

PATENT SPECIFICATION

(11)

1 440 317

1 440 317

(21) Application No. 47697/72 (22) Filed 17 Oct. 1972

(23) Complete Specification filed 17 Oct. 1973

(44) Complete Specification published 23 June 1976

(51) INT. CL.³ B32B 27/08 B29D 9/00 B32B 27/32

(52) Index at acceptance

B5N 2708 2732

B5B 230 250 25Y 35Y 363 412 422 611 615

(72) Inventors WILLIAM JOHN ANDREWS and

WILLIAM JOHN MANDER PHILPOTT



(54) HEAT-SEALABLE PLASTICS FILMS

(71) We, BRITISH CELLOPHANE LIMITED, a British Company, of Bath Road, Bridgwater, Somerset, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

This invention is concerned with heat-sealable plastics films.

Polypropylene film in recent years have been used to an increased extent as a wrapping and packaging material due to its excellent clarity and to its strength which is considerably enhanced when the film is stretched in one or more directions under stretch-orientatable conditions which at least partially orientate the molecular structure in the direction of stretch. By "stretch-orientatable conditions" for polypropylene film is meant performing the stretching operation when the film is within a temperature range between 2°C. below the crystalline melting point of the polypropylene and its second order transition temperature.

For efficient wrapping purposes, particularly upon high speed wrapping machinery, it is necessary for the polypropylene film to be readily and easily heat-sealable to itself. Whereas polypropylene film is inherently heat-sealable to itself, at the temperatures necessary to provide seals of adequate strength (that is about 160°C.) orientated film will shrink and produce undesirable buckling.

The present invention is concerned with providing orientated polypropylene film with a heat-sealable layer which will permit adequate heat-seals to be made at a temperature at which there is insignificant heat-distortion of orientated polypropylene film.

According to the present invention, a heat-sealable orientated plastics film comprises an orientated polypropylene film having on at least one surface a heat-sealable layer comprising a predominantly linear random copolymer of ethylene and up to 12 mole per cent of at least one further alpha-olefin having at least three carbon atoms per molecule.

The term "polypropylene film" includes a film of polypropylene containing in admixture a small proportion of a compatible polyolefin which does not significantly affect the physical characteristics of the film.

The copolymer may be formed by reacting the monomers under conditions which favour the formation of linear chains of ethylene units with little branching and random distribution of the comonomer along the chains, for example low pressure catalytic conditions, such as are used in the polymerisation of ethylene to form high density polyethylenes. Under these conditions, the reaction takes place at relatively low pressures in the presence of a coordination or organometallic catalyst such as a so-called Zeigler catalyst, or a transition metal oxide catalyst or similar catalyst.

When the copolymer has a content of the further alpha-olefin exceeding about 12 mole per cent it tends to become tacky resulting in the plastics film being difficult to handle in roll form and upon film converting machinery.

The proportion of the further alpha-olefin in the random copolymer preferably lies in the range of between 2 and 8 mole per cent of the copolymer and more preferably between 2.5 and 5 mole per cent of the copolymer. The further alpha-olefin may, for example, be propylene or butene-1.

The copolymers used in the present invention are preferably characterised by having a melting point of below 135°C. as determined by Differential Thermal Analysis (D.T.A.) and those particularly useful in the performance of the invention have a D.T.A. melting point below 125°C. The D.T.A. melting point is determined by use of a differential scanning calorimeter marketed by Perkin-Elmer of Norwalk, Connecticut, United States of America in which the heating rate is 16 Centigrade degrees per minute.

The heat-sealable layer may be applied to the polypropylene film by any of the known methods. For example, a preformed film of the random copolymer may be laminated to

50

55

60

65

70

75

80

85

90

95

the polypropylene film by a suitable adhesive or by stretching the preformed film or preferred films in intimate contact with the polypropylene film when the combination combines to form a unitary film. Also, the random copolymer may be melt extruded on to one or both of the surfaces of a polypropylene film followed by cooling prior to the polypropylene film being stretched under stretch-orientable conditions.

Preferably, the heat-sealable plastics film is formed by co-extruding the polypropylene film with one or two layers of the random copolymer through a slot or annular orifice die followed by quenching and then stretching under stretch-orientable conditions.

Since the random copolymer is compatible with polypropylene, it is possible to return a small quantity of waste heat-sealable film to the extruder for the polypropylene film without significantly affecting the characteristics of the film.

