

PATENT SPECIFICATION

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(54) IMPROVEMENTS IN OR RELATING TO TUBULAR PLASTICS FILM

(71) We, LAMIPAK INDUSTRIES PTE LIMITED, a company incorporated under the laws of the Republic of Singapore of 209 Kallang Bahru, Singapore 12 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:-

10 This invention relates to tubular plastics films, in particular, to polyolefin films, and to a process for the preparation thereof.

Tubular polyolefin films manufactured by extrusion have found widespread use as packaging materials and in many other applications. Such films are commonly formed using low density polyethylene and more recently using high density polyethylene polymers.

20 While films manufactured from low density polyethylene have advantageous properties with respect to their printability and the ease of stacking of packages and bags produced therefrom, they suffer from a low mechanical strength for a given film thickness, exhibit a poor suitability with respect to thermal sterilisation and packages and bags produced from such films are not easily opened. In addition, such films have a high gaseous permeability, which in some circumstances is undesired.

30 On the other hand films manufactured from high density polyethylene have a low gaseous permeability, poor printability and packages and bags produced therefrom are not easily stacked. However, such films do have a high mechanical strength for a given film thickness, are suitable for thermal sterilisation and packages and bags produced therefrom are easily opened.

40 According to one aspect of the present invention there is provided a tubular plastics film (as herein defined) comprising a first axially extending circumferential layer comprising high density polyethylene (as herein

defined) and a second axially extending circumferential layer comprising a further thermoplastic polyolefin (which is other than high density polyethylene).

The term "tubular film", as used herein, is intended to mean a cylinder-like structure having walls of a substantially uniform and relatively small thickness. The term "high density polyethylene", as used herein, is intended to mean a polymer made by low-pressure polymerisation, and comprising monomeric units derived wholly or predominantly from ethylene. High density polyethylene generally has a high density of not less than about $0.950 \times 10^3 \text{ kg. m}^{-3}$.

In a preferred embodiment, the films according to the present invention consist of two layers, one of which consists of high density polyethylene. In general, the high density polyethylene layer will be the inner layer. The further thermoplastic polyolefin in the films according to the invention advantageously consists of low density polyethylene (as herein defined).

The term "low density polyethylene", is used herein to designate a polymer usually made by high pressure polymerisation and comprising monomeric units derived wholly or predominantly from ethylene. Low pressure polyethylene generally has a density of not more than about $0.925 \times 10^3 \text{ kg. m}^{-3}$.

The films according to the present invention generally have a thickness of from about 10 to 60 μm . In films of the preferred embodiment consisting of two layers, the first high density polyethylene layer conveniently has a thickness of from 7 to 42 μm , and the second layer of low density polyethylene conveniently has a thickness of from 3 to 18 μm .

The films according to the present invention may conveniently be produced by co-extrusion.

Thus, according to a further aspect of the present invention there is provided a pro-

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cess for the manufacture of a tubular plastics film which comprises extruding high density polyethylene (as herein defined) through a slit-shaped annular die orifice at a temperature above the softening point of said high density polyethylene and simultaneously extruding a further thermoplastic polyolefin through the same or a concentric slit-shaped annular die orifice at a temperature above the softening point of said further thermoplastic polyolefin so as to produce a tubular plastics film of the invention.

The process according to the invention is preferably effected using low density polyethylene as the further thermoplastic polyolefin.

The coextrusion of the process according to the invention is advantageously effected by extrusion through the same die orifice. By this technique the individual plastics components of the films are introduced separately into the die block and are brought together at or before the die orifice so as to form the different layers on extrusion. The extrusion is normally effected through an annular die orifice. In this case, air at a pressure higher than the ambient air pressure may, if desired, be introduced into the zone bounded by the extruded plastics film and the die so as to expand, and thereby thin, the plastics film while the latter is at a temperature higher than the softening point of its components.

According to a further aspect of the present invention there is provided apparatus for manufacturing a tubular plastics film which comprises means for separately introducing high density polyethylene (as herein defined) and a further thermoplastic polyolefin into a die block provided with one or more slit-shaped annular die orifices and means for extruding from said die orifices a tubular plastics film of the invention.

Embodiments of the process according to the present invention will hereinafter be particularly described with reference to the accompanying drawing which shows an apparatus for manufacturing a tubular plastics film according to the invention.

