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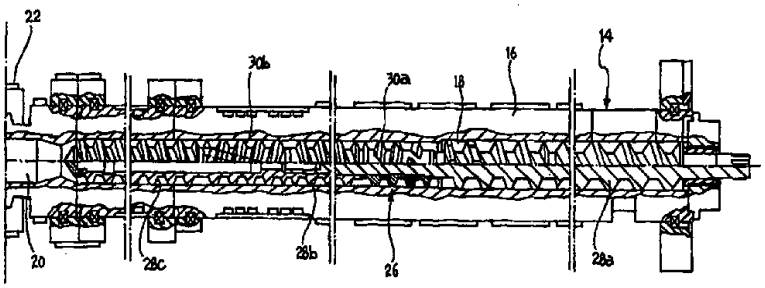

(57) Abstract

The process for the production of expanded polyester, in particular PET, is performed by extrusion of polyester starting material having an intrinsic viscosity of at least 0.8 dl/g and an added expanded agent. To this end a twin screw extruder (14) is utilised provided with two interpenetrating screws (26) having a ratio between their axial separation and diameter lying between 0.6 and 0.8 and co-rotating at a speed of between 15 and 40 rpm. Preferably the ratio between the axial separation and diameter of the screws (26) lies between 0.69 and 0.78 and the ratio between the length and diamter of the screws (26) lies between 20 and 26.

A process for the production of expanded polyester, in particular PET

The present invention relates to a process for the production of expanded polyester, in particular PET for the production of articles such as, for example, panels, sheets and tubes, which can be used in particular in the building and packaging field.

Specifically, the invention provides a process for production of expanded polyester, in particular PET by means of extrusion from a twin screw extruder of a polyester starting material having an intrinsic viscosity of at least 0.8 dl/g and an added expanding agent, said twin screw extruder being provided with two interpenetrating screws having a ratio between axial separation and diameter lying between 0.6 and 0.8 and co-rotating at a speed lying between 15 and 40 rpm.

The invention also provides apparatus for the production of expanded polyester, in particular PET, by the above process, the apparatus comprising extrusion means consisting of a single twin screw extruder provided with two interpenetrating screws having a ratio between axial separation and diameter lying between 0.6 and 0.8 and co-rotating at a speed lying between 15 and 40 rpm.

The present invention therefore provides a process of the above indicated type which will allow the production of an expanded product of adequate characteristics for the above listed uses. This involves, in particular, obtaining a final product of density at least to 40kg/m^3, uniform cellular structure of fine cells, and without degradations evidenced by reductions in molecular weight and viscosity with respect to the starting product, which are due for example to possible hydrolysis reactions.

Further advantages and characteristics of the present invention will become apparent from the following detailed description, provided purely by way of non-limitative example, with reference to the attached drawings, in which;

Figure 1 is a schematic side view of apparatus for performing the process of the invention;

Figure 2 is a sectional view on an enlarged scale of a detail of the extruder of the apparatus of the invention, and

Figure 3 is a section on an enlarged scale of the nozzle of the extruder of the apparatus of the invention.

Apparatus for the production of expanded polyester comprises (Figure 1) a drier 10 of polyester starting material and a conveyor device 12 for conveying this latter to an extruder 14. Both the drier 10 and the conveyor device 12 are known per se and therefore will not be described in detail herein.

The extruder 14 has a tubular body 16 with an internal cavity in which there can be distinguished, in succession, a polyester feed and melting zone 18 and a cooling and homogenisation zone 20 comprising a static heat exchanger 22 and a homogeniser 24.

In the feed and melting zone 18 the body has apertures not shown in the drawings for the introduction of polyester starting material and an expanding agent.

In the cavity of the feed zone 18 are located two interpenetrating and co-rotating screws 26 with a ratio of axial separation (i.e. the distance between the respective central lines) to diameter lying between 0.6 and 0.8, and preferably between 0.69 and 0.78, and a length to diameter ratio lying between 20 and 26.