The heat-sealable plastics film in accordance with the invention may be laminated to another such film with copolymer layer to copolymer layer, to form a laminate having useful properties.

The laminate may be formed by the application of heat and pressure or by stretching the two films when in surface contact with each other.

The invention also includes a method for the manufacture of a heat-sealable orientated plastics film comprising applying to at least one surface of a polypropylene film a layer of a predominantly linear random copolymer of ethylene and up to 12 mole per cent of the copolymer of at least one further alpha-olefin having at least three carbon atoms per molecule, bringing the combination to a stretch-orientable condition and stretching in at least one direction.

The invention will now be more specifically described with reference to the following Examples:

EXAMPLE 1

A polypropylene melt was co-extruded through a slot die at 300 feet per minute with outer layers of a melt of a substantially linear random copolymer marketed by Shell Chemicals (UK) Limited of London under the trade-mark Carlona 40-045/09 to produce a three layer molten laminate approximately 300 microns in thickness. The polypropylene constituted 90% of the thickness and each copolymer layer 5% of the thickness. The copolymer had a D.T.A. melting point of 114°C. and a density of 0.940. It consisted of ethylene copolymerised with about 2.5 mole per cent of butene-1 under low pressure catalytic conditions.

The molten laminate, after extrusion, was immediately quenched in cold water and was then heated to 100-115°C. and stretched by 20% in the machine direction between a

series of rollers in which the rollers at the output end were rotated at a greater peripheral speed than the rollers at the input end.

The uniaxially stretched film was then fed to a stenter where it was heated to about 150°C and stretched transversely to eight times its original width. The film now biaxially orientated was cooled, trimmed at the edges and wound into a roll. The film had high clarity and was approximately 30 microns in thickness.

It was found that samples of the film would readily heat-seal to each other at 125°C. under a pressure of 14 pounds per square inch in one second to give a heat-seal strength of 600 grams per 38 millimetre width of film. On examination of the sealed strips it was found that no distortion of the film had taken place during the sealing operation.

EXAMPLE 2

The procedure as set out in Example 1 was repeated except that the "Carlona" copolymer was replaced by a predominantly linear random copolymer of ethylene and propylene in which the propylene content amounted to 4 mole per cent. The copolymer had been made under low pressure catalytic conditions and had a density of 0.930 and a D.T.A. melting point of 115°C.

The waste trimmed from the edges of the film after biaxial orientation but before winding into a roll was chopped up, ground and fed back to the extruder for the polypropylene melt.

The biaxially orientated film was approximately 30 microns in thickness. It readily heat-sealed to itself at 118°C. under a pressure of 14 pounds per square inch for one second to give a heat-seal strength of 700 grams per 38 millimetres of film. No distortion of the film took place during the sealing operation.

EXAMPLE 3

A predominantly linear random copolymer of ethylene and butene-1 in which the butene-1 content amounted to 3 mole per cent was cast into a sheet 3 thousandths of an inch thick. The copolymer had been produced under low pressure catalytic conditions and had a density of 0.930 and D.T.A. melting point of 117°C.

The cast copolymer sheet was then laminated to a cash sheet of polypropylene 40 thousandths of an inch thick by heating the assembly to 140°C. and applying a pressure of 250 pounds per square inch.

The resultant laminate was then heated to a temperature of 160°C. and was stretched simultaneously 700% in two directions perpendicularly to each other to produce a biaxially orientated laminate.

The laminate readily heat-sealed to itself, copolymer side to copolymer side, at 120°C. under a pressure of 14 pounds per square inch for one second to give a heat-seal

strength of 1000 grams per 38 mm. width of film. No distortion in the film was observed as a result of the heat-sealing operation.

WHAT WE CLAIM IS:—

1. A heat-sealable orientated plastics film comprising an orientated polypropylene film having on at least one surface a heat-sealable layer comprising a predominantly linear random copolymer of ethylene and up to 12 mole per cent of at least one further alpha-olefin having at least three carbon atoms per molecule.
2. A plastics film as claimed in claim 1 in which the further alpha-olefin content of the copolymer lies in the range of between 2 and 8 mole per cent.
3. A plastics film as claimed in claim 2 in which the further alpha-olefin content of the copolymer lies in the range between 2.5 and 5.0 mole per cent.
4. A plastics film as claimed in any one of the preceding claims in which the further alpha-olefin is propylene.
5. A plastics film as claimed in any one of claims 1 to 3, in which the further alpha-olefin is butene-1.
6. A plastics film as claimed in any one of the preceding claims in which the D.T.A. melting point of the copolymer is below 125°C.
7. A plastics film as claimed in any one of the preceding claims when laminated to another such film with copolymer layer to copolymer layer.
8. A plastics film as claimed in claim 1 substantially as hereinbefore described in Example 1.
9. A plastics film as claimed in claim 1

substantially as hereinbefore described in Example 2 or Example 3.