In the process illustrated in the Figure, high density polyethylene (HDPE) elastomer is fed to the die block 1 by the screw extruder 2. Simultaneously, low density polyethylene (LDPE) elastomer is also fed to the die block by the screw extruder 3. The screw extruders and the die block are heated by the heaters 4 to a temperature sufficient to ensure that the elastomers emerge from the annular die orifice 5 at a temperature above their respective softening points. The die block 1 incorporates a cylindrical passage for the elastomers terminating in the die orifice 5, such that the LDPE elastomer forms an outer layer surrounding an inner

layer of HDPE elastomer. The die orifice 5 is annular and is formed by the die ring 6 and the mandrel 7. Thus, the elastomers emerge from the die block in the form of a tube having two layers, the outer layer consisting of LDPE and the inner layer HDPE.

A passage 8 is provided in the die block, which passage passes through the mandrel, whereby air may be introduced at a pressure greater than the ambient air pressure into the zone bounded by the elastomer film emerging from the die orifice and the mandrel. As the film emerging from the die orifice is still soft, the increased air pressure within the film causes the film to expand and thus its thickness may be readily controlled. By the time the tube-like film reaches the line 9, it has cooled to a temperature below the softening point of its constituent elastomers and thereafter no further expansion of the film occurs. The blown film then passes over the guide rollers 10 to the pinch rollers 11. The blown film thus forms a "bubble" 12 serving to maintain the air pressure in the zone above the die orifice above ambient air pressure. The air ring 13 helps in maintaining the desired form of the bubble 12. After passing over idler and tensioning rollers the finished film tube may be collected on wind-up rollers 14.

The plastics films according to the invention have improved properties as a result of the combination of the good properties of high density polyethylene and the further thermoplastic polyolefin employed in their manufacture. Thus films according to the invention formed from high density polyethylene and low density polyethylene exhibit, particularly when the low density polyethylene layer is the outer layer, a high mechanical strength for a given film thickness, have good printability and low gaseous permeability, are suitable for thermal sterilisation and packages produced therefrom are easily opened and are readily stacked.

WHAT WE CLAIM IS:-

1. A tubular plastics film (as herein defined) comprising a first axially extending circumferential layer comprising high density polyethylene (as herein defined) and a second axially extending circumferential layer comprising a further thermoplastic polyolefin (which is other than high density polyethylene).
2. A plastics film as claimed in claim 1 wherein the further thermoplastic polyolefin comprises low density polyethylene (as herein defined).
3. A plastics film as claimed in either of claims 1 and 2 consisting of two layers.
4. A plastics film as claimed in any of the preceding claims having a thickness of from 10 to 60 μm .
5. A plastics film as claimed in claim 3



cess for the manufacture of a tubular plastics film which comprises extruding high density polyethylene (as herein defined) through a slit-shaped annular die orifice at a temperature above the softening point of said high density polyethylene and simultaneously extruding a further thermoplastic polyolefin through the same or a concentric slit-shaped annular die orifice at a temperature above the softening point of said further thermoplastic polyolefin so as to produce a tubular plastics film of the invention.

The process according to the invention is preferably effected using low density polyethylene as the further thermoplastic polyolefin.

The coextrusion of the process according to the invention is advantageously effected by extrusion through the same die orifice. By this technique the individual plastics components of the films are introduced separately into the die block and are brought together at or before the die orifice so as to form the different layers on extrusion. The extrusion is normally effected through an annular die orifice. In this case, air at a pressure higher than the ambient air pressure may, if desired, be introduced into the zone bounded by the extruded plastics film and the die so as to expand, and thereby thin, the plastics film while the latter is at a temperature higher than the softening point of its components.

According to a further aspect of the present invention there is provided apparatus for manufacturing a tubular plastics film which comprises means for separately introducing high density polyethylene (as herein defined) and a further thermoplastic polyolefin into a die block provided with one or more slit-shaped annular die orifices and means for extruding from said die orifices a tubular plastics film of the invention.

Embodiments of the process according to the present invention will hereinafter be particularly described with reference to the accompanying drawing which shows an apparatus for manufacturing a tubular plastics film according to the invention.

