

1

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METHOD OF MAKING COATED PAPER RECEPTACLES

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This invention relates to receptacles, and more particularly to methods of making paper receptacles of improved character.

This is a division of my copending application Serial No. 283,247, filed April 19, 1952.

The invention is applicable to receptacles of a wide variety of shapes and sizes and for a wide variety of uses, including, for example, drinking cups for hot and cold beverages; pie and picnic plates; and carrying and storage containers for milk and other dairy products, alcoholic and non-alcoholic beverages, paints, organic solvents, sea food products, frozen foods, and many other materials.

An object of this invention is to provide paper receptacles of generally improved character, and of high resistance to potable liquids and other substances which may be placed therein. Another object is to provide improved methods for making such receptacles.

In carrying out this invention in accordance with the above and other objects, paper is formed to the desired shape of the receptacle. Then to the surface of the pre-formed paper article is applied an aqueous dispersion of any curable amino resin and any thermoplastic resin having reactive side groups, the former being present in major amount and the latter in minor amount. The resin-treated shaped paper is subjected to curing conditions to bring about chemical union between the amino resin and the thermoplastic resin through side groups of the latter, and further to bring about curing of the amino resin. The cured resin forms a uniform, impervious coating over the surface to which it is applied, a coating which is anchored to the substance of the paper. The resulting coated paper receptacles are resistant to liquids and other substances over a wide range of temperatures, from well below the freezing point of water to well above the boiling point thereof, and at the same time the receptacles possess improved mechanical properties such as rigidity without brittleness. The coatings on the receptacles are odorless and tasteless in themselves, and impart no odor or taste to the contents of the receptacles. Furthermore the coatings prevent the imparting of taste characteristics by ingredients of the paper. The invention provides economy in the use of paper, in view of the stiffening effect of the coating, in that a thinner and lighter weight grade of paper may be employed than would otherwise be the case.

The invention will now be specifically illustrated with respect to a drinking cup of the type in which a substantially cylindrical body portion is crimped to a separate disk-shaped bottom portion. In making such a cup in accordance with this invention, the longitudinal edges of a suitably shaped flat body blank are adhesively secured together in the usual way to form a generally cylindrical, somewhat frusto-conical body portion. The upper edge may be rolled in the usual manner. The lower edge of the body portion is crimped to a disk-shaped bottom portion, but this crimping need not be carried out to the extent of rendering the mechanical joint leakproof, nor need glue be supplied to render the joint leakproof at this state, because leakproofness will be imparted by the coating subsequently to be applied. The thus-prepared pre-formed paper article is now ready for the coating operation.

2

According to this specific illustration, a coating composition in the form of an aqueous dispersion is provided as follows:

	Parts by weight
Urea-formaldehyde condensate	540
Styrene copolymer having carboxylic side groups	40
Wetting agent	2
Buffered acid catalyst	30
Water	388
	1000

In the above specific formulation, the urea-formaldehyde condensate (amino resin) is relatively highly polymerized but still water-dispersible, a product which is commercially available as such. The styrene copolymer is a copolymer of styrene with a small percentage of carboxyl containing comonomer, a commercially available product; a suitable material is available under the commercial name of "Lustrex X-601-40," marketed by Monsanto Chemical Company. The wetting agent is the sodium sulfonate of an acid ester of an aliphatic compound. The catalyst is of a type commonly employed with urea-formaldehyde resins, namely ammonium acid phosphate. The resin dispersion is alkaline in character. The acid catalyst is preferably buffered, as indicated above, so that the further condensation of the coating constituents will not take place prematurely, but will take place only after the application of heat in the manner described below.

The above-described pre-formed cup assembly is completely immersed in the coating composition and then withdrawn therefrom, drained for five minutes, and then heated in an oven for ten minutes at 210° F. As a result of the heating operation, the urea-formaldehyde condensate and the styrene copolymer are co-condensed through the carboxylic side groups of the latter. The co-condensate is insoluble.

The resulting coated cup is leakproof, non-toxic, and unaffected by potable liquids, such as water, hot or iced coffee, hot or iced tea, alcoholic or non-alcoholic beverages and in fact by liquids in general. The coating extends over the entire surface of the cup, both inside and outside, and is smooth, uniform, lustrous and transparent. The finished cup is considerably stiffer and more rigid than the shaped paper pre-form from which it was made. Furthermore, liquids contained therein do not render the cup limp. The coating is disposed essentially on the surface of the paper, but is anchored securely to the substance thereof.

Paper of any desired character may be employed in carrying out this invention, and as previously indicated, paper of lighter weight may be employed than is required in the manufacture of receptacles which are uncoated. Sized paper is preferred because less coating composition is required.

The amino resins suitable for this invention are selected from water-dispersible amine-aldehyde resins. In the selected amine-aldehyde resin, amine may be urea, melamine, dicyandiamide, or related or similar amines. Furthermore, in the selected amino resin, the aldehyde may be, and conveniently is, formaldehyde. Where a dark-colored coating is unobjectionable, furfuraldehyde may be employed. Acetaldehyde and other aldehydes known in the field of amine-aldehyde resins are regarded as being within the scope of the invention. A single amino resin, or a mixture of amino resins may be used.

The thermoplastic resin copolymer with reactive side groups is water-dispersible. The reactive side groups in the copolymer are those groups which will co-condense with the amino resin and are selected for the practice of the invention from hydroxyl, carboxyl, nitrile, ketone, or other group, or mixtures of such groups. The copolymer may include a vinyl resin as the thermoplastic

constituent. Polystyrene is highly satisfactory. Polyvinyl acetate and polyacrylonitrile may be used. Mixtures of resins may be employed. Silicone analogs, wherein silicon takes the place of carbon, may be employed, but these are at present expensive.

