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NONTACKY SYNTHETIC FILM

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This invention relates to the production of coated structures. More particularly, it relates to moistureproofing coating compositions containing a new type of slip-promoting agent and the use of such coating compositions in the production of thin, non-fibrous, optionally transparent sheets and films suitable for moistureproof wrapping tissue having a coating which is substantially non-tacky through a wide range of temperature conditions.

Thin transparent sheets and films of non-fibrous cellulosic materials containing moistureproof coatings are well known as wrapping tissue. In general, the coatings of such sheets and films comprise a film-forming constituent such as a cellulose derivative or a resin, a moisture-proofing agent such as a wax, a blending agent such as a resin, and a plasticizer. Such moistureproofing coating compositions and methods for compounding and applying the same are disclosed in detail in U. S. Patent No. 1,737,187 to Charch & Prindle, and French Patent No. 718,440 to Charch.

Difficulty has long been experienced in the handling and storing of such sheets and films because of their lack of slipperiness and adherence of contiguous sheets to each other. These difficulties are caused by at least two factors. One factor is that some of the constituents of the moistureproofing composition may be inherently tacky; this is especially so in the case of heat-sealing moistureproofing compositions. A second factor is that the surfaces of these sheets are so smooth that, when they lie in close juxtaposition, they have a tendency to exclude air from between them, thus causing a vacuum action which renders it very difficult to separate the sheets. At the same time, in view of the large area of contact the frictional resistance is high. This smoothness is not overcome and, in fact, is accentuated by the ordinary constituents of the moistureproofing composition, particularly the moistureproofing agent, for since it prevents the passage of moisture, it apparently forms a smooth continuous phase.

Furthermore, it has been observed that these handling difficulties are greatly augmented by a slight rise in temperature. A sheet, and especially a sheet coated with a moistureproofing heat-sealable composition, which proves perfectly satisfactory as to surface conditions at ordinary room temperatures may become very tacky and unmanageable when stored in heated places or when subjected to abnormally high room temperatures. Similar conditions have been found to arise in the use of automatic wrapping machinery. As long

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as such wrapping tissue is manually applied to packages, a slight degree of stickiness and frictional resistance, while an inconvenience, is of no considerable consequence. It becomes of extreme importance, however, when such adherence and frictional resistance are increased by the transmission of heat or the heat developed by friction in an automatic machine. It is found actually that even a difference of 1° or 2° may cause a sticking of the material to some part or other of the machine and completely foul its operation. Furthermore, due to the high speeds developed in such automatic machinery, normal adherence and frictional resistance, even of the same degree as can be tolerated in manual operation, are objectionable even in the absence of a temperature rise.

An attempt has been made to overcome the adhesive tendency inherent in these films by the use of a thin layer of talcum powder. This method has the disadvantage, however, that while it lessens the adhesion of the sheets, it opaques the film.

It has also been suggested to incorporate small amounts of finely divided, insoluble materials, such as kaolin, aluminum hydroxide, titanium oxide, etc., in the moistureproofing coating compositions which are to be applied to the film. Since such solid matter is in a very finely divided form and since the coating bath is of relatively high viscosity, it is possible to disperse these solid particles in the bath and apply evenly to the surfaces of the film. The presence of such solid matter produces numerous points of separation between contiguous sheets in stacked relation or between the surface of the sheet and other smooth surfaces, and thus insures good surface slip. However, the introduction of insoluble matter into the bath composition has several disadvantages. For example, it is often very difficult to adequately disperse solid materials without prolonged stirring and agitation; in many instances the dispersion is not stable over long periods of time or in all conditions of operation so that pipe lines and apparatus become clogged with sediment; and generally the insoluble material in the coating adversely affects the clarity of the film.

Another film defect from the use of such solid insoluble slip agents used heretofore has been a lowering of the moistureproof quality which is perhaps caused by interference with the continuity of the wax surface.

Therefore, it is an object of this invention to provide improved slip characteristics in non-fibrous film coated with moistureproofing com-

positions without impairing the moistureproofness, anchorage, clarity and other desirable properties of the coated film.

