United States Patent Office 3,697,475 Patented Oct. 10, 1972

3,697,475

INORGANIC-ORGANO TITANATE POLYMERIC FILM

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No Drawing. Filed Oct. 30, 1969, Ser. No. 872,757
Int. Cl. C08f 45/06; C08k 1/12
U.S. Cl. 260—41 A 7 Claims

ABSTRACT OF THE DISCLOSURE

Oriented opaque ultrathin films comprising thermoplastic polymers containing up to about 60 parts by weight of an inorganic filler-organo titanate compound are described. The films are prepared by extruding the compositions as films and thereafter drawing the resultant films at a temperature below that at which the films remain translucent. The films of our invention are useful as packaging material in preparing ultrathin paper, and in laminates, non-woven fabric, rug backing and mesh structures.

BACKGROUND OF THE INVENTION

(a) Field of invention

This invention relates to thin oriented films of thermoplastic polymers. More particularly, the invention relates to thermoplastic polymers which have been modified by the incorporation therein of an inorganic filler, the surface of which has been reacted with an organic derivative of ortho titanic acid containing at least two hydrolyzable groups, and which have been oriented under conditions which produce a white, opaque film of high brightness and tensile strength.

(b) Description of the prior art

Paper has been made conventionally by felting naturally occurring cellulosic fibers such as cotton and wood. To produce cellulosic paper of publication grade, it is frequently the practice to fill the body stock, i.e., the raw uncoated paper from the felting and subsequent drying and smoothing operations, with an inert, white mineral filler and to coat both sides of the body stock with a high brightness white pigment, e.g., kaolin clays, in a binder of casein latex, starch or other adhesives to achieve a sheet opacity of at least 88 to 90% and a TAPPI brightness of 70%. The resulting publication grade paper stock has a weight of 34 to 45 pounds per ream, a thickness of 3 to 4 mils, uncalendered, and a tensile strength of 3000 to 5000 p.s.i. for uncoated stock.

OBJECTS OF THE INVENTION

One object of this invention is to produce thermoplastic films suitable as a replacement for paper having high opacity, brightness and tensile strength and low weight.

A further object of this invention is to provide thermoplastic films suitable as a replacement for paper which contain from about 2 to about 60 percent of a treated inorganic filler in a thermoplastic material.

Still another object is to provide colored thermoplastic films suitable as a replacement for paper.

Yet another object of the invention is to provide fibrillated filled films.

SUMMARY OF THE INVENTION

These and other objects are attained by incorporating into a thermoplastic material an inorganic filler which has been reacted with an organic derivative of ortho titanic acid containing at least two hydrolyzable groups, forming films therefrom and cold drawing the films under conditions which produce a white, opaque film of high brightness and tensile strength. To obtain colored films, inorganic pigments conventionally used as coloring agents, which have been reacted with an organo titanium compound containing at least two hydrolyzable groups are used or may be included with other organo titanium treated inorganic fillers. Alternatively, organic dyes may be incorporated in the organo titanium compound which is reacted with the filler.

The organo titanium compounds used to react with the inorganic filler material are represented by the formula $Ti(OR)_mR'_{4-m}$ wherein R is a hydrogen radical containing from 1 to 12 carbon atoms and R' may be OCOR", OR"' or a hydrocarbon substituted silicic acid radical (OSiR") wherein R" is a substituted or unsubstituted hydrocarbon radical having from 1 to 40 carbon atoms and wherein R"' is a substituted or unsubstituted hydrocarbon radical having from 6 to 40 carbon atoms providing that R"' and R are not identical. In the formula *m* is equal to 2 or 3. At least two hydrolyzable groups, preferably OR groupings, must be present in the organo titanium compound in order that hydrolysis of the organo titanium compound occurs followed by its polymerization to produce a film of organo-substituted titanium oxide at the filler surface. Through this reaction the filler is provided with a hydrophobic, organophilic film.

The organo titanium compounds can be prepared by reacting 1 mol of $Ti(OR)_4$ with from 1 to 2 mols of a compound represented by the formula AR' wherein A is hydrogen or a group capable of reacting to remove an OR from the $Ti(OR)_4$ molecule and R' is as described above. A mixture of two or more compounds of the formula AR' may be used. The preparation of illustrative organo titanium compounds is more particularly described in Langkammerer's U.S. Pat. 2,621,193 [see also page 15 of the E. I. du Pont de Nemours & Co. publication entitled "Tyzor," Versatile Chemicals for Industry (1965, revised 1966) which describes the reaction product of Langkammerer's process as a monomer whose formula is identical to the $Ti(OR)_mR'_{4-m}$ formula given above, but which also points out that the monomers are unstable and under certain conditions may decompose by reacting with one another to yield a polymeric reaction product of a structure identical to that shown in col. 4, lines 51–58 of the Langkammerer patent; as pointed out by Langkammerer (col. 4, lines 40–42), the exact structure of this polymeric reaction product is unknown].

Reverting to the starting material $Ti(OR)_4$, R may be selected from the group consisting of alkyl, cycloalkyl, aryl, aralkyl, and alkaryl radicals containing from 1 to 12 carbon atoms. Specific examples of compounds represented by the formulae are tetramethyl titanate, tetraethyl titanate (ethyl orthotitanate), tetrabutyl, tetraisopropyl, tetraamyl, tetraoctyl, tetradodecyl, tetra-2-ethylhexyl, etrabenzyl, tetraphenyl and tetra-betanaphthyl titanates.

The radical R" mentioned above represents a hydrocarbon radical having from 1 to 40 carbon atoms taken from the group consisting of alkyl, cycloalkyl, aryl, aralkyl, alkaryl hydrocarbon radicals which may contain various substituents such as halogens, e.g., a perfluoro methyl radical, hydroxyl groups, keto group (radical of levulinic acid) amino, nitro and heterocyclic groups. Examples of R" groups are methyl, ethyl, propyl, butyl, isobutyl, pentyl, hexyl, heptyl, octyl, octadecyl, cyclohexyl, cycloheptyl, phenyl, naphthyl, tolyl, xylyl, benzyl, phenyl ethyl, chlorophenyl, dibromophenyl, 2,3-dihydroxy propoxy. The various hydrocarbon radicals may contain aliphatic unsaturation as well as aromatic unsaturation. Perfluoro compounds may be used. R"' is of similar scope