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GELATINOUS SHEETS, FILMS, AND PLASTIC MASSES

Anderson W. Ralston, Chicago, Ill., assignor to Armour and Company, Chicago, Ill., a corporation of Illinois

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This invention relates to gelatinous films, filaments, sheets and plastic masses, and it comprises filaments, films, sheets and plastic masses formed from gelatinous materials, or solutions thereof, such as gelatin, glue, and similar gelatinous materials of the water-soluble protein type, said products containing, as a modifying agent, an amount of a monoglyceride of a fatty acid having from six to twelve carbon atoms.

Gelatin films and sheets have been known for many years. As early as 1863 gelatin solutions were applied to wire netting and dried to form a glass substitute. And in 1880, Brigham U. S. Patent 233,973 described a process for making ornamental films by flowing gelatin solution on an etched surface.

Within recent years, however, filmlike materials suitable for wrapping, sausage skins, and the like, have been made from cellulosic substances, such as regenerated cellulose. Although gelatin, glue, and similar protein materials are abundant and cheap, and can be made to form films, the art has largely turned to the preparation of such films and sheets from cellulose because of certain inherent objections in protein films, sheets and plastic masses which have hitherto not been satisfactorily overcome.

Although films and filaments made from water-soluble gelatin, glue, and like water-soluble protein materials are flexible when first prepared, such materials undergo aging phenomenon resulting in greatly reduced flexibility and pliability. They become brittle and crack on flexing. Such disadvantages have been recognized in the prior art and softening agents have been added to the film-forming protein solution prior to film-forming for the purpose of imparting softness, flexibility and pliability of a somewhat permanent nature to the resulting film or filament. Softening agents hitherto proposed have not been wholly satisfactory. Although the exact mechanism by which the softening agents function is not clearly understood there are certain requirements which must be met. For many purposes to which the films are to be put the softening agent incorporated in the film or sheet should be colorless and contribute no change in appearance. Many of the softening agents hitherto proposed do not satisfy this requirement because they contribute definite changes in appearance to the formed sheet or film. Some of them impart a smoky appearance to the film, others tend to "sweat out," still others contribute tackiness or stickiness when the film or sheet is used under conditions of relatively high humidity. Many of the softening agents used are not effective at low temperatures. In other words, even though they are present in the film the film tends to become brittle and lose its flexibility at low temperatures.

A satisfactory softening agent should be one which imparts no apparent change in physical appearance to the film or sheet but which so modifies its flexibility characteristics that the sheet or film remains flexible under all conditions of use. If the sheet or film is used in an environment where the temperature is relatively high and the humidity relatively low the film should not dry out and become brittle. If the film must be used under circumstances of high humidity it should be free of any stickiness or impairment in film strength. Resistance to changes in atmospheric influences is thus an important characteristic of commercial films made from protein, film-forming materials. Similar requirements are met with when the film-forming solution is used to make filaments and strands.

Moreover, the softening agent must be compatible with the gelatin solution. Not only must it dissolve in the solution, but the solution containing the softening agent must yield transparent films free of any cloudiness. Under some conditions of use, such as films deliberately colored for ornamental purposes some degree of cloudiness or lack of transparency may not be objectionable. It is, however, a relatively simple matter to impart changes in color and degree of transparency to such films by the addition of dyes, fillers and the like provided the film itself is normally colorless and transparent.

Thus, it will be seen that the discovery of suitable softening agents is not at all a simple matter because of the peculiar requirements these agents must meet. The sulfonated oils, glycerine and similar agents hitherto used have been deficient in one or more of the requirements noted above.

I have now discovered a class of compounds which can be incorporated in protein, film-forming solutions to give films which retain their flexibility under all normal conditions of widely varying temperatures and humidity, do not lessen the transparency of the film or sheet, and do not deteriorate in the film. Moreover, my softening agents are compatible with the protein solutions and do not tend to sweat out of the form sheet, film or filament.

The class of compounds which I use as softening agents for film and sheet-forming materials of this character can be generically defined as mon-

oglycerides of fatty acids having from six to twelve carbon atoms. Thus, I can use monocaproin, monocaprylin, monocaprin and monolaurin. These are monoglycerides of caproic, caprylic, capric and lauric acids.

Monoglycerides of fatty acids having less than six carbon atoms are not suitable because they tend to sweat out of the dried protein sheets. The higher molecular weight monoglycerides, such as those made from stearic acid, impart a smoky appearance to the sheets and are objectionable for this reason.

In broad aspects then, my invention comprises a film, filament, sheet or plastic mass made from solutions of protein film-forming materials and containing small amounts of monoglycerides of fatty acids having from six to twelve carbon atoms.

As protein film-forming materials I can, of course, use any of those substances hitherto suggested for the formation of sheets, films and plastic masses in the prior art. Gelatin is one of the commonest materials of protein film-forming nature. Glue is another.

In addition to adding softening agents to the film-forming solution it is common in the art to incorporate hardening agents, such as dichromates, formaldehyde, and similar materials which "tan" the gelatin, glue or casein. These hardening agents can be added to the solution, or the formed article can be hardened with formaldehyde.

I shall now give examples of how my invention may be practised.

Example 1

Twenty-five parts of gelatin are dissolved in 500 parts of water and 1.5 parts of sodium dichromate and 2 parts of α-monocaproin, B. P. 146–8° C./1 mm., are added. The mixture is then placed in a shallow pan and dried for twelve hours. The resulting product is a sheet which is insoluble in water and is permanently flexible under all conditions of use which would not actually destroy the gelatin itself.

Example 2

Twenty-five parts of gelatin are dissolved in 500 parts of water and 1.5 parts of sodium dichromate and 2 parts of α-monocaprylin, B. P. 171–2° C./1 mm., are added. The mixture is then poured on a pan and dried. The product is a thin sheet, insoluble in water and permanently flexible.

In like manner monocaprin and monolaurin can be added to gelatin solutions prior to film or sheet forming. The proportions given above can be varied over rather wide limits depending upon the degree of flexibility desired in the film. Ordinarily the softening agent comprises about 3% to 10% of the dried film. More than 10% is wasteful and for many purposes only about 1% of the film need be a monoglyceride. In a similar manner I add small amounts of my monoglycerides to glue solutions and casein solutions, pour the films on a suitable film-forming base and dry.

My softening agents are also suitable for use in gelatin filaments and similar plastic masses made from protein, film-forming materials. The gelatin solution containing my softening agents can also be coagulated by extrusion into coagulating baths for the formation of filaments.

Having thus described my invention, what I claim is:

1. A solution for forming articles of the class consisting of sheets, films and filaments, comprising an aqueous solution of a water soluble protein film-forming material containing a small amount of a monoglyceride of a fatty acid having from six to twelve carbon atoms.

2. An aqueous gelatin solution for film-forming purposes containing a small amount of a monoglyceride of a fatty acid having from six to twelve carbon atoms.

3. Articles of the class consisting of sheets, films and filaments composed of a water soluble protein film-forming material containing a monoglyceride of a fatty acid having from six to twelve carbon atoms as a softening agent.

4. An article of the class consisting of sheets, films and filaments composed of gelatin containing a monoglyceride of a fatty acid having from six to twelve carbon atoms as a softening agent.

5. A hardened gelatin film containing a monoglyceride of a fatty acid having from six to twelve carbon atoms as a softening agent.

6. A hardened gelatin film containing monocaproin.

7. A hardened gelatin film containing monocaprylin.

ANDERSON W. RALSTON.