The invention relates to a plastic part of a protective helmet, characterised in that the parts undergo a treatment in order to improve the technical specifications thereof, in particular the mechanical strength of a part of a protective helmet at low and high temperatures, said treatment comprising the application of ionising radiation to the parts.
IMPROVEMENT TO A PLASTIC PART OF A PROTECTIVE HELMET

[0001] The present invention is in the field of the production of plastic parts and more particularly the production of plastic parts of a protective helmet. According to the invention, a process is provided for treating these materials in order to improve their strength at low and high temperatures.

[0002] The parts of a protective helmet are intended more particularly for firefighters’ helmets and are in particular the outer shell thereof and the plastic parts associated therewith, such as the parts for holding the chinstrap or the breathing mask, for example, or the pivot pins for protective shields, inner headband, etc.

[0003] Protective helmets, in particular firefighters’ helmets, have a shell produced from thermoplastic and are currently made either of polyamide or an acrylonitrile-butadiene-styrene/polycarbonate (ABS/PC) alloy. It is difficult to reconcile the resistance at high temperature, for example at +120° C., with the resistance at low temperature, such as in particular at −40° C., of one and the same thermoplastic.

[0004] Of course, the parts of which the helmet consists could be made of a different material, for example metal, curable polymer or high-performance thermoplastic, such as polyphthalamide (PPA), polyethylene sulfone (PES), polyetheretherketone (PEEK). However, in the case of a protective helmet, weight is an important factor, as is the manufacturing cost.

[0005] The present invention aims to solve the abovementioned problems by providing a particularly simple and effective process for giving the helmet parts produced from thermoplastic qualities identical to those they would have if they were produced from other materials such as thermosetting plastic, for example.

[0006] Thus, according to the invention, the helmet parts made of thermoplastics are ionized, it being known that ionization is a process which is essentially only used for sterilizing medical and surgical material and for preserving agricultural food products.

[0007] It is known that at low temperatures, the impact properties are worse, while at high temperatures the mechanical strength is greatly reduced. The parts treated according to the invention have mechanical characteristics around 5 to 10% better for the same range of temperatures, and the novel mechanical characteristics make it possible to use the helmet in a wider range of uses.

[0008] In summary, the protective helmet produced according to the invention has greatly improved cold and heat resistance, and this is particularly advantageous for a firefighter’s helmet. Thus, according to the invention, the plastic part of a protective helmet is characterized in that it is subjected to a treatment to improve its technical characteristics and in particular the mechanical strength at low and high temperatures of a part of a protective helmet, said treatment consisting in subjecting these parts to ionizing radiation.

[0009] According to a complementary characteristic, the part is made of plastic of the thermoplastic type, such as of thermoplastic of the polyamide 6 (PA-6) type, for example, or of polyamide 6,6 (PA-6,6).

[0010] According to another characteristic, the part is an outer shell of a protective helmet made of thermoplastic.

[0011] It may be added that, according to the invention, the ionizing radiation is electron ionization or photon ionization.

[0012] The invention also relates to the process for producing parts, which comprises the following steps:

[0013] in a preliminary first step, the parts are produced from plastic, for example by thermoplastic injection molding.

[0014] in a second step, the parts are introduced into an ionizing chamber in order to be subjected to ionizing radiation, and

[0015] in a third step, the parts, once they have been ionized, are removed.

[0016] According to a complementary characteristic of the process, before the injection molding, a coagent is introduced into the formulation, the aim of the coagent being to enable the bridging of macromolecular chains while the double bonds of which it is composed are opened.

[0017] Further characteristics and advantages of the invention will emerge from the following description.

[0018] The plastic parts of the protective helmet, such as its shell and/or its accessories and various parts associated with it, which are produced with a thermoplastic, are subjected according to the invention to a treatment intended to improve their resistance to both low and high temperatures, these parts not having this resistance without having been subjected to the treatment of the invention.

[0019] The treatment of the invention consists in a process utilizing ionizing radiation, which, with sufficient energy, gives rise to reactive entities known as ions within the material. In the case of the plastic of the helmet and its accessories or associated parts, the ions are immediately converted into active free radicals, which by combining create new permanent chemical bonds.

