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RELEASE AGENT FOR FILM-CASTING AND
EMBOSSING OPERATIONS

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This invention relates to cellulose ether compositions and more particularly to a release agent therefor.

In the production of films or foil, and of embossed articles from cellulose ether compositions one of the difficulties encountered is in the separation of the finished article from the forming member, i. e. from the casting wheel or table, or from the die or press surface against which the surface of the article is formed. In the case of sheets, such as films or foils, undesirable sticking, tearing and stretching of the sheet frequently occurs when its removal from the surface is attempted. Easy release of the plastic composition is particularly necessary in the case of embossing operations, such as in the making of sound records, where patterns of intricate detail are impressed in the record with a matrix, which is usually heated, and where extremely faithful reproduction of the matrix pattern must be maintained during separation of the pattern from the still heated matrix.

Because of these difficulties it has become common practice to incorporate in the composition, which is to be cast into sheets or embossed, a lubricating agent which will facilitate removal of the article from the forming member. Among the substances which have been employed for the purpose are stearic acid, beeswax, carnauba wax, paraffin, aluminum palmitate, etc. Many of these substances, however, are unsatisfactory because they are compatible with the cellulose derivative over a wide range of proportions and do not remain on the surface of the composition in sufficient quantity to effect the desired degree of lubrication. Others of these materials tend to crystallize out of the composition upon aging thereby causing blushing, blooming or hazing of the article. Others impart a sticky or greasy feel to the surface of the article or render it so soft that it is easily scratched or marred. Still others cause embrittlement of the composition upon aging.

It is therefore an object of the invention to provide a film- and embossing-release agent which may be incorporated in cellulose ether compositions and which, when so incorporated, renders the composition easily separable from the surfaces of members used in forming it.

An additional object is to provide a cellulose ether composition which may be cast into sheets on smooth surfaces and which subsequently may be separated easily therefrom.

An additional object is to provide a cellulose ether composition which may be embossed with

a heated die to secure faithful reproduction of the die surface.

These and related objects are readily accomplished by incorporating as a release agent in a cellulose ether film-forming or embossing composition from 0.5 to 12 per cent by weight of a higher polyglycol ester, i. e. of an ester derived from a polyglycol having a molecular weight of from about 2000 to about 5000. The cellulose ether composition containing the polyglycol ester may, but does not necessarily, contain one or more plasticizers such as those usually employed in preparing cellulose ether compositions for use in film-casting or embossing operations. Due to the action of the release agent no difficulty is encountered in removing cast sheets from the casting surfaces used in forming them. Cleaning of the casting surfaces is substantially eliminated. Compositions containing the release agent of the invention are particularly adapted to having intricate patterns, such as decorative designs, sound tracks and the like, embossed in the surface of previously formed shapes by means of a heated matrix or die carrying a master design. Although the surface of the plastic shape may be partially fused by the embossing die, there is no tendency for it to adhere to the die. The effectiveness of the polyglycol esters as release agents is particularly remarkable in view of the fact that non-volatile ester type compounds, such as alkyl phthalates, alkyl citrates, aryl phosphates, etc., are frequently employed in cellulose ether lacquers to improve their adhesion to surfaces. When, however, only a minor proportion, e. g. from 0.5 to 12 per cent by weight of a corresponding higher polyglycol ester, e. g. of polyglycol phthalate, etc., is included in the composition, ready release of the dried coating from smooth surfaces is obtained without distortion or tearing of the film. Films and the like prepared from compositions containing the polyglycol esters carry very little static electricity on their surfaces due, apparently, to the slightly hygroscopic nature of the esters.

It may be mentioned that a higher polyglycol ester may, if desired, also be used effectively as a release agent, particularly in embossing operations, by dissolving it in a solvent, such as an alcohol, a mixture of an alcohol and an aromatic hydrocarbon, etc., and coating the surface of the die with the solution. After the solution has dried, leaving a film of the ester on the surface, sheets of cellulose ether compositions may be embossed with the coated die. Ready release of the die from the embossed sheet occurs. If desired, the solution of the release agent may be applied

on the surface of the sheet instead of on the die. Certain of the esters are somewhat soluble in water and aqueous solutions of these may be used to advantage.

