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(54) Titre : PROCEDE DE TRAITEMENT DES REBUTS DE POLYESTER
(54) Title: A METHOD FOR PROCESSING POLYESTER WASTES

(57) **Abrégé/Abstract:**

A method for processing polyester wastes, especially used polyester bottles, which comprises shredding, washing, drying and melting the waste mixture to obtain a starting raw material wherein a modifying agent selected from the group comprising a combination of polysiloxane and a plasticizer selected from the group of phthalates, or a combination of silazanes and silanes is added to the shredded and dried waste mixture, the amount of the modifying agent being 4 to 6 % by weight, based on the waste mixture.



Abstract

A method for processing polyester wastes, especially used polyester bottles, which comprises shredding, washing, drying and melting the waste mixture to obtain a starting raw material wherein a modifying agent selected from the group comprising a combination of polysiloxane and a plasticizer selected from the group of phthalates, or a combination of silazanes and silanes is added to the shredded and dried waste mixture, the amount of the modifying agent being 4 to 6 % by weight, based on the waste mixture.

A METHOD FOR PROCESSING POLYESTER WASTES

The present invention relates to a method for processing polyester wastes, especially used polyester bottles, comprising shredding, washing, drying and melting the waste mixture to obtain a recycled source of polyester material. The wastes include materials based on polyethylene terephthalate, commonly known as PET, especially known from packaging technology, for example so called PET bottles. The recycled source of polyester material is most often supplied in the form of a granulate.

10 **Description of the prior art**

Polyesters belong to well known and widely used materials, showing no adverse health effects, used for instance in the packaging industry, film manufacture, copying technology etc. Apparently, the most commonly used type of polyesters is polyethylene terephthalate (PET) and used PET containers are the most common waste PET material to be recovered.

The most environmentally acceptable way of the disposal of used polyester containers is their recycling the aim of which is to obtain useful materials usable for the original applications. Recycling processes, e.g.
20 processes used for processing used PET containers include several operations, namely crushing the wastes, washing, drying the shredded material and its subsequent melting, usually to form a granulate which is a starting material for the manufacture of new products, such as packaging material, using extrusion or injection moulding machines. The manufacture of the granulate in this way is accompanied by undesirable phenomena such as the oxidation and hydrolysis of polyester macromolecules, which may in turn result, during the further processing of the recycled raw material, in obtaining either a higher proportion of wastes, or final products having lower quality. The undesirable properties of the
30 final products may include the yellow tinge of mouldings. Another undesirable property may be an increased level of CO₂ permeability and an increased

content of low-molecular fractions, including aldehydes, in the recycled polyester material. Such fractions are transferred from the raw material into the packaging products and impair their quality.

In order to eliminate such shortcomings and to secure production of high-quality packaging materials for foodstuffs, it has been necessary to use further specialized procedures. Such procedures are mostly very complex and in any case they mean higher costs of the manufacturing process.

For instance, according to the US patents Nos. 5 395 858 and 5 580 905, the recycling process includes the conversion of polyesters to the original starting chemical compounds. Polyester materials are mixed with an alkaline mixture and while exposed to high temperatures they are transformed to alkaline salts by saponification. In this way, various contaminants as well as organic and inorganic compounds are eliminated from the waste. Nevertheless, this process is considerably demanding both from the technological and economical points of view.

In the Czech patent application PV 2001-926 a process for the purification of shredded polyester by heating it in an anhydrous environment of an alkaline mixture which has been dried in advance wherein the polyester is partly saponified but not melted, which makes possible the subsequent physical clarifying and removal of impurities, is disclosed. Similarly to the process mentioned above, even this process is a multi-step process which includes the use of alkaline materials in the form of alkaline hydroxides.

The aim of the invention is to provide a method which would be capable of transforming used PET bottles, especially by shredding and further processing such polyester wastes, to form a raw material useful for the manufacture of high-quality packaging materials for foodstuffs, without the necessity of using any complex or costly procedures during the preparation of the recycled material.

Summary of the invention

As broadly claimed this invention relates to a method for processing polyester wastes, which comprises shredding, washing, drying and melting the waste mixture to obtain a recovered source of polyester material, characterized by adding a modifying agent selected from the group comprising a combination of a polysiloxane and a plasticizer selected from the group of phthalates, or a combination of silazanes and silanes, to the shredded and dried waste mixture wherein the amount of the modifying agent is 4 to 6 % by weight,
10 based on the waste mixture.

More specifically, the subject matter of the invention is a method for processing polyester wastes, especially used polyester bottles, which comprises shredded, washing, drying and melting the waste mixture to obtain a recovered source of polyester material, characterized by adding a modifying agent selected from the group comprising a combination of a polysiloxane and a plasticizer selected from the group of phthalates, or a combination of silazanes and silanes to the shredded and dried waste mixture wherein the amount of the modifying agent is 4 to 6% by weight, based on the waste mixture.