[0020] The plastic parts of the helmet of the invention are made for example of a thermoplastic polymer, such as polyamide (PA), and are advantageously of the polyamide 6 (PA-6) or the polyamide 6,6 (PA-6,6) type, these being materials which react perfectly with electrons; the material could, however, be of the polyamide 4,6 (PA-4,6) or polyamide 11 (PA-11) type.

[0021] Two types of ionization may be used for the process of the invention, namely electron ionization (beta treatment) or photon ionization (gamma treatment).

[0022] In the course of electron ionization, the electrons emitted by an electric source lose some of their kinetic energy each time they collide with an atom of the part treated.

[0023] In the course of photon ionization, the photons emitted by a radioactive source move the electrons in order to create ions.

[0024] Crosslinking by ionization increases the choice of materials. Thus, the protective helmet and/or its attachments may be produced from thermoplastic and crosslinking by ionization gives these parts an identical strength to that of thermosetting polymers or high performance thermoplastics (PPA, PES, PEEK).

[0025] Thus, the parts produced and crosslinked by ionizations are lighter for given characteristics and their preparation, for example by injection molding, is easier, with a reduced cycle time.

[0026] According to the process of the invention, the sharp melting point of the material is eliminated, thereby giving the material improved stability of mechanical properties at high temperatures.

[0027] During ionization, bridging of molecular chains takes place and this tends to give the thermoplastic the same behavior as a thermosetting plastic.
The process for treating parts comprises the following steps:

In a preliminary first step, the parts are produced from plastic, for example by thermoplastic injection molding, such as from polyamide 6 or polyamide 6,6, for example.

The parts are produced, for example, by injection molding on the basis of granules of the abovementioned materials. A coagent has previously been introduced into the formulation, the aim of the coagent being to enable the bridging of macromolecular chains while the double bonds of which it is composed are opened. The use of a coagent in the formulation also brings about a substantial lowering of the amount necessary for crosslinking the macromolecular chains. The preferred coagents are from the methacrylate or allyl family. The volume of incorporation of the coagent into the formulation is, for example, between 0.05% and 10% by weight.

In a second step, the parts are introduced into an ionizing chamber in order to be subjected to ionizing radiation.

In a third step, the parts, once they have been ionized, are removed.

It has been understood that, by virtue of the ionizing treatment, the impact strength of the part treated by ionization is improved, and particularly its low-temperature impact strength. It is noted that in order to increase the low-temperature impact strength of a polyamide of the PA-6 or PA-6,6 type it is possible to use two treatment techniques:

either grafting linked to the exposure of the material to radiation, such as with compounds of ethylene dimonomer (EPDM) or copolyamides-6,12 (CoPA-6,12) or else thermoplastic polyester elastomers (TPE-E).

Of course, the invention is not limited to the embodiments described and shown by way of example, but also comprises all the technical equivalents and their combinations.

A plastic part of a protective helmet, characterized in that the parts are subjected to a treatment to improve their technical characteristics and in particular the mechanical strength at low and high temperatures of a part of a protective helmet, said treatment consisting in subjecting these parts to ionizing radiation.

The plastic part of a protective helmet as claimed in the preceding claim, characterized in that the part is made of plastic of the thermoplastic type.

The plastic part of a protective helmet as claimed in the preceding claim, characterized in that the part is made of plastic of the thermoplastic type of the polyamide 6 (PA-6) type.

The plastic part of a protective helmet as claimed in the preceding claim, characterized in that the part is an outer shell of a protective helmet made of thermoplastic.

The plastic part of a protective helmet as claimed in any one of the preceding claims, characterized in that the ionizing radiation is electron ionization.

The plastic part of a protective helmet as claimed in any one of claims 1 to 5, characterized in that the ionizing radiation is photon ionization.

Process for producing parts as claimed in any one of the preceding claims, characterized in that the process comprises the following steps:

in a preliminary first step, the parts are produced from plastic, for example by thermoplastic injection molding,
in a second step, the parts are introduced into an ionizing chamber in order to be subjected to ionizing radiation, and
in a third step, the parts, once they have been ionized, are removed.

The process as claimed in the preceding claim, characterized in that, before the injection molding, a coagent is introduced into the formulation, the aim of the coagent being to enable the bridging of macromolecular chains while the double bonds of which it is composed are opened.

The process as claimed in the preceding claim, characterized in that the coagent is from the methacrylate or allyl family.

The process as claimed in the preceding claim, characterized in that the volume of incorporation of the coagent into the formulation is between 0.05% and 10% by weight.

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