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(54) Title: STRETCH WRAPPING OF A HORIZONTAL BEAM

(57) Abstract

A process for wrapping articles, particularly large or heavy articles, with a stretch wrap film is disclosed. The film is at least 45 μm thick and is made from a polymer blend, such blend comprising (i) from 1 to 20 wt.-% of at least one polybutene having a number average molecular weight of from 500 to 10,000 and (ii) a polyethylene selected from the group consisting of at least one linear ethylene/C_4-C_{10} α-olefin copolymer having a density of from 0.915 to 0.940 g/cm^3 and blends of such copolymer with a second polymer, selected from a homopolymer of ethylene and a copolymer of ethylene and vinyl acetate, said second polymer having a density of from 0.910 to 0.940 g/cm^3, said polyethylene having up to 70 wt.-% of said second polymer, and wherein said film has a low crystallinity.

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STRETCH WRAPPING OF A HORIZONTAL BEAM

Technical Field

The present invention relates to the wrapping of an article with a stretch wrap film. In particular it relates to wrapping of a rolled and other products, e.g. of paper, carpet, non-woven fabric, fibre spools, with a stretch wrap film.

Background Art

Stretch wrap films are known. For example, U.S. Patent 4 657 982 to Breck and Mollison, which issued 1987 April 14, discloses stretch wrap films made from 80-90 percent by weight of a polyethylene, 0.5 to 10.0 percent by weight of a polybutene having a number average molecular weight of from 500 to 1500 and 0.5 to 10.0 percent by weight of a polybutene having a number average molecular weight of from 1700 to 10 000. West German Patent 2 821 733 A49, to British Cellophane Limited, published 1978 November 30, discloses a method of manufacturing a wrapping film suitable for use in spin wrapping applications, comprising extruding a blend of polyethylene and 0.5 to 10 percent by weight of polyisobutylene to form a film, and treating one surface of the film with corona discharge. Low density polyethylenes are exemplified. U.S. Patent 4 337 188 to Climenhage and Eadie, which issued 1982 June 29 also describes cling films made from polyolefins, an elastomer and one or more of an N,N-bis(2-hydroxyethyl) alkylamine, a mineral oil, a liquid polyolefin, and organic phosphate ester, polyethylene glycol, glycerol oleate and N-(3 alkoxy-2-hydroxypropyl) ethanolamine.

It is also known to wrap articles in a spin wrap operation whereby the articles are rotated about a vertical axis. The film used to wrap such articles is usually made from low density polyethylene or linear low density polyethylene blended with at least one polybutene in a conventional blown film process. Film thicknesses are generally from 20 μm to 30 μm. Unsuccessful attempts have been made to wrap large roll stock, e.g. paper,

carpets and the like, on a horizontal beam, or heavy articles, e.g. bricks on a pallet, with linear low density polyethylene film, where such film has been made using a conventional blown film process and has a thickness of about 51 μm. Such attempts showed non-uniform stretching of the film, especially if it is prestretched to at least about 100%. Prestretching at higher ratios tends to cause a higher frequency of breaks in the film. Such processes are wasteful. The present invention is intended to alleviate the aforementioned difficulties.

Disclosure of Invention

Accordingly the present invention provides in a process for wrapping an article with a stretch wrap film, an improvement wherein the film is at least 45 μm thick and is made from a polymer blend, such blend comprising i) from 1 to 20 wt.% of at least one polybutene having a number average molecular weight of from 500 to 10 000 and ii) a polyethylene selected from the group consisting of at least one linear ethylene/C_4-C_{10} α-olefin copolymer having a density of from 0.905 to 0.940 g/cm^3 and blends of such copolymer with a second polymer, selected from a homopolymer of ethylene and a copolymer of ethylene and vinyl acetate, said second polymer having a density of from 0.910 to 0.940 g/cm^3, said polyethylene having up to 70 wt.% of said second polymer, and wherein said film has a low crystallinity.

Preferably the article is cylindrical, and circular in cross-section.

In one embodiment the article has a ratio of length to height of at least about 1.5.

In another embodiment of the process the film is prestretched at least 200%, preferably at least 250%, and more preferably at least 400%, immediately prior to wrapping the article.

In yet another embodiment the ethylene/C_4-C_{10} α-olefin copolymer is an ethylene/octene-1 copolymer or an ethylene/hexene-1 copolymer having a density of from 0.910

to 0.930 g/cm3.

In a further embodiment the polybutene has a number average molecular weight of from 700 to 5000, especially from 900 to 3000.

In yet another embodiment the polymer blend contains from 2 to 12 wt.% of polybutene, especially from 3 to 10 wt.%.

In a further embodiment the film is from 50 μm to 110 μm in thickness.

In a further embodiment the gloss of the film is at least about 90%, measured using ASTM Procedure D-2457 at a 20° reflectance angle.

In another embodiment the gloss of the film is from 90 to 120%.

In another embodiment the haze of the film is from about 4% to 6%, as measured using ASTM Procedure D-1003.