10. A method for the manufacture of a heat-sealable orientated plastics film comprising applying to at least one surface of a polypropylene film a layer of a predominantly linear random copolymer of ethylene and up to 12 mole per cent of at least one further alpha-olefin having at least three carbon atoms per molecule, bringing the combination to a stretch-orientatable condition and stretching in at least one direction.

11. A method as claimed in claim 10 in which the layer of the copolymer is applied to the polypropylene film during co-extrusion of a melt of the copolymer and of the polypropylene through a slot die followed by quenching prior to stretching under stretch-orientatable conditions.

12. A method as claimed in claim 10 or claim 11 in which the further alpha-olefin content of the copolymer lies in the range of between 2 and 8 mole per cent of the copolymer.

13. A method as claimed in any one of claims 10 to 12 in which the further alpha-olefin is propylene or butene-1.

14. A method as claimed in claim 10 substantially as hereinbefore described in Example 1.

15. A method as claimed in claim 10 substantially as hereinbefore described in Example 2 or Example 3.

16. A heat-sealable orientated plastics film when prepared by the method as claimed in any one of claims 10 to 15.

BOULT, WADE & TENNANT,
Chartered Patent Agents,

34 Cursitor Street, London EC4A 1PQ.

strength of 1000 grams per 38 mm. width of film. No distortion in the film was observed as a result of the heat-sealing operation.

WHAT WE CLAIM IS:—

1. A heat-sealable orientated plastics film comprising an orientated polypropylene film having on at least one surface a heat-sealable layer comprising a predominantly linear random copolymer of ethylene and up to 12 mole per cent of at least one further alpha-olefin having at least three carbon atoms per molecule.
2. A plastics film as claimed in claim 1 in which the further alpha-olefin content of the copolymer lies in the range of between 2 and 8 mole per cent.
3. A plastics film as claimed in claim 2 in which the further alpha-olefin content of the copolymer lies in the range between 2.5 and 5.0 mole per cent.
4. A plastics film as claimed in any one of the preceding claims in which the further alpha-olefin is propylene.
5. A plastics film as claimed in any one of claims 1 to 3, in which the further alpha-olefin is butene-1.
6. A plastics film as claimed in any one of the preceding claims in which the D.T.A. melting point of the copolymer is below 125°C.
7. A plastics film as claimed in any one of the preceding claims when laminated to another such film with copolymer layer to copolymer layer.
8. A plastics film as claimed in claim 1 substantially as hereinbefore described in Example 1.
9. A plastics film as claimed in claim 1

substantially as hereinbefore described in Example 2 or Example 3.

10. A method for the manufacture of a heat-sealable orientated plastics film comprising applying to at least one surface of a polypropylene film a layer of a predominantly linear random copolymer of ethylene and up to 12 mole per cent of at least one further alpha-olefin having at least three carbon atoms per molecule, bringing the combination to a stretch-orientatable condition and stretching in at least one direction.

11. A method as claimed in claim 10 in which the layer of the copolymer is applied to the polypropylene film during co-extrusion of a melt of the copolymer and of the polypropylene through a slot die followed by quenching prior to stretching under stretch-orientatable conditions.

12. A method as claimed in claim 10 or claim 11 in which the further alpha-olefin content of the copolymer lies in the range of between 2 and 8 mole per cent of the copolymer.

13. A method as claimed in any one of claims 10 to 12 in which the further alpha-olefin is propylene or butene-1.

14. A method as claimed in claim 10 substantially as hereinbefore described in Example 1.

15. A method as claimed in claim 10 substantially as hereinbefore described in Example 2 or Example 3.

16. A heat-sealable orientated plastics film when prepared by the method as claimed in any one of claims 10 to 15.

BOULT, WADE & TENNANT,
Chartered Patent Agents,

34 Cursitor Street, London EC4A 1PQ.



* C L M S *