Although any organo-soluble cellulose ether, such as organo-soluble ethyl cellulose, methyl cellulose, butyl-cellulose and benzyl cellulose, may be used in preparing the herein described composition, the invention is of particular value as relating to ethyl cellulose compositions due to its being more readily available commercially than any of the other cellulose ethers. Ethyl cellulose of a wide range of viscosity types and of ethoxyl content may be used.

The higher polyglycols are well known commercial products which are usually prepared by the polymerization of ethylene or propylene oxides and which usually have a molecular weight of from 2000 to 5000. One of these, known commercially as "Carbowax 4000," and thought to be a polymerization product of ethylene oxide, is a waxy solid having a molecular weight of about 3700 to 4000. The esters of the higher polyglycols may be prepared readily by reacting the polyglycols with organic acids or their anhydrides or with acid chlorides in accordance with known methods for the preparation of esters. Purification of the crude ester is not usually necessary. Either one or two hydroxyl groups of the polyglycol may be esterified. Among the higher polyglycol esters of value as release agents in cellulose ether compositions may be mentioned the maleate, mono-stearate, di-laurate, mono-oleate, di-oleate, mono-laurate, phthalate, palmitate, succinate, ricinoleate, and butyrate of Carbowax and of polymerized propylene oxide. The esters of polycarboxylic acids and of high molecular weight, monocarboxylic acids, such as those having from 10 to 20 carbon atoms inclusive in the molecule, are of particular value.

The higher polyglycol esters are effective as film- and embossing-release agents in cellulose ether compositions when used in amounts of from 0.5 to 12 per cent by weight of the composition. In some instances, they are of limited compatibility, i. e. compatible to the extent only of from 3 to 10 per cent by weight with the cellulose ether. In such cases, it is preferable to use the esters in proportions below the limit of their compatibility. However, larger amounts may be used, if desired, although in such cases the finished film may be clouded in appearance.

As mentioned previously, plasticizers and other modifying agents may, if desired, be included in the composition. The choice of a plasticizer will depend to some extent on the particular cellulose ether used and the properties desired in the finished film. The art of plasticizing cellulose ether compositions to impart to them desired properties is well known and need not be discussed here. Compatible resins may be added to alter the hardness of the composition as well as pigments, soluble dyes, and other modifying agents.

The composition of the invention may be prepared and articles formed therefrom in any convenient manner. Thus the cellulose ether and the polyglycol ester together, if desired, with a plasticizer, may be dissolved in a volatile organic solvent and film or foil then cast from the solution. After drying, the sheet may be removed readily from the casting surface without distortion or sticking. The polyglycol esters are effective release agents not only during film-casting operations, but also during subsequent embossing or laminating operations with the formed article.

Thus films cast from the composition may be lifted easily from the casting table and subsequently molded to paper in a heated press. The laminated product may be separated from the still hot press plates without marring of the plastic surface. Previously formed blanks for sound records may be embossed with a heated matrix to impress the sound track thereon and the finished record separated from the matrix with little or no intermediate cooling.

Certain advantages of the invention may be seen from the following examples which are, however, not to be construed as limiting.

Example 1

20 parts by weight of a composition consisting of 72 per cent of ethyl cellulose having an ethoxy content of about 45.5 per cent and a viscosity of 50 centipoises, 20 per cent of monophenyl di(o-xenyl) phosphate and 8 per cent of Carbowax maleate were dissolved in 80 parts of a solvent consisting of 70 parts by volume of toluene and 30 parts of ethanol. The solution was used in casting a film, which was 0.002 inch thick when dry, on a polished chromium plated panel. The lacquer was dried on the panel for 3 hours at about 70° F. and then for 2 hours at 125° F. and then exposed for 3 hours to air at 72° F. and a relative humidity of 50 per cent. The dried and conditioned film, while still on the panel, was cut into strips 1 inch wide with a sharp knife. The panel was then suspended with the strips in a vertical position. A single strip was separated at its upper end from the panel with a knife and, by means of a small clip and a fine wire a tray was suspended from the loose end of the strip. Lead shot were then added to the tray until the strip peeled evenly and slowly from the panel. The sum of the weights of the clip, wire and shot which just caused the strip to peel from the panel was 1.8 grams. The surface of the strip was uninjured during its removal. By way of comparison a composition consisting of 80 parts by weight of the same ethyl cellulose and 20 parts of monophenyl di(o-xenyl) phosphate was tested in a similar manner. The total weight required in this case was 270 grams. In still another comparative test unesterified Carbowax was substituted for the Carbowax maleate. A weight of 440 grams was required in this case.