The present invention is particulary suited to wrapping large or heavy articles. In one embodiment the article is a beam of paper, fabric or carpet. The article is more usually wrapped on a horizontal wrapping machine because it is more convenient to support the weight of the article or roll horizontally, although a vertical wrapping machine may be used, if convenient.

Molecular weights of the polybutenes referred to herein, unless otherwise specified, are number average molecular weights determined using ASTM Procedure D-2503-67.

The term "polybutene" as used herein in relation to the present invention, refers to polymers having a backbone predominantly based on n-butene or isobutylene. Polybutenes known in the trade as polyisobutylenes may be made by catalytically polymerizing an isobutylene-rich mixtures, with more 1- and 2-butenes being incorporated in the lower weight polyisobutylenes than in the higher molecular weight polyisobutylenes. Polybutenes may also be synthesized, by a low temperature catalytic process,

from a refinery gas stream containing polymerizable olefins, particularly isobutylene.

The constituents of the composition of the film may be blended by methods known in the art, e.g. the constituents may be preblended, the polybutene may be incorporated in a masterbatch concentrate and then "let down" by admixing with polyethylene, or the polybutene may be directly injected into the film extruder. In any event, the polybutene should be well mixed with the polyethylene in order to provide as uniform a film as possible. The blend may be directly extruded into film form in a flat film or blown film process which causes the film to have low crystallinity, as described more fully hereinafter.

Crystallinity is not easily measured in films of the present invention but an indication of crystallinity may be given by the clarity of the film. Indicators of crystallinity are gloss and haze levels of the film. Gloss is measured by ASTM Procedure D-2457, measured at a 20° reflectance angle and haze is measured by ASTM Procedure D-1003, both with 51 μm thick films. In the context of the present invention, gloss levels of at least 90% are desirable, with preferred levels being from 90% to 120%. Haze levels of from about 4% to about 6% are preferred, and especially from 4% to 5.5%. For comparison, films made by conventional processes have gloss levels of from about 35% to 70% and haze levels of from 7% to 15%.

The blown film process is the preferred process for forming the film useful in the present invention. In the blown film process the polymer blend is extruded through a circular die. The resulting film is pulled from the die by cooperating nip rollers which collapse the tubular film at the nip. The tubular film, between the circular die and the nip is sometimes referred to as a bubble. While in the molten or plastic formative state the tubular film is expanded by air or inert gas admitted

into the bubble through an orifice in the centre of the circular die. The film may be cooled by directing air onto the exterior of the film while in the plastic formative state. The film is cooled until it is in the solid state. Cooling to the solid state is often referred to as quenching. The faster the film is cooled the lower the level of crystallinity. Fast quenching, in the blown film process, may be accomplished by passing the expanding film about a cooled mandrel which is situated within the bubble. One such process, using a cooled mandrel, is disclosed in Canadian 893 216 which issued 1972 February 15 to M. Bunga and C.V. Thomas. Fast heat transfer from the film to the mandrel can be improved by using a gas inside the bubble which has excellent heat transfer properties, such as helium. Such a process would provide the level of crystallinity required in the present invention. Conventional blown film processes do not have rapid quenching and do not permit development of the required level of crystallinity.

It is to be understood that the films used in the present invention may contain ultra-violet light stabilizers, pigments, antioxidants and other modifiers known in the art.

The invention may also be better understood by reference to the following examples:

Example I:

On a horizontal stretch wrapping apparatus, a large roll of non-woven fabric was attempted to be stretch wrapped with a 51 μm thick stretch wrap film (Control). Such film was made from a blend of polybutene and linear low density polyethylene, which had been made into film using a conventional blown film process. The apparatus was capable of prestretching film at ratios from 50 to 650%. The film yielded in a non-uniform manner, and tended to lack high prestretch capability and have insufficient cling, at prestretch ratios of 50 to 100%. The film tended to stretch and then fail to stretch,

forming transverse lanes 25 to 50 mm wide, 51 μm thick, followed by a length 1 μm thick. The unstretched portions were hazy and the stretched portions were clear. Above stretch ratios of 100% the film tended to break more frequently, which caused a loss of productivity. Similar performance was noted with stretch wrap films having a thickness of 51 μm, made from non-linear polyethylene in a conventional blown film process.

A similar film composition to the Control was blown into film form, using a blown film process in which there was a cooled metal mandrel and helium gas inside the film bubble. The film (Film A) was substantially less crystalline than the Control film, as evidenced by the clarity of Film A as opposed to the lack of clarity in the Control film and the lack of haze of Film A compared to the Control film. While gloss and haze was not measured for Film A as used in this example, films with the same composition, made under similar conditions, had a gloss of 100.2% and haze of 5.1% (the averages of ten measurements). Film A was used to wrap large rolls of paper at prestretch ratios of 50, 100, 150, 200, 250, 300, 350, 400, 450, 500, 550, 600 and 650%. No film breaks were experienced over the entire prestretch ratio range. Additionally the film stretched evenly at all prestretch ratios and cling properties were retained. Furthermore the film was crystal clear after stretching. This example clearly demonstrates the surprising improvement in performance of films having low crystallinity.

