G. Molding

The molding of pulp preforms is carried out in contoured dies consisting of one of the following component variations: (1) two solid members, (2) one solid member and an elastomeric plug member, and (3) one solid member and an elastomeric bag member. The preforms used for molding may be either the preferred die dried, or merely presqueezed and oven dried, or felted and oven dried. In all cases, the preform more or less closely conforms to the dimensions of the finished article, and the operation is simply placing the impregnated preform between the die members and applying heat and pressure. One excellent feature of the process is that the material flow demanded is negligible, because the preform is very close to the shape of the final molding. That is, flow is done in place, which makes it possible to produce large articles with little more trouble than small articles, except for some handling difficulties that are usually mechanical.

UTILIZATION OF POLYESTERS

These resins offer a number of interesting and highly desirable properties. The outstanding advantages found in the use of the polyesters may be stated:

1. Absence of solvents

The molded pulp industry, has generally used impregnating materials employing solvents that are lost during the oven curing or during solvent removal prior to molding. Unless solvent recovery systems are used (which is impractical for small operations), this means additional processing cost is involved. When using the polyester type resins while no solvents are used, some styrene or other copolymerizing solvent, such as diallyl esters, may be added. Most of the styrene polymerizers and becomes usable resin. If the piece is to be compression molded, practically none of the styrene is lost, because the peroxide catalysts used for the polyesters are also catalysts

for styrene, and other copolymerizable solvents that may be used in lieu thereof.

2. Fast curing

The polyesters, as is well known, cure rapidly either in an infra-red oven, hot air oven, or between heated dies. This constitutes a great advantage over the oxidizing type varnish or other commonly used pulp molding impregnants. The polyesters, due to their exothermic reaction, will cure rapidly once their exotherm point has been reached. In most cases, this point is so low that it can be attained very rapidly.

3. Economics

The use of polyesters with their seemingly high unit cost has given rise to a number of economic questions. However, when comparing impregnating materials for either pulp impregnating and molding or impregnating and oven curing, the real cost criterion lies in the cost per pound of usable material. In using polyesters, it should be remembered that in most cases the resin is 100% usable. With varnishes, there is always the solvent loss when treating and oven curing; and when using other type molding resins, there is again the solvent loss in oven treatment prior to molding. In varnish used, the solvent is of the order of 70% of the total solution weight. Impregnating resins used for pulp preform impregnation other than polyesters range from 50 to 60% of the solution weight. On this basis, it can readily be seen that a pound of usable resin of the polyester type may be considerably less expensive than the varnish type impregnants.

IMPREGNATION TECHNIQUES

To insure satisfactory results in the use of polyesters for preformed pulp impregnate treatment, certain simple procedures and controls are to be observed. These are listed below:

(a) Solution viscosity

Solution viscosity must be such that thorough penetration can be obtained in a relatively short time. Viscosities may vary in relation to the density of pulp preform. Solution viscosities for treating pulp preforms made by the three methods previously covered would range as follows:

	Centipoises
1. Die dried preform.....	25 to 50
2. Presqueezed and oven dried.....	50 to 125
3. Felted and oven dried.....	125 to 250

The viscosity must be low enough in all cases that the resin not only penetrates, but also diffuses throughout the preform. In most cases, to obtain the proper impregnation viscosity, it has been necessary to dilute the polyester with copolymerizable solvents, such as monomeric styrene, diallyl phthalate, etc.

(b) Immersion time

All that need be said regarding time of pulp preform immersion is that sufficient time be allowed to insure thorough penetration and distribution of the resin throughout. This seldom, if ever, requires more than twenty minutes, unless of course, the pulp preform has been die dried under extremely high pressure and is therefore, very dense. In most cases, a 1 to 5 minute dip is sufficient.

(c) Moisture in preform

For optimum results, both in resin absorption and finished piece, it is essential that the pulp

preform be thoroughly dry prior to resin impregnation. Tests have shown that even a very small amount of water in the preform at time of impregnation lowers the amount of resin absorbed, and also greatly affects the water resistance in the finished piece. Due to the hydroscopic nature of cellulosic materials, it is always advisable to impregnate the pulp preform as soon as possible after its removal from the drying dies or the drying oven.

(d) Resin content

The resin content in either a die dried preform to be oven cured, or a presqueezed and oven dried, or felted and oven dried preform will be dictated by the use conditions of the article in question. Numerous factors have been established for controlling this resin content within relatively narrow limits. These are all based on the following, which are all more or less inter-related: preform density, resin solids concentration (where solvent is used), resin viscosity, moisture in preform prior to impregnating, time of impregnation, and type of fibers used in formulation.