The use of the thermoplastic resin with reactive side groups in conjunction with the amine-aldehyde resin has the highly advantageous effect, in addition to imparting flexibility, that it precludes excessive penetration of the amino resin into the paper, and causes the amino resin to remain essentially on the surface of the paper, although anchored to the substance thereof. After the "curing" step, however, the thermoplastic resin with reactive side groups co-condenses with the amino resin through said reactive side groups, and the resulting co-condensation product is insoluble, and is not affected by liquids with which the coated receptacle may come in contact.

In the coating composition, the relative amounts of amino resin, and thermoplastic resin with reactive side groups, is not critical. The amino resin is present in major amount, and the thermoplastic resin with side groups is present in minor amount. Generally speaking, 5 to 10% by weight of the latter based on the amino resin has been found to be effective. Amounts of thermoplastic resin in the lower portion of the range result in lower gloss in the coating.

In order to promote the insolubilization of the coating composition, or in other words, the co-condensation of the amino resin and the thermoplastic resin with reactive side groups, a catalyst or accelerator is incorporated in the coating composition. A buffered catalyst is preferred, as the catalytic effect thereof is not exerted significantly, in the coating bath during a working day. Such catalyst becomes effective, however, when the coated article is subjected to "curing" temperatures.

A wetting agent, such as the sodium sulfonates of an acid ester of an aliphatic compound referred to hereinabove in the illustrative composition, conveniently is employed. Any other suitable wetting agent, such as those known in the art, conveniently may be employed. While the use of a wetting agent is not absolutely essential, such use does assist in the smooth application of the coating to the pre-formed paper article, and in the prevention and dispersal of air bubbles from the coating composition and the applied coating.

To increase the flexibility of the coating, a plasticizer for the thermoplastic resin may be incorporated in the coating composition. Such plasticizer may be selected from those known in the art, for example, dibutyl phthalate.

The illustrative coating composition set forth hereinabove provides a coating which is glossy and transparent. Accordingly, printing and decoration appearing on the preformed paper article is clearly observable there-through and is protected thereby. Colored transparent coatings may be provided by incorporating suitable dyes in the coating composition. A porcelain-like surface may be provided by incorporating china clay in the coating composition, and colored opaque coatings may be produced by incorporating colored pigments and dyes, in the coating composition.

The coating operation may be carried out to any desired extent and in any suitable manner. Thus, the coating may cover the entire inside and outside surfaces, of the receptacle, or just one of said surfaces of the receptacle, or indeed, any desired portion of the total surface. The coating may be applied by dipping, brushing, spraying or otherwise, and in one or more coats.

It will be understood that substantial variation may be made in the time and temperature of curing of the coating. Generally speaking, lower temperatures will require longer times for curing. Temperatures will not be employed which are so high as to have a deleterious effect upon the paper of the receptacle.

It will further be understood that the invention is not limited to any particular shape or size of receptacle.

It will be understood that various modifications may be made while still coming within the scope of the invention.

Having disclosed my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. The method of preparing a stiffened, liquid-resistant receptacle, which comprises forming paper to the desired shape, applying to the surface of the shaped paper an aqueous dispersion of a curable amine-aldehyde resin and a thermoplastic resin having reactive side groups, and subjecting the resin-treated shaped paper to conditions to bring about co-condensation of the amino resin and the thermoplastic resin.

2. The method of preparing a stiffened, liquid-resistant receptacle, which comprises forming paper to the desired shape, applying to the surface of the shaped paper an aqueous dispersion containing a major amount of a mixture of curable urea-formaldehyde and melamine-formaldehyde resins and a minor amount of a polystyrene having reactive side groups, and heating the resin-treated shaped paper to bring about co-condensation of the coating resins.

3. The method of coating a formed paper receptacle, which comprises applying to the receptacle a curable amine-aldehyde resin in aqueous dispersion, concomitantly applying to the receptacle in aqueous dispersion a thermoplastic resin with reactive side groups in amount about 5 to about 10% of the amine-aldehyde resin, and chemically uniting the amine-aldehyde resin and the thermoplastic resin through side groups of the latter by heating the coated receptacle for a time sufficient to cure the amine-aldehyde resin.

4. The method of coating a formed paper receptacle, which comprises applying to the receptacle a curable amine-aldehyde resin in aqueous dispersion, concomitantly applying to the receptacle in aqueous dispersion a thermoplastic resin with reactive side groups in amount about 5 to about 10% of the amine-aldehyde resin, concomitantly applying a wetting agent to the receptacle to prevent and disperse air bubbles, and chemically uniting the amine-aldehyde resin and the thermoplastic resin through side groups of the latter by heating the coated receptacle for a time sufficient to cure the amine-aldehyde resin.

5. The method of coating a formed paper receptacle, which comprises applying to the receptacle a curable urea-formaldehyde resin in aqueous dispersion, concomitantly applying to the receptacle in aqueous dispersion a styrene copolymer having carboxylic side groups in amount about 5 to about 10% of the urea-formaldehyde resin, and chemically uniting the urea-formaldehyde resin and the thermoplastic resin through carboxylic side groups of the latter by heating the coated receptacle for a time sufficient to cure the amine-aldehyde resin.

6. The method of coating a formed paper receptacle, which comprises applying to the receptacle an aqueous dispersion containing a major amount of a curable amine-aldehyde resin and a minor amount of a thermoplastic vinyl resin having reactive side groups, and heating the coated receptacle to bring about co-condensation of the coating resins.

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