Each screw 26 comprises (Figure 2) three conveyor sections 28a, 28b, 28c separated from one another by two back mixing sections 30a, 30b.

Downstream from the cooling and homogenisation section 20 of the extruder 14 is located a nozzle 32 which (Figure 3) has two facing lips 34 having a rectilinear profile in a direction transverse that of the extrusion so as to define a rectangular extrusion orifice which causes the formation of a laminar extruded product. Moreover the lips 34 have, in a direction parallel to that of the extrusion, a profile with a protuberance 36 facing the corresponding protuberance 36 of the opposite lip 34 and joined to the exit edge 38.

Downstream from the nozzle 32 (Figure 1) is located a calibration device 40 for calibrating the thickness of the extruded product, comprising a pair of belts 42 rotating in closed loops and having respective facing sides which define a space of adjustable height through which the product passes. Advantageously the belts 42 are of glass wool clad in fluorated polymer and can be temperature regulated.

In a manner known per se, downstream of the calibration device 40 there are further located a roller table 44 passing over which the extruded product can cool, a cutting device 46 and various finishing and preparation tools 48 for storage of the cut extruded product.

The operation of the apparatus just described is as follows.

A polyester starting material having an intrinsic viscosity of at least 0.8dl/g, preferably at least 0.9dl/g, is transferred by means of the conveyor device 12 from the drier 10 to the feed zone 18 of the extruder 14 at the first conveyor section 28a of the screws 26.

Advantageously the polyester starting material is obtained by polycondensation of an aromatic bicarboxylic acid, such as terephthalic acid, isophthalic acid or naphthalene dicarboxylic acid, with a diol such as ethylene glycol, tetramethylene glycol, cyclohexane dimethanol or 1,4-butanediol, in the presence of various possible additives (chain extenders, stabilisers, nucleating agents and fireproofing agents) known in the art. The preferred starting material is in particular PET.

It is intended that the intrinsic viscosity is determined according to the ASTM D 4603-86 regulations on solutions of 0.5g of granular polyester in 100 ml of a 60/40 mixture by weight of phenol and tetrachloroethane at 25°c.

An expanding agent is fed in at the second conveyor section 28b of the screws 26. This latter agent can be any of those commonly used in the production of expanded plastics materials. For example it can be chosen from the group comprising inert gases (in particular carbon dioxide and nitrogen), aliphatic, cycloaliphatic and aromatic hydrocarbons, and partially or completely halogenated hydrocarbons (CFC, HCFC, HFA).

The temperature of the polyester with added expanding agent in the feed and melting zone lies between 280°c and 310°c whilst in the cooling and homogenisation zone it lies between 220°c and 280°c. The screws 26 are made to rotate at a relatively low speed lying between 15 and 40rpm.

After a residence time of between 15 and 30 minutes in the extruder, the polyester with added expanded agent is extruded through the orifice of the nozzle 32 in the form of a laminar product having a density lying between 40 and 200 kg/m^3 and an intrinsic viscosity substantially unchanged with respect to that of the starting material.

These characteristics are optimal in view of the uses to which the extruded product is intended to be put and are obtained thanks in particular to the shape and the manner of rotation of the screws which do not impart damaging stresses to the melt which could compromise its physical and chemical properties.

The thickness of the extruded product can then be regulated to the desired value following passage through the calibration device 40. The extruded product, translating on the roller table 44, then cools until it assumes a consistency such that manipulations to which it is subsequently subjected do not damage it.

It can thus be cut into the desired dimensions by the device 46 and finally be finished and prepared for storage and transport by the various tools 48.

Naturally, the principle of the invention remaining the same, the details of construction and embodiments can be widely varied with respect to what has been described and illustrated in the drawings, without by this departing from the ambit of the present invention.