Of the six factors listed, the most important are the density, resin viscosity and time. Where density is high it was found, unless only a limited amount of impregnation is required, that the viscosity be low or the immersion time relatively long, etc. In some cases, acetone is used as a solvent thus enabling resin solids pickup control by use of resin solids concentration. This method is not recommended, as the acetone is lost during curing. Limited control of resin content can also be affected through the use of certain type fibers. Cotton rag and high cellulose fibers absorb more resin than kraft or sulphite wood pulp types and where extremely high resin content is desired, it is advisable to use these types combined with the other components for high absorption.

(e) Diffusion following impregnation

In some cases, particularly when the treated pulp preform is to be oven cured, it is advisable to allow a short period between impregnation and curing. This is recommended to allow the resin to diffuse more uniformly throughout the piece. It is usually essential where high density preforms are being treated. However, if the impregnating solution is a system incorporating styrene, it is advisable to make this period as short as possible to avoid styrene loss through evaporation. Where polyesters not incorporating styrene are used, the preform should be allowed to diffuse until any residual surface resin has either drained off or been absorbed. If solution viscosities are adequately controlled, this should not, as a rule, require more than fifteen minutes. If the preform is placed in an oven for polymerization with residual resin on its surface, this resin will set-up and sanding will be necessary to remove it.

(f) Factory life of catalyzed resin

The polyesters, as is well known, are catalyzed with peroxide catalysts which are usually mixtures containing benzoyl peroxide. The catalyst is ordinarily added to the extent of 1% to 2% of the total resin weight. After addition of the catalyst the storage life of the resin is reduced as polymerization at room temperature is very slow. Polyester resins catalyzed with 2% Lupercol ATP-1 (50% benzoyl peroxide with an aryl phosphate) have remained usable, when kept at room

temperature (70° F.), for as long as twelve days. This time is more than adequate for the average production set-up where the resin is usually prepared and used daily. No difficulty has been encountered in periods of 48 to 72 hours unless the resin temperature is allowed to rise above 90° F.

POLYMERIZATION

(a) Oven curing

The polymerization of polyester resins in pulp preforms may be conveniently carried out by either of two procedures, (a) curing in an infra-red or circulating hot air oven, and (b) molding in heated dies. The oven curing is usually restricted to impregnated preforms that have been previously die dried. This is done in an electric infra-red or hot air oven at temperatures in the order of 300° F. to 325° F. After impregnation and diffusion, the preforms are placed in the oven, heated to 300° F. Potentiometer records indicate that it requires from two to four minutes for the treated preforms to approach oven heat (variable—depending upon the pulp used). As the oven temperature is being approached, the potentiometer will record a sudden rapid rise in temperature not accounted for by the oven alone; this is due entirely to the exothermic reaction of the polymerization of the polyester resin. When this reaction is initiated, polymerization will continue almost to completion without additional external heat. Polyester resin treated preforms can be cured satisfactorily using an overall oven cycle as short as ten minutes at 300° F. under infra-red lights. In a recent production run, polyester resin impregnated, die dried preforms have been satisfactorily cured in six minutes on a conveyor type infra-red oven at a temperature ranging between 275° F. and 325° F. The curing of the resins in a hot air oven takes a somewhat longer time compared to infra-red equipment. However, satisfactory cures can be obtained at 325° F. in as short a time as 30 minutes.

(b) Molding

Three types of mold equipment have been tested for molding of polyester impregnated pulp preforms, and have proven satisfactory. The first is the conventional mold consisting of a solid metal plunger and cavity. The third consists of an elastomeric bag and a solid metal cavity. In all cases, it is advisable to chrome plate the metal member to insure good surfaces and to facilitate removal of the molded preform. The metal die components are usually made of brass castings, polished and plated. Because of the low molding pressure requirements, the ability to use cast dies results in a substantial saving over the molding dies used for high pressure molding. The elastomeric members are made of rubber. Because rubber inhibits the polymerization reaction, and because it softens and swells under the influence of styrene, it is necessary to use a barrier sheet of cellophane, polyvinyl alcohol, or other plastic films, to protect it when styrene solvent is employed with the polyester resins. Lower molding pressures can be used where one member is made of an elastomeric material, as the behavior of the elastomer tends to equalize molding pressure.