Another object of this invention is to provide a moistureproofing, heat-sealable coating composition for non-fibrous, water-sensitive film or sheets, which composition contains a slip agent free of the objectionable features above related.

Still another object is to produce a wrapping tissue comprising a non-fibrous, clear, transparent base film of regenerated cellulose coated with a moistureproof, heat-sealable, non-tacky coating, which coating remains non-tacky even at substantially elevated temperatures, and does not adversely affect the clarity of the base film.

These and other objects will more clearly appear hereinafter.

These objects are realized by the present invention which, briefly stated, comprises incorporating a small amount of ethylene-1,3-dioxolane copolymer in the usual moistureproofing heat-sealable coating compositions for regenerated cellulose and the like and comprising generally a film-former such as cellulose nitrate, polyvinyl butyral, chlorinated rubber, etc.; optionally a plasticizer such as dibutyl phthalate; a moistureproofing agent such as paraffin wax; a blending agent such as Gum Damar, ester gum, etc.; a volatile solvent mixture for these constituents; and, if desired, an agent to render the coating heat-sealable. The resulting coating composition is applied in the usual way to the base film, and the solvent is thereafter removed to form a clear non-tacky coating.

The ethylene-1,3-dioxolane copolymers with which the presest invention is concerned are those having a molecular weight within the range of 500–1500 and preferably within the range of 800–1000; an oxygen (O_2) content of from 2% to 4%, and preferably from 2.5% to 3%; and a melting point of 85°–130° C. and preferably of 108°–113° C.

The preparation of ethylene-1,3-dioxolane copolymers useful for purposes of this invention is fully described in U. S. patent application Serial No. 471,058, filed January 1, 1943. In brief, ethylene-1,3-dioxolane copolymers are formed by reacting 1,3-dioxolane and ethylene in the presence of peroxygen type catalyst under an ethylene pressure above 50 pounds per square inch and at a temperature between 50° and 300° C. Completion of the reaction is indicated by sudden drop in pressure, and the copolymer is isolated for use in the form of a waxy solid soluble in organic solvents.

Ethylene-1,3-dioxolane copolymers impart a remarkable improvement in slip characteristics of the coating even when used in amounts as low as 0.05% by weight based upon the weight of solids in the coating composition. Amounts in excess of 2.0% tend to impair the clarity of the film. Preferably, the copolymer is employed in amounts within the range of from 0.3 to 0.5%, based upon the solids content of the coating composition.

As will be apparent from the description hereinafter, the coating compositions containing ethylene-1,3-dioxolane copolymer can be used in the production of moistureproof sheets from thin, non-fibrous, transparent base sheets and films normally used for wrapping tissue. These materials may include sheets or films of regenerated cellulose whether they be made by the viscose process, the cuprammonium process or by any other manufacturing technique; cellulose ethers, such as ethyl, benzyl or glycol cellulose; cellulose esters, such as cellulose nitrate or cellulose acetate; lowly etherified or esterified materials, such as lowly etherified ethyl cellulose, lowly etherified benzyl cellulose or lowly etherified glycol cellulose, and lowly esterified cellulose nitrate or lowly esterified cellulose acetate; gelatin, casein or the like. The materials may also include film-forming compounds, such as rubber hydrochloride (Pliofilm), cyclized rubber (Pliolite), vinyl resins, such as polyvinyl acetate, polyvinyl acetals and also polyvinyl alcohol.

The moistureproofing and preferably heat-sealing coating compositions modified according to my invention are applied to the base film by any of the conventional methods known to the art, i. e., by dipping, spraying, roller-coating, brushing, or the like.

The solvent may be removed and the coating material subjected to an elevated temperature at least equal to the melting point of the wax whereby a clear, transparent, moistureproof film may be obtained. The technique of this procedure is set forth in the Charch & Prindle Patent No. 1,737,187.

The following examples illustrate specific embodiments of my invention. Quantities are given in parts by weight unless otherwise indicated.

Example I

The following composition was coated on 450 gauge regenerated cellulose film softened with glycerol, and the solvent was evaporated:

	Parts
Polyvinyl butyral (10–15% free hydroxyls)	70.0
Maleate modified ester gum (M. P. 102° C.)	10.0
Paraffin wax (M. P. 60° C.)	4.8
Ethylene-1,3-dioxolane copolymer	0.2
Dibutyl phthalate	15.0

20% of the above solids in a solvent composition consisting of 65% ethyl acetate and 35% toluene.