It is to be understood that, throughout the description and claims of the specification the word ''comprise'' and variations of the word, such as ''comprising'' and ''comprises'', is not intended to exclude other additives, components, integers or steps.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A process for production of expanded polyester, in particular PET by means of extrusion from a twin screw extruder of a polyester starting material having an intrinsic viscosity of at least 0.8 dl/g and an added expanding agent, said twin screw extruder being provided with two interpenetrating screws having a ratio between axial separation and diameter lying between 0.6 and 0.8 and co-rotating at a speed lying between 15 and 40 rpm.

2. A process according to claim 1, wherein the ratio between axial separation and diameter of the screws lies between 0.69 and 0.78.

3. A process according to any preceding claim, wherein the length-to-diameter ratio of the screws lies between 20 and 26.

4. A process according to any preceding claim, said extruder having, in succession, a feed and melting zone in which the polyester is held at a temperature lying between 280°C and 310°C, and where said screws are located, and a cooling and homogenisation zone in which the polyester is held at a temperature lying between 220°C and 280°C.

5. A process according to claim 4, the said cooling and mixing zone including a static heat exchanger and a homogeniser.

6. A process according to any preceding claim, each of said screws comprising three conveyor sections separated from one another by two back mixing sections.

7. A process according to claim 6, wherein the feed of polyester resin takes place at the first conveyor section whilst the feed of expanding agent takes place at the second conveyor section.

8. A process according to any preceding claim, wherein the polyester with added expanded agent is extruded through a nozzle positioned at the exit end of the extruder, the said nozzle having two facing lips of rectilinear shape in a direction transverse the extruding direction so as to define a rectangular extrusion orifice which causes the formation of an extruded sheet product having a density lying between 40 and 200 kg/m^3.

9. A process according to claim 8, wherein the said lips have, in a direction parallel to the extruding direction, a shape with a protuberance facing the corresponding protuberance of the opposite lip and joined to the exit edge.

10. A process according to any preceding claim, wherein said extruded sheet product is made to pass through a calibration device allowing its thickness to be regulated.

11. A process according to claim 10, wherein said calibration device comprises a pair of belts rotating in closed loops and having respective facing sides defining a space of adjustable height through which the sheet product passes.

12. A process according to claim 11, said belts being of glass wool clad in fluorated polymer.

13. A process according to any preceding claim, wherein said polyester resin having an intrinsic viscosity of at least 0.8 dl/g is obtained by polycondensation of an aromatic bicarboxylic acid such as terephthalic acid, isophthalic acid or naphthalene dicarboxylic acid, with a diol such as ethylene glycol, tetramethylene glycol, cyclohexane dimethanol or 1,4-butanediol.

14. A process according to any preceding claim, wherein said expanding agent is chosen from the group comprising inert gases, aliphatic, cycloaliphatic and aromatic

hydrocarbons, and partially or completely halogenated hydrocarbons.

15. A process according to any preceding claim, wherein the residence time of the resin in the extruder lies between 15 and 30 minutes.

16. Apparatus for the production of expanded polyester, in particular PET, by the process of any preceding claim, comprising extrusion means consisting of a single twin screw extruder provided with two interpenetrating screws having a ratio between axial separation and diameter lying between 0.6 and 0.8 and co-rotating at a speed lying between 15 and 40 rpm.

17. An apparatus according to claim 16, wherein the ratio between axial separation and diameter of the screws lies between 0.69 and 0.78.

18. An apparatus according to any one of claims 16 to 17, wherein the length-to-diameter ratio of the screws lies between 20 and 26.

19. An apparatus according to any one of claims 16 to 18, wherein said extruder has, in succession, a feed and melting zone in which the polyester is held at a temperature lying between 280°C and 310°C, and where the said screws are located, and a cooling and homogenisation zone in which the polyester is held at a temperature lying between 220°C and 280°C.

20. An apparatus according to claim 19, wherein said cooling and mixing zone includes a static heat exchanger and a homogeniser.