In a preferred embodiment a modifying agent selected from the
20 group comprising a combination of polyhydrosiloxane and a plasticizer selected from the group of dioctylphthalate, dinonylphthalate, dibutylsebacate, or a combination of hexamethyldisilazane and tetraethoxysilane is added to the shredded and dried waste mixture wherein the amount of the modifying agent is 4 to 6% by weight, based on the waste mixture.

A further embodiment includes the following more specific features: the modifying agent contains 20 to 30% by weight of liquid polyhydrosiloxane and 70 to 80% by weight of a plasticizer selected from the group of dioctylphthalate, dinonylphthalate, dibutylsebacate, or 55 to 65% by weight of hexamethyldisilazane and 35 to 45% by weight of tetraethoxysilane.

The modifying agent is added to the waste mixture in a reactor-mixer at a temperature of $130 \pm 5^{\circ}\text{C}$ and then the waste mixture is subjected to stirring for 50 to 100 minutes.

Advantageously, the waste mixture is further processed at a temperature of 240 to 250°C to form a granulate.

By the claimed process the increased resistance of the recycled waste polyester against its destruction caused by oxidation and hydrolysis and the improvement of the time necessary for processing in comparison with similar processes are achieved while maintaining the other basic parameters
10 corresponding to the standard polyester. At the same time, the elimination of the undesired harmful fractions and the reduction of the gas permeability of the final products take place.

Unlike commonly known types of recycled materials, the resulting material shows better elasticity while maintaining the required strength, better heat stability and a higher crystallization temperature, up to 110°C .

Examples of the invention

Example 1

20

10 kg waste polyester bottles were shredded in a shredder, rinsed in a washer and the resulting waste mixture was dried in a dryer. The waste mixture was charged in a reactor-mixer and heated to a temperature of $130 \pm 5^{\circ}\text{C}$. At this temperature a modifying agent, in an amount of 400 g, was added to the reactor. The modifying agent had the following composition: 25% by weight of liquid polyhydrosiloxane and 75% by weight of dioctylphthalate, as a plasticizer. Then, the mixture was stirred at the same temperature for 60 minutes. The resulting waste mixture was then processed in an extruder at a temperature within the range of 240 to 250°C to form a granulate. The resulting
30 granulate was dark grey and showed a high level of lustre.

Example 2

10 kg waste polyester containers were shredded in a crusher, rinsed in a shredder and the resulting waste mixture was dried in a drier. The waste mixture was charged into a reactor-mixer and heated to a temperature of $130^{\circ}\text{C} \pm 5^{\circ}\text{C}$. At this temperature, a modifying agent, consisting of 60% by weight of hexamethyldisilazane and 40% by weight of tetraethoxysilane, in an amount of 400 g was added to the reactor. Then, the mixture was stirred at the same temperature for 60 minutes. The resulting waste mixture was then
10 processed in an extruder at a temperature within the range of from 240 to 250°C to form a granulate. The resulting granulate was clear and showed a high level of lustre.

In comparison to standard products, the recovered materials showed high elasticity while maintaining the required strength, better heat stability and a higher crystallization temperature, up to 110°C .

Industrial Applicability

20 The method according to the invention can be used in a process for recycling polyester wastes, especially the so called PET bottles, to form a standard quality source material which is useful for manufacturing containers for foodstuffs.

WHAT IS CLAIMED IS:

1. A method for processing polyester wastes, which comprises shredding, washing, drying and melting the waste mixture to obtain a recovered source of polyester material, characterized by adding a modifying agent selected from the group comprising a combination of a polysiloxane and a plasticizer selected from the group of phthalates, or a combination of silazanes and silanes, to the shredded and dried waste mixture wherein the amount of the modifying agent is 4 to 6 % by weight, based on the waste mixture.

10 2. The method for processing wastes according to claim 1, characterized by adding a modifying agent selected from the group comprising a combination of polyhydrosiloxane and a plasticizer selected from the group of dioctylphthalate, dinonylphthalate, dibutylsebacate, or a combination of hexamethyldisilazane and tetraethoxysilane to the shredded and dried waste mixture.

3. The method for processing wastes according to claim 1, characterized in that the modifying agent contains 20 to 30% by weight of liquid polyhydrosiloxane and 70 to 80% by weight of a plasticizer selected from the group of dioctylphthalate, dinonylphthalate, dibutylsebacate, or 55 to 65% by
20 weight of hexamethyl-disilazane and 35 to 45% by weight of tetraethoxysilane.

4. The method for processing wastes according to claim 1, characterized by adding the modifying agent to the waste mixture in a reactor-mixer at a temperature of $130 \pm 5^{\circ}\text{C}$ and then subjecting the waste to stirring for 50 to 100 minutes.

5. The method for processing wastes according to claim 3, characterized by further processing the waste mixture at a temperature of 240 to 250°C to obtain a granulate.

6. The method for processing wastes according to one of claims 1 to 5, characterized in that the polyester wastes are used polyester bottles.