(c) Molding pressures

Satisfactory moldings have been made at pressures as low as 75 p. s. i., using either a die dried preform or a presqueezed oven dried preform. Where the felted, oven dried preform is

used, it is necessary to mold at 100 p. s. i. or higher to "iron out" the irregular pulp preform surface. Molding pressures are also closely related to the resin content of the pulp preform. In general, the lower the resin content, the higher the molding pressure. Molding pressure exerts considerable influence on physical properties, particularly water absorption. Here the higher pressure results in a more dense structure and better resin distribution, due to decrease in total volume. Generally speaking, the higher pressure gives better tensile hardness and impact values, but excellent properties can also be obtained with relatively low molding pressures, as will be shown in the section dealing with physical properties.

(d) Molding time-temperatures

Two factors influence control over the molding time; the temperature of the dies and the section thickness of the preform. Tests have been conducted using temperatures ranging from 220° F. to 330° F. As is to be expected, the moldings made at the lower temperature required longer time, but always with satisfactory results. This cannot be said where the higher temperatures are used, particularly when the molding pressure is low and the preform section thick. In these cases, there is always the possibility of resin crazing due to rapid cure, occasioned by high temperatures not only of the die but also of the exothermic reaction of the resin. In moldings made at 325° F., the temperature in thick sections has risen to as high as 350° F., once the exothermic reaction was initiated. An $\frac{1}{8}$ " thick pulp preform can be molded in from 3 to 3½ minutes at 300° F. A $\frac{1}{16}$ " thick pulp preform can be molded in 1½ to 2 minutes at 300° F., using moderate pressures for both moldings. The most satisfactory molding temperatures range from 275° F. to 300° F. At these temperatures, both thick and thin sections can be molded in short time and at moderate pressures with excellent results.

During molding, some exudation of resin is always encountered. The amount is usually dependent upon three factors: molding pressure, temperature, and the amount of resin in the preform prior to molding. Pressure is responsible for the largest amount of loss due to exudation by actually squeezing out excess resin as the pulp preform is densified. Temperature enters the picture because if it is high enough to effect a rapid cure, the resin will enter the gel stage rapidly, and resist exudation to some extent through its flow being reduced. The amount of resin in the preform and its subsequent loss due to exudation upon molding requires no explanation. It is very possible, with a low density pulp preform, to incorporate more resin in the section than is needed when the density is increased by molding.

FINISHING

(a) Spray and bake finishes

As was mentioned earlier, the conventional method for finishing die dried impregnated pulp preforms is to spray them with either air drying lacquers or baking enamels. Die dried impregnated preforms can be finished satisfactorily using air drying lacquers of the cellulose nitrate or acetate type or baking enamels of the alkyd, phenolic, or urea and melamine types. Adhesion of these spray finishes to the polyester treated surfaces is excellent. This application

introduces no difficulty over the spraying of either of like nature.

(b) *Molded finishes*

1. SPECIAL APPLICATION PREGELLED POLYESTER RESINS

This special application pregelled polyester resin in volatile solvent is designed primarily for surfacing of polyester impregnated pulp preforms that are to be compression molded. This finish can be pigmented or used clear, and is applied by spraying the impregnated uncured pulp preform. After spraying, it is necessary to oven bake in order to remove the solvent before molding. The solvent evacuation takes from 1½ to 2 hours at 120° F. Molding is done at 220° F. to 250° F., time varying with total section thickness. The finish will mold satisfactorily at pressures as low as 75 p. s. i. but for optimum results a pressure of 150 p. s. i. is recommended. After molding, the finish becomes an integral part of the molded preform. There is no problem

of adhesion, as the polyester used for impregnation and the pregelled polyester used for finishing are completely compatible and mold as one. This special pregelled polyester makes possible for the first time, the molding of a finish on a relatively straight sidewall. In the past, the molding of a finish on a contoured pulp article having a sidewall that was relatively straight was extremely difficult due to the rubbing off of the surface when entering into the mold. The special application pregelled polyester, however, has the property of resisting the rubbing off action encountered upon die entry. The finish obtained is extremely tough, and can be molded to a high gloss, and has excellent abrasion and water resistance. The finish can be pigmented to any color desired, through use of pigments that do not inhibit the polymerization of the polyesters. Moldings can be made using any of the die combinations covered in the preceding section dealing with molding of pulp preforms. The best results are usually obtained, however, when one die member is elastomeric. The elastomeric member tends to equalize pressure applied to the pulp preform. Finishing has long been one of the major problems in the molded pulp-resin process, the use of this excellent surfacing material solves some of the finishing problems; and, while it is by no means a solution for all surfacing problems, it certainly enlarges the use of molded resin pulp articles, and serves to introduce the process into new fields of application.