21. An apparatus according to any one of claims 16 to 20, wherein each of the said screws comprises three conveyor sections separated from one another by two back mixing sections.

22. An apparatus according to any one of claims 16 to 21, wherein the polyester with added expanded agent is extruded through a nozzle positioned at the exit end of the extruder, the said nozzle having two facing lips of rectilinear shape in a direction transverse the extruding direction so as to define a rectangular extrusion orifice which causes the formation of a sheet extruded product having a density lying between 40 and 200 kg/m^3.

23. An apparatus according to claim 22,said lips having, in a direction parallel to the extruding direction, a shape with a protuberance facing the corresponding protuberance of the opposite lip and joined to the exit edge.

24. An apparatus according to any one of claims 16 to 23 comprising a calibration device, through which the extruded sheet product is made to pass allowing its thickness to be regulated.

25. An apparatus according to claim 24,said calibration device comprising a pair of belts rotating in closed loops and having respective facing sides defining a space of adjustable height through which the sheet product passes.

26. An apparatus according to claim 25,said belts being of glass wool clad in fluorated polymer.

27. A process substantially as herein described with reference to the accompanying drawings.

28. An apparatus substantially as herein described with reference to the accompanying drawings.

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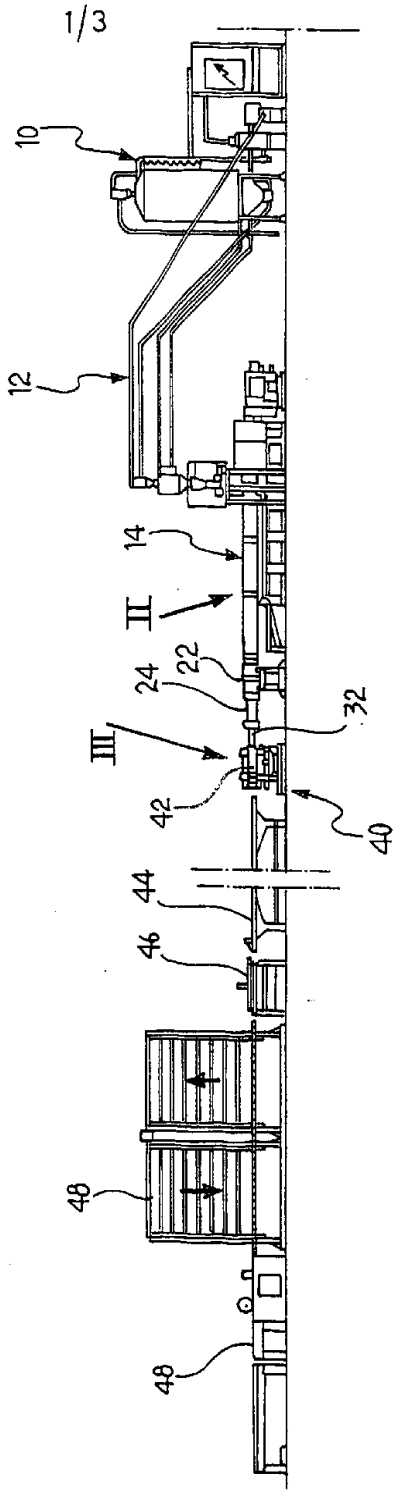