The Carbowax maleate used in the above example was prepared by stirring 200 parts by weight of "Carbowax 4000" and 6 parts of maleic anhydride together at 150° C. for 2 hours. The reaction product was then used as a release agent without purification.

Example 2

23 parts by weight of a composition consisting of 96 per cent of ethyl cellulose, 2 per cent of monophenyl di(o-xenyl) phosphate and 2 per cent of Carbitol phthalate were dissolved in 77 parts of a solvent consisting of 80 parts by volume of benzene and 20 parts of methanol. Foil as thin as 0.0005 inch, when cast from the solution on a metal surface, was readily removed without tearing or marring its surface. Similar results were obtained with a composition consisting of 96 per cent of the same ethyl cellulose and 4 per cent of Carbitol maleate.

Example 3

A thin film was solvent-cast as in Example 2 from a composition consisting of 48 per cent by weight of ethyl cellulose having an ethoxy con-

tent of 46 per cent and a viscosity of 10 centipoises, 35 per cent of monophenyl di(o-xenyl) phosphate, 15 per cent of di(p-tert.-butyl-phenyl) mono(5-tert.-butyl-2-xenyl) phosphate and 2 per cent of Carbowax phthalate. The film was separated from the casting surface easily and without distortion. The film was then molded to paper between polished press plates at 300° F. and 1000 pounds per square inch pressure. The press was opened and the laminated product removed without cooling. The hot laminated product showed no tendency to stick to the press plates.

Example 4

87 parts by weight of ethyl cellulose having an ethoxy content of about 46 per cent and a viscosity of about 60 centipoises, 6 parts of di(p-tert.-butyl-phenyl) mono(5-tert.-butyl-2-xenyl) phosphate, 3 parts of monophenyl di(o-xenyl) phosphate and 1 part of Carbowax phthalate were dissolved in 80 parts of a mixture consisting of 80 parts by volume of benzene and 20 parts of methanol. 2 parts by weight of Titanox AA (a white pigment) and 1 part of Toluidine Toner (a red coloring agent) were added and a film about 0.015 inch thick was solvent-cast from the mixture. The dried film was readily removed from the casting surface without sticking. A sound track was impressed simultaneously in each side of a circular section of the film. The matrices used in forming the sound track were heated to about 270° F. and a pressure of 1000 pounds per square inch was used. After slight cooling of the matrices, the embossed film was removed from the press without sticking. The record,

upon being played back, reproduced the original sound faithfully.

We claim:

1. A composition including an organo-soluble cellulose ether, a plasticizer for the cellulose ether and, as a release agent, from 0.5 to 12 per cent by weight of a polyglycol ester of an organic carboxylic acid, said polyglycol having a molecular weight of from 2000 to 5000.

2. A composition including ethyl cellulose, a plasticizer for the ethyl cellulose and, as a release agent, from 0.5 to 12 per cent by weight of a polyglycol ester of an organic carboxylic acid, said polyglycol having a molecular weight of from 2000 to 5000.

3. A composition including ethyl cellulose, a plasticizer for the ethyl cellulose and, as a release agent, from 0.5 to 12 per cent by weight of a polyethyleneglycol ester of an organic carboxylic acid, said polyethylene-glycol having a molecular weight of from 2000 to 5000.

4. A composition including ethyl cellulose, a plasticizer for the ethyl cellulose and, as a release agent, from 0.5 to 12 per cent by weight of polyethyleneglycol phthalate, said polyethylene-glycol having a molecular weight of from 2000 to 5000.

5. A composition including ethyl cellulose, a plasticizer for the ethyl cellulose and, as a release agent, from 0.5 to 12 per cent by weight of a polyethyleneglycol maleate, said polyethylene-glycol having a molecular weight of from 2000 to 5000.

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