In the process illustrated in the Figure, high density polyethylene (HDPE) elastomer is fed to the die block 1 by the screw extruder 2. Simultaneously, low density polyethylene (LDPE) elastomer is also fed to the die block by the screw extruder 3. The screw extruders and the die block are heated by the heaters 4 to a temperature sufficient to ensure that the elastomers emerge from the annular die orifice 5 at a temperature above their respective softening points. The die block 1 incorporates a cylindrical passage for the elastomers terminating in the die orifice 5, such that the LDPE elastomer forms an outer layer surrounding an inner

layer of HDPE elastomer. The die orifice 5 is annular and is formed by the die ring 6 and the mandrel 7. Thus, the elastomers emerge from the die block in the form of a tube having two layers, the outer layer consisting of LDPE and the inner layer HDPE.

A passage 8 is provided in the die block, which passage passes through the mandrel, whereby air may be introduced at a pressure greater than the ambient air pressure into the zone bounded by the elastomer film emerging from the die orifice and the mandrel. As the film emerging from the die orifice is still soft, the increased air pressure within the film causes the film to expand and thus its thickness may be readily controlled. By the time the tube-like film reaches the line 9, it has cooled to a temperature below the softening point of its constituent elastomers and thereafter no further expansion of the film occurs. The blown film then passes over the guide rollers 10 to the pinch rollers 11. The blown film thus forms a "bubble" 12 serving to maintain the air pressure in the zone above the die orifice above ambient air pressure. The air ring 13 helps in maintaining the desired form of the bubble 12. After passing over idler and tensioning rollers the finished film tube may be collected on wind-up rollers 14.

The plastics films according to the invention have improved properties as a result of the combination of the good properties of high density polyethylene and the further thermoplastic polyolefin employed in their manufacture. Thus films according to the invention formed from high density polyethylene and low density polyethylene exhibit, particularly when the low density polyethylene layer is the outer layer, a high mechanical strength for a given film thickness, have good printability and low gaseous permeability, are suitable for thermal sterilisation and packages produced therefrom are easily opened and are readily stacked.

WHAT WE CLAIM IS:-

1. A tubular plastics film (as herein defined) comprising a first axially extending circumferential layer comprising high density polyethylene (as herein defined) and a second axially extending circumferential layer comprising a further thermoplastic polyolefin (which is other than high density polyethylene).

2. A plastics film as claimed in claim 1 wherein the further thermoplastic polyolefin comprises low density polyethylene (as herein defined).

3. A plastics film as claimed in either of claims 1 and 2 consisting of two layers.

4. A plastics film as claimed in any of the preceding claims having a thickness of from 10 to 60 μm .

5. A plastics film as claimed in claim 3



wherein the high density polyethylene layer has a thickness of from 7 to 42 μm , and the further thermoplastic polyolefin layer has a thickness of from 3 to 18 μm .

5 6. A tubular plastics film as claimed in claim 1 substantially as herein described.

7. A tubular plastics film substantially as herein described with reference to the accompanying drawings.

10 8. A process for the manufacture of a tubular plastics film which comprises extruding high density polyethylene (as herein defined) through a slit-shaped annular die orifice at a temperature above the softening point of said high density polyethylene and simultaneously extruding a further thermoplastic polyolefin through the same or a concentric slit-shaped annular die orifice at a temperature above the softening point of said further thermoplastic polyolefin so as to produce a tubular plastics film as claimed in claim 1.

15 9. A process as claimed in claim 8 wherein the further thermoplastic olefin comprises low density polyethylene (as herein defined).

25 10. A process as claimed in either of claims 8 and 10 wherein the high density polyethylene and the further thermoplastic polyolefin are extruded through the same die orifice.

30 11. A process as claimed in any of claims 8 to 10 wherein air at a pressure higher than the ambient air pressure is introduced into the zone bounded by the extruded plastics film and the die so as to expand and thereby thin the plastics film while the temperature of said plastics film is above the softening point of its components.

35 12. A process as claimed in claim 8 substantially as herein described.

40 13. A process for the manufacture of a plastics film substantially as herein described with reference to the accompanying drawings.

45 14. A plastics film whenever prepared by a process as claimed in any of claims 8 to 13.

50 15. Apparatus for manufacturing a plastics film as defined in claim 1 which comprises means for separately introducing high density polyethylene (as herein defined) and a further thermoplastic polyolefin into a die block provided with one or more slit-shaped annular die orifices and means for extruding from said die orifices a tubular plastics film as defined in claim 1.

55 16. Apparatus as defined in claim 15 substantially as herein described with reference to the accompanying drawings.

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