FIG. 1

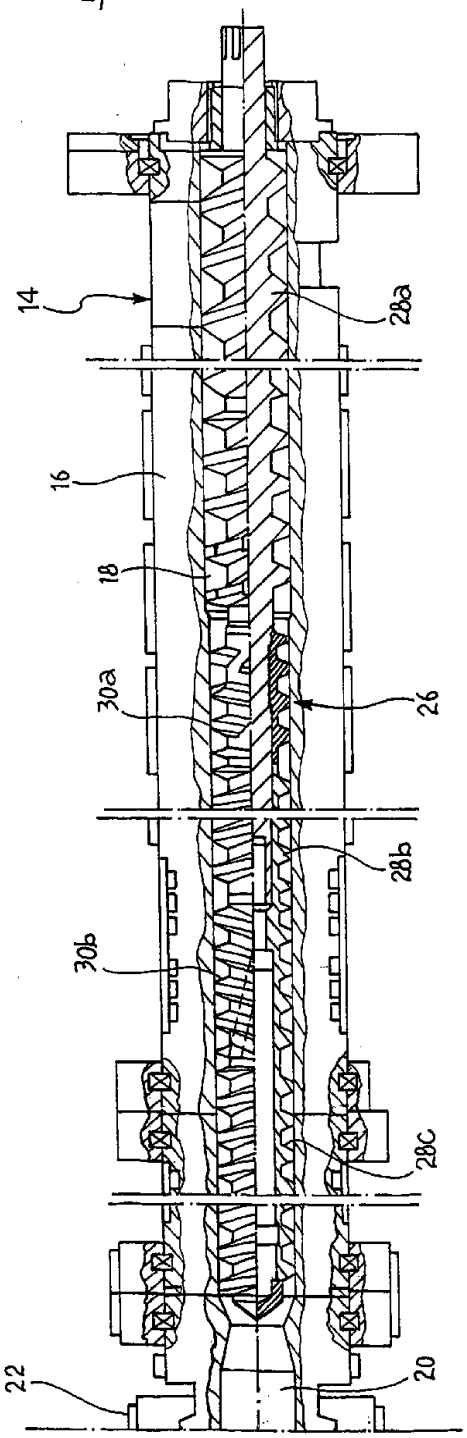

FIG. 2

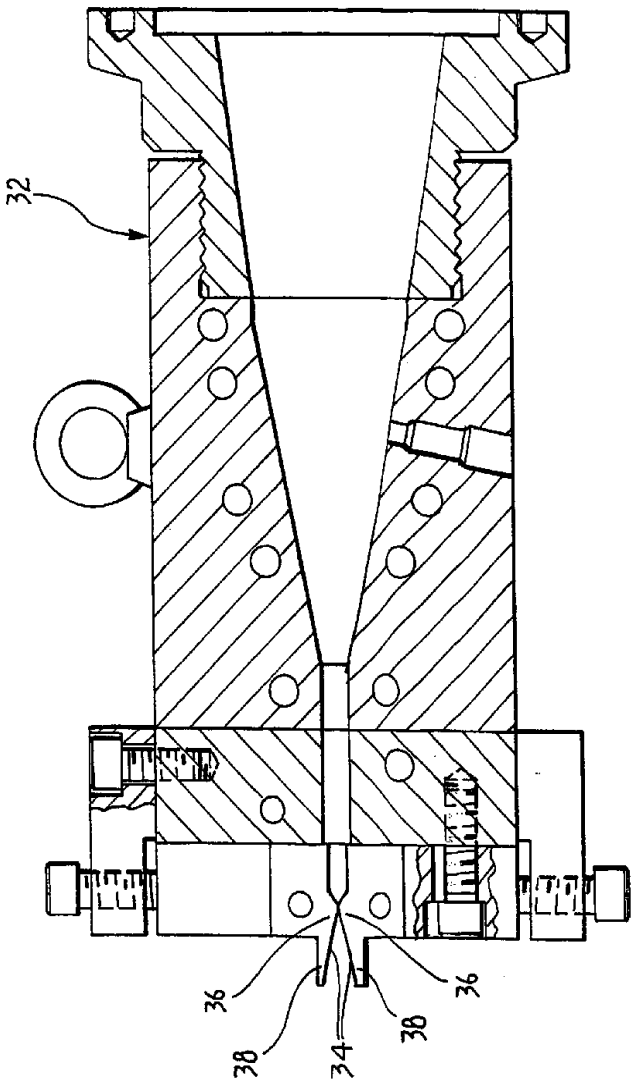

FIG. 3