In the single step of molding impregnating sections and surface sections simultaneously, the pulp preforms were die dried at 100 p. s. i., heated and dried to constant weight for heated impregnation, impregnated with the polyester styrene mixture, and then sprayed with the pregelled

resin solution, after which the sprayed and gelled preforms were put into a circulating spray oven for 1 hour at 100° F., to evacuate the solvent from the surfacing composition. The preforms were then molded for 20 minutes at 220° F. and 150–175 p. s. i. In fact, the molds were closed at a temperature of 110° F., and the complete pressure applied, at which time the temperature was raised to 220° F., which technique gave the best results.

PHYSICAL PROPERTIES

The following tables will serve to illustrate the physical properties that can be obtained in both molded pulp-resin preforms, and die dried, impregnated and oven cured pulp preforms. Six plys or preforms of treated pulp were laminated according to the procedure outlined hereinabove, to provide the desired thickness. All tests conducted conformed to A. S. T. M. standards. All resin formulations were catalyzed with 2% by weight of 50% benzoyl peroxide and an aryl phosphate.

Physical properties

A. POLYESTER PULP MOLDINGS

[Moldings made at 200 p. s. i., 105° C., 20 minutes]

Polyester Resin	Resin Solids, percent	Density	Hardness	Strength				24 Hr. Water Absorption, percent
				Tensile, p. s. i.	Compression, p. s. i.	Flexural, p. s. i.	Impact, ft. lbs.	
A-----	55	1.14	M 73	8,100	11,500	13,900	1.5	3 to 6
B-----	55	1.18	M 75	10,225	14,100	14,100	1.74	10 to 12
C-----	56	1.15	M 67	8,200	5,700	8,100	0.94	9 to 11
D-----	50	1.12		6,200				10 to 14

B. MOLDED PULP—DIE DRIED, IMPREGNATED AND OVEN CURED

Polyester Resin Mix	Resin Solids, percent	Tensile Strength, p. s. i.	24 Hr. Water Absorption, percent
80% C-----	20	6,400	25 to 30
20% Styrene-----			
92% B-----	29	11,500	25 to 30
8% Styrene-----			
80% D-----	24	7,500	30 to 35
20% Styrene-----			
33.3% A-----	24	9,500	20 to 25
33.3% D-----			
33.4% Styrene-----			

The polyester pulp moldings were made by employing the steps of pulp preparation, using melamine-formaldehyde acid colloid, felting, presqueezing at 100 p. s. i. and oven drying at 250° F., impregnating for 30 minutes at 150° F., and air drying for 30 minutes at 75° F., and then molding at 200 p. s. i. and 105° C. for 20 minutes.

The molded pulp was preformed by employing the steps of pulp preparation using a melamine-formaldehyde acid colloid, felting, and die dried at 100 p. s. i. The die dried preform was then impregnated for 1½ minutes, and cured under infra-red lights for 3–8 minutes at 250° F., and in a circulating air oven for 25 minutes at 275–300° F.

APPLICATIONS

The ease with which large and multiple contoured pieces may be made by the molded pulp method, and the excellent physical properties developed by polyester impregnated or molded fiber, appear to open up attractive possibilities in the production of a wide range of consumer products.

Thus far, these methods and materials have

been applied to the production of one piece tops for boys' sleds, children's chair seat and backs, high chair trays, and small table tops. These typical applications represent a wide range of contour, physical property requirements, and conditions of use. Among applications which are suitable for the teachings of this invention, there may be mentioned bread boxes for home use, carrying boxes for the bakery and candy industries, vacuum cleaner bodies, automobile glove compartments, luggage frames, and clothes hampers.

There appears to be utility for this invention in the manufacture of such products as davenport or upholstered chair frames, currently being made of wood. Such frames would be inexpensive, light weight, one piece units. The use of molded fiber for these products would permit the designer a much wider latitude in the use of compound curvatures obtainable with standard methods, only at considerable cost both of labor and materials. Because of the ease with which it is possible to incorporate such structural elements as corrugations, adequate stiffness values may be obtained in a piece having a very satisfactory strength-weight ratio.

The acid colloid of reference hereinabove, as beater addition for fiber bonding, may be prepared by making 88 gallons of water at a temperature between 80-100° F., 4 gallons of muriatic acid 20 degrees Baumé, and 100 pounds of trimethylol melamine. In lieu of this procedure, any of the resins prepared according to the process of U. S. Patent No. 2,345,543 may be employed.

