Thermoplastic polymer composition

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Invention

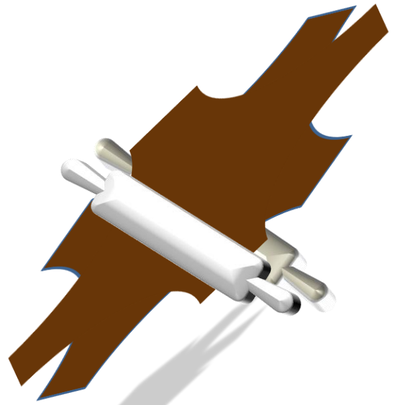
The present invention relates to **new thermoplastic polymeric compositions useful for the production, by hot extrusion, of biodegradable, compostable products and packaging**, having at the same time performances and costs comparable to those of products obtained with traditional non-biodegradable thermoplastic polymeric materials, such as polyolefins.

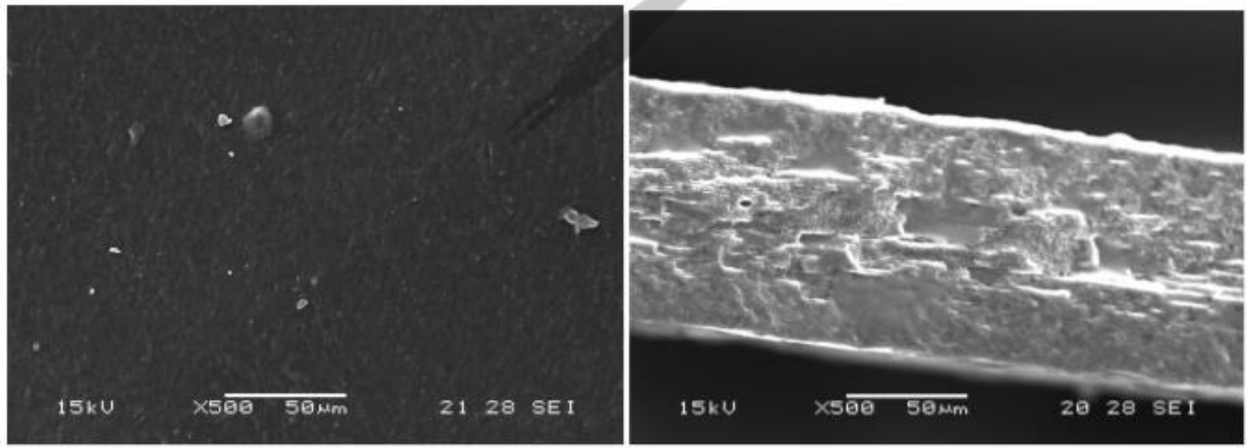
The composition is based on the **synthetic polymer polycaprolactone (PCL)**, which is biodegradable, can be used in a mixture with a **protein hydrolyzed material derived from leather fleshing/shaving operations of the tanning industry**. The use of the mixture aims to obtain a new thermoplastic polymeric composition, heat processable by extrusion or filming procedures for manufacturing a wide range of products.

The manufactured products proved to be **completely biodegradable, compostable and with performances and costs comparable to those of traditional thermoplastic polymeric materials** based on non-biodegradable polymers. Advantageously, the two components of the new composition, i.e. polycaprolactone and protein hydrolysate, showed an astonishing mutual compatibility without the addition of any compatibilizing additive, resulting in a composition with a high hot processability, much higher than, for example, the processability of polycaprolactone alone, in order to produce completely homogeneous products and films with high mechanical resistance. The protein portion is also a hydrolysate of animal collagen from a **waste product of the tanning industry, or from waste and/or by-products of other industrial processes**, which until now had limited possibilities of use or recycling.

PO.TE.CO. S.C.R.L. - SOCIETÀ GENERALE PER LA GESTIONE DEL POLO TECNOLOGICO CONCIARIO is also a patent applicant.

Drawings & pictures





A B

Figure 1. *Images obtained by scanning electron microscopy (SEM) of the surfaces (A) and section (B) for a composition sample of the invention consisting of PCL with 20% by weight of protein hydrolysate from fleshing relative to the total weight of the composition, produced in the form of thin films. It can be seen that both surface A and section B of the film are homogeneous and show good incorporation of the protein hydrolysate into the PCL polymer matrix.*

Industrial applications

The invention is the result of an intense and prolonged research activity, aiming to improve the environmental sustainability of the entire tanning production cycle through an **original and innovative integration between tanning processes and one of the strategic industrial sectors of chemistry**, such as the production of polymeric materials. It is well known that, in the chemical field, the sector of innovative and sustainable polymers represents one of the fastest growing sectors in the world in terms of future perspectives.

The proposed invention can therefore open up **original production chains to the tanning sector**: it can be combined and integrated with the traditional tanning cycles, covering new market sectors with scenarios of competitive advantage at world level of absolute importance in the field of **new materials with low environmental impact**.
The **addition of protein hydrolysate, derived from the residue of the fleshing of animal hides, to the PCL** makes it thermoplastic and hot extrudable with excellent results in terms of mechanical and thermal properties of the solid products obtained, which have also proved to be completely biodegradable.

With the process of preparing the patented composition and its use for prototyping with 3D printers, various types of articles can thus be obtained, such as:

- semi-finished pellet-shaped products;
- thin films, films for packaging in general;
- tubes;
- wires;
- bags, sacks, or
- bottles.

Possible developments

The invention was born thanks to the collaboration of PO.TE.CO. in order to give a turning point in the field of **eco-sustainability of the tanning process**: it can find further uses involving other partners of many industrial sectors, where thermoplastic polymer compositions are manufactured and utilized.

The collaboration with the co-owner of the patent may continue in the development of an integrated solution for the **valorization of leather waste and the reduction of the environmental impact of the tanning industry**. In addition, the joint work and/or future collaborations may allow the development on an industrial/commercial scale up of the research results and the patent claims with effective activation of new integrated production chains.

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