Example II

Eighteen spools of synthetic fibre were wrapped into a three-layer unit on a vertical stretch wrap machine. Two three-layer units were then wrapped together using a second vertical stretch wrap machine. The film used to stretch wrap the spools and units was a 30.5 μm thick commercially available conventional stretch wrap polyethylene film. The prestretch ratio was about 120%. The film, after being wrapped around the spools and units

was hazy and exhibited non-uniform stretch, sometimes called zebra stripes in the art. Additionally, although the process generally ran well, there was one period of film breakage. About 200 g of film was required for each package.

The film was then replaced with Film A of Example I, of the present invention, and operated at prestretch ratios of from 350 to 450%. While a low breakage frequency was experienced at a prestretch ratio of 450%, there were no breaks at 350, 375 and 425%. The film stretched uniformly and was clear. About 125 g of film was required for each package. This example clearly demonstrates the improved performance of the present invention.

CLAIMS:

1. In a process for wrapping an article with a stretch wrap film, an improvement wherein:

the film is at least 45 μm thick and is made from a polymer blend, such blend comprising i) from 1 to 20 wt.% of at least one polybutene having a number average molecular weight of from 500 to 10 000 and ii) a polyethylene selected from the group consisting of at least one linear ethylene/C_4-C_{10} α-olefin copolymer having a density of from 0.915 to 0.940 g/cm^3 and blends of such copolymer with a second polymer, selected from a homopolymer of ethylene and a copolymer of ethylene and vinyl acetate, said second polymer having a density of from 0.910 to 0.940 g/cm^3, said polyethylene having up to 70 wt.% of said second polymer, and wherein said film has a low crystallinity.

2. A process according to Claim 1 wherein the gloss of the film is at least about 90%.

3. A process according to Claim 1 wherein the haze of the film is from about 4% to about 6%.

4. A process according to Claim 1 or Claim 2 or Claim 3 wherein the article is cylindrical, and circular in cross-section.

5. A process according to Claim 1 or Claim 2 or Claim 3 wherein the article has a ratio of length to height of at least about 1.5.

6. A process according to Claim 1 or Claim 2 or Claim 3 wherein the process the film is prestretched at least 200% immediately prior to wrapping the article.

7. A process according to Claim 1 or Claim 2 or Claim 3 wherein the process the film is prestretched at least 400% immediately prior to wrapping the article.

8. A process according to Claim 1 or Claim 2 or Claim 3 wherein the ethylene/C_4-C_{10} α-olefin copolymer is selected from an ethylene/octene-1 copolymer and an ethylene/hexene-1 copolymer, said copolymer having a

density of from 0.910 to 0.930 g/cm^3.

9. A process according to Claim 1 or Claim 2 or Claim 3 wherein the polybutene has a number average molecular weight of from 700 to 5000.

10. A process according to Claim 1 or Claim 2 or Claim 3 wherein the polymer blend contains from 2 to 12 wt.% of polybutene.

11. A process according to Claim 1 or Claim 2 or Claim 3 wherein the ethylene/C_4-C_{10} α-olefin copolymer is selected from an ethylene/octene-1 copolymer and an ethylene/hexene-1 copolymer, said copolymer having a density of from 0.910 to 0.930 g/cm^3 and the polymer blend contains from 2 to 12 wt.% of polybutene.

12. A process according to Claim 1 or Claim 2 or Claim 3 wherein the film is from 50 μm to 110 μm in thickness.

INTERNATIONAL SEARCH REPORT

International Application No PCT/CA 91/00226

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 C08J5/18 ; C08L23/16 ; B29C47/00

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	C08J ; C08L ; B29C

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category °	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
Y	US,A,4 657 982 (A. K. BRECK ET AL) 14 April 1987 cited in the application see column 2, line 33 - column 3, line 50; claims 1-2	1-12
Y	FR,A,2 580 224 (PLASTIQUES DE LA DEOME) 17 October 1986 see page 1, line 1 - page 4, line 33	1-12
A	EP,A,0 291 166 (MOBIL OIL) 17 November 1988 see column 4, line 27 - column 5, line 53; claim 1	1
A	EP,A,0 317 166 (EXXON CHEMICAL PATENTS) 24 May 1989 ABSTRACT	1

° Special categories of cited documents :[10]

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
25 OCTOBER 1991	13. 11. 91
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	GOOVAERTS R.E.

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ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. CA 9100226 SA 48552

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 25/10/91
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A-4657982	14-04-87	CA-A- 1206675	24-06-86
FR-A-2580224	17-10-86	None	
EP-A-0291166	17-11-88	US-A- 4833017 US-A- 4963388	23-05-89 16-10-90
EP-A-0317166	24-05-89	JP-A- 1198672	10-08-89