Process and apparatus for continuously manufacturing composites of polymer and cellulosic fibre (EP 1 075 377 B1)

The present invention relates to a process for continuously manufacturing composites of polymer and cellulosic fibres and to the compounded material obtained therewith. It also relates to an extruder to be used in this process.

Lately, the focus on reinforcing fibres is shifting from glass fibres to certain kinds of cellulosic fibres which have outstanding intrinsic mechanical properties. These have the potential to compete with glass fibres as reinforcing agents in plastics. The specific strength of these agrofibres is 50 to 80 percent of glass fibres, whereas the specific modulus can exceed that of glass fibres. Supplementary benefits include low cost, low density, renewability and (bio)degradability. In addition, they are less abrasive during processing with thermoplastics and do not expose operators to potential safety or health problems.

When cellulosic fibres are used it is important that during the extrusion process these fibres obtain and maintain a high aspect ratio so as to obtain a compounded material with mechanical properties comparable with those of materials containing glass fibres. This means that the diameter should be as small as possible, preferably so called elementary fibres are used. Further the length of the fibres should be as large as possible. This is achieved by the present invention. The present invention relates to a process for continuously manufacturing composites of polymer and cellulosic fibres, comprising the steps of:

a) feeding a polymer upstream into an extruder;
b) melting and mixing the polymer in a zone (A) of the extruder; wherein zone (A) comprises at least one positive transportation screw element,
c) feeding cellulosic fibres into the extruder in a zone (B) of the extruder, which zone (B) is located downstream of zone (A);
d) transporting the mixture of polymer and cellulosic fibre obtained in zone (B) through a degassing zone (C), which zone (C) is located downstream of zone (B), wherein zone (C) comprises at least one positive transportation screw element and
e) transporting the mixture obtained in zone (C) through a pressure building zone (D) of the extruder, which zone (D) is located downstream of zone (C), wherein zone (D) comprises at least one positive transportation screw element.
f) releasing the mixture obtained in zone (D) into a die,

characterised in that zone (B) comprises at least one positive transportation screw element, at least one kneading section and at least one negative transportation screw element such that in zone (B) of the extruder the cellulosic fibres are fibrillated to obtain cellulosic fibres with an aspect ratio as high as possible, while simultaneously mixing the cellulosic fibres with the melted polymer.

The design of this process is such that during the continuous mixing the cellulosic fibres are opened up to elementary fibres (fibrillation) with a high aspect ratio, which are homogeneously distributed in the polymeric melt. The process results in a compounded material with improved rigidity and strength.

The present invention also relates to an extruder which can be used to carry out the process. The present invention comprises all extruders with two separate feeding ports and a degassing port. The preferred extruder for performing the process of the present invention is a co-rotating twin-screw extruder.