The gelled resin of reference hereinabove, used for surface finishing, may be conveniently prepared by dispersing in 50 parts of ethyl acetate, 50 parts of unsaturated polyester resin, preferably containing monomeric styrene or diallyl phthalate. The resultant solution is then heated to reflux, accompanied by rapid agitation in the presence of a peroxide catalyst, and preferably approximately .125% benzoyl peroxide based on the weight of resin. In approximately 1-1½ hours, gellation occurs suddenly, at which point, 0.01% hydroquinone in diallyl phthalate is added, and the mixture rapidly cooled. The resin prepared in this manner, is a smooth gelled dispersion of liquid consistency. Other suitable processes and products may be conveniently prepared according to the disclosure of U. S. patent application No. 757,919, filed June 28, 1947, now U. S. Patent No. 2,562,140.

As examples of suitable polyester impregnants of reference hereinabove, the following convenient methods of preparation are given:

Resin A

Resin A comprises 4 parts of the reaction product of approximately 3½ molecular equivalents of ethylene glycol, 3 molecular equivalents of diethylene glycol, 4 molecular equivalents of fumaric acid, and 2 molecular equivalents of phthalic anhydride, dispersed in 1 part of diallyl phthalate.

Resin B

This resin is similar to Resin A, with the exception that 2 parts of the unsaturated alkyd reaction product is dispersed in 1 part of monomeric styrene, whereas the ratio in Resin A is 4 parts of alkyd to one part of monomeric styrene.

Resin C

This resin comprises 2 parts of unsaturated al-

kyd resin, comprising the reaction product of approximately 6 molecular equivalents of diethylene glycol, 5 molecular equivalents of fumaric acid, and 1 molecular equivalent of sebacic acid, dispersed in 1 part of monomeric styrene.

Resin D

This resin comprises 3 parts of the reaction product of approximately 3½ molecular equivalents of propylene glycol, 1 molecular equivalent of fumaric acid, and 2 molecular equivalents of phthalic anhydride, dispersed in 2 parts of monomeric styrene.

Other suitable resins may be conveniently prepared according to the disclosures of Patent No. 2,409,633.

We claim:

1. A method of pulp molding which comprises preparing a slurry of cellulosic fibers, adding from 1% to 4% by weight based on the dry weight of the cellulosic fibers of an acid colloid melamine-formaldehyde resin to said fiber slurry, collecting and forming said fibers and resins into a preform, drying said preform, impregnating said preform with a solution of a copolymerizable mixture of an unsaturated polyester resin and a copolymerizable monomeric solvent therefor selected from the group consisting of styrene and diallyl phthalate, coating the surface of said impregnated preform with a volatile dispersion of a gelled polyester resin and removing the volatile therefrom, and curing said resin impregnated and coated preform by the application of heat.

2. A method of pulp molding which comprises preparing a slurry of cellulosic fibers, adding from 1% to 4% by weight based on the dry weight of the cellulosic fibers of an acid colloid melamine-formaldehyde resin to said fiber slurry, collecting and forming said fibers and resins into a preform, drying said preform, impregnating said preform with a solution of a copolymerizable mixture of an unsaturated polyester resin and a copolymerizable monomeric solvent therefor of styrene, coating the surface of said impregnated preform with a volatile dispersion of a gelled polyester resin and removing the volatile therefrom, and curing said resin impregnated and coated preform by the application of heat.

3. A method of pulp molding which comprises preparing a slurry of cellulosic fibers, adding from 1% to 4% by weight based on the dry weight of the cellulosic fibers of an acid colloid melamine-formaldehyde resin to said fiber slurry, collecting and forming said fibers and resins into a preform, drying said preform, impregnating said preform with a solution of a copolymerizable mixture of an unsaturated polyester resin and a copolymerizable monomeric solvent therefor of diallyl phthalate, coating the surface of said impregnated preform with a volatile dispersion of a gelled polyester resin and removing the volatile therefrom, and curing said resin impregnated and coated preform by the application of heat.

4. A method of pulp molding which comprises preparing a slurry of cellulosic fibers, adding from 1% to 4% by weight based on the dry weight of the cellulosic fibers of an acid colloid melamine-formaldehyde resin to said fiber slurry, collecting and forming said fibers and resins into a preform, drying said preform, impregnating said preform with an unsaturated polyester resin, coating the surface of said impregnated preform with a volatile dispersion of a gelled polyester resin and removing the volatile therefrom, and

curing said resin impregnated and coated preform by the application of heat.

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