The resulting coated film, containing 10 grams of coating per square meter of film, had a heat-seal strength of 300 g./1.5 inch strip, a moistureproofness of 20 g./100 m^2-hr. at 53 mm. vapor pressure difference, and was of excellent clarity. Superposed coated sheets readily slipped over each other under finger pressure denoting excellent slip characteristics. Moreover, the film showed no tendency to block when used in automatic wrapping machines.

In contrast, 450 gauge regenerated cellulose film coated with the same thickness of a coating identical with that above save that the ethylene-1,3-dioxolane copolymer was omitted, exhibited substantially the same heat-seal strength and moistureproofness values. It was, however, so tacky that it could not be wound without wrinkling.

Example II

450 gauge regenerated cellulose film was coated as in Example I with a coating composition of the following formula:

	Parts
Polyvinyl butyral (10–15% free hydroxyls)	85.6
Dibutyl sebacate	10.0
Paraffin wax (M. P. 60° C)	4.0
Ethylene-1,3-dioxolane copolymer	0.4

12% of the above solids in a solvent composition consisting of 65% ethyl acetate and 35% toluene.

The moistureproof film resulting had good slip characteristics and the clarity of the film was not affected.

Example III

The following composition was cast as a self-supporting film:

	Parts
Polyvinyl butyral (10–15% free hydroxyls)	80.6
Dibutyl sebacate	15.0
Paraffin wax (M. P. 60° C.)	4.0
Ethylene-1,3-dioxolane copolymer	0.4

12% of the above solids in a solvent composition consisting of 65% ethyl acetate and 35% toluene.

The film thus formed was transparent and possessed good surface slip and storage characteristics.

Example IV

450 gauge, gylcerol softened, regenerated cellulose film was coated with a composition consisting of:

	Parts
Nitrocellulose (11.4% nitrogen)	50.0
Dibutyl phthalate	32.0
Damar resin	10.0
Paraffin wax (M. P. 60° C.)	2.9
Petrex resin (U. S. P. 2,236,546)	5.0
Ethylene-1,3-dioxolane copolymer	0.1

12% solids in 65% ethyl acetate, 33% toluene, 2% ethyl alcohol mixed solvent.

A transparent moistureproof film having good surface slip characteristics was produced.

Example V

The following composition was coated on polyvinyl alcohol film:

	Parts
Ethyl cellulose	70.6
Paraffin wax (M. P. 60° C.)	4.0
Ethylene-1,3-dioxolane copolymer	0.4
Sulfurized castor oil	5.0
Dibutyl phthalate	20.0

12% solids in a solvent composition of 80% toluene, and 20% ethyl acetate.

Results similar to those of Example IV were obtained.

Example VI

The following composition was coated on cellulose acetate film:

	Parts
Chlorinated rubber (67% Cl)	59.4
Paraffin wax (M. P. 60° C.)	6.0
Damar resin	10.0
Dibutyl phthalate	24.0
Ethylene-1,3-dioxolane copolymer	0.6

12% solids in toluene.

A clear film of good slip characteristics resulted.

Example VII

Regenerated cellulose film (450 gauge) was coated with a composition consisting of:

	Parts
Butyl methacrylate	94.5
Paraffin wax (M. P. 60° C.)	5.0
Ethylene-1,3-dioxolane copolymer	0.5

12% solids in toluene.

The results were similar to those of Example I.

Example VIII

Regenerated cellulose film (300 gauge) softened with 15% glycerol was coated with a composition consisting of:

	Parts
Cyclized rubber (U. S. P. 1,797,188)	94.5
Bleached montan wax	5.0
Ethylene-1,3-dioxolane copolymer	0.5

12% solids in toluene.

Results were similar to those of Example I.

The surface conditioning agent of the present invention, when incorporated in coating compositions for use with wrapping tissue, has been found to give a product which is eminently suited for use upon automatic wrapping machinery. For such use it is necessary that the tightly wound rolls of material supplied for use upon such machines unwind and deliver the film very smoothly and evenly through the machine. Even though rolls of such material have been tightly wound and stored at somewhat elevated temperatures, it is found that there will be substantially no sticking between the surfaces of the film, allowing it to unroll with great ease and freedom from tears, marred surfaces and other blemishes. It is furthermore essential that such material will pass evenly and smoothly through the whole course of the wrapping machine without adherence to various portions of said machine. Very often, certain heated elements form a part of such machine, said elements generally being used for the formation of heat-seal at a certain stage of the wrapping operation. Should the adjacent surfaces of the machine become warm by conduction or convection, serious trouble may result in the operation of the machine by sticking of the wrapping tissue to these surfaces. The present invention produces a wrapping tissue which is far less likely to adhere to such surfaces than wrapping tissues previously available.

Where the coated material is in the form of sheets, said sheets may be stacked and stored for long periods of time without any appearance of adhesion between the sheets so stacked. Such sheets may be readily separated and handled manually or by machinery.

Because ethylene-1,3-dioxolane copolymers are compatible in effective amounts with the other ingredients of the coating compositions, they produce an improved surface without affecting the clarity of film. Furthermore, these copolymers, being solvent soluble, are easily and economically incorporated in coating compositions to produce a stable composition wherein the slip-promoting agent is uniformly distributed. And of the utmost importance is the fact that there is no observable degradation of other properties of the coating when ethylene-1,3-dioxolane copolymers are used to improve slip.

Since the invention is subject to numerous modifications and variations from the details hereinabove described without departing from the spirit and scope thereof, it is to be understood that the invention is not to be limited except as defined in the appended claims.

I claim:

1. A wrapping tissue comprising a non-fibrous, transparent base sheet of organic, synthetic, film-forming material and a moistureproof coating thereon comprising from 0.05% to 2.0% by weight, based upon the weight of the coating, of ethylene-1,3-dioxolane copolymer.

2. A wrapping tissue comprising a non-fibrous, transparent base sheet of organic, synthetic, film-forming material and a moistureproof coating thereon comprising from 0.3% to 0.5% by weight, based upon the weight of the coating, of ethylene-1,3-dioxolane copolymer.

3. A wrapping tissue comprising a self-sustain-

ing film of regenerated cellulose with a moistureproof coating thereon comprising from 0.05% to 2.0% by weight, based on the weight of the coating, of ethylene-1,3-dioxolane copolymer.

4. A moistureproof, heat-sealable, transparent wrapping tissue comprising regenerated cellulose film coated with a moistureproof, heat-sealable coating composition for regenerated cellulose film, said composition containing from 0.05% to 2.0% by weight, based upon the weight of the coating, of ethylene-1,3-dioxolane copolymer.

5. As a wrapping tissue a self-sustaining, non-fibrous, transparent film comprising essentially an organic, synthetic, film-forming material, a moistureproofing agent, and from 0.05% to 2.0% by weight, based upon the weight of the film, of ethylene-1,3-dioxolane copolymer.

6. In the method of producing a thin, flexible, moistureproof, heat-sealable, non-fibrous film or sheet suitable as wrapping tissue wherein a transparent non-fibrous film or sheet of organic, synthetic, film-forming material is coated with a coating composition comprising essentially a film-former, a moistureproofing agent, and a heat-sealing agent dissolved in organic volatile solvent, and the solvent is thereafter removed, the improvement which comprises incorporating in said coating composition at least 0.05% by weight, based upon the weight of solids, of ethylene-1,3-dioxolane copolymer whereby the coated film is rendered slippery and anti-blocking.

7. In the method of producing a thin, flexible, transparent, moistureproof, heat-sealable, non-fibrous film or sheet wherein regenerated cellulose film or sheet is coated with a coating composition comprising essentially a film-former, a moistureproofing agent, and a heat-sealing agent dissolved in organic volatile solvent, and the solvent is thereafter removed, the improvement which comprises incorporating in said coating composition from 0.05% to 2.0% by weight, based upon the weight of solids, of ethylene-1,3-dioxolane copolymer whereby the coated film is rendered slippery and anti-blocking.

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The following references are of record in the file of this patent:

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