The invention relates to a high-strength glove and manufacturing process thereof. The special glove comprises, from the inside of a glove toward the outside, a high-strength fabric layer. The fabric layer is covered, over part or all of its surface, with at least one layer of an elastomer. The layer is obtained from an aqueous dispersion of the elastomer. The layer of elastomer is also covered, over part or all of its surface, by at least one layer of an elastomer obtained from a solution of the elastomer in one or more organic solvents or in water.
PROTECTIVE GLOVE WITH REINFORCED MECHANICAL STRENGTH AND METHOD FOR MAKING SAME

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a glove of increased strength and to its manufacturing process, as well as to the uses of such a glove.

[0002] The handling of sharp or rough objects, tools or equipment requires effective protection of the user's hands by him wearing gloves. High-strength fabrics, such as those formed from KEVLAR® fibers or from DYNEEMA® fibers (from DSM), constitute particularly suitable materials for producing such gloves.

[0003] For the purpose of making these fabrics impermeable and to protect their fibers from the external environment (water, oils, various chemicals), it is necessary to coat the outside of the gloves with a protective material, such as an elastomer.

[0004] For this purpose, Patent EP 0 716 817 in the name of Hutchinson discloses gloves affording high protection against the risk of cutting, which comprise, on that side of the glove intended to cover the palm of one's hand, material having a high cut resistance (such as a knit of para-aramid fibers), whereas that side of the glove intended to cover the back of one's hand is formed from an elastic fabric of natural or synthetic fibers (such as a knit of cotton fibers), all or part of the external surface of the glove being coated with an elastomer.

[0005] To protect the user's hands effectively, it would be desirable to use elastomers which, apart from their role of making the fabric impermeable and protected from the external environment, possess good mechanical properties, especially from the standpoint of puncture and tear resistance. In this regard, it would be more advantageous to use elastomers coming from solutions, which may possess better mechanical properties than when they come from aqueous dispersions (for example in the case of certain polyurethanes). Moreover, certain elastomers can be processed only in the form of solutions and cannot therefore be available in the form of aqueous dispersions, as is the case for example for butyl rubbers.

[0006] Now, Patent EP 0 716 817 discloses the coating of a fabric only with elastomers in the form of aqueous dispersions, by successively dipping the fabric into these aqueous dispersions. As is known to those skilled in the art, dipping a fabric directly into an elastomer solution is in fact to be prohibited, since it would involve, owing to the high penetrability of elastomer solutions, complete inclusion of the fabric (over its entire thickness) in the elastomer. This would result in a loss of pliancy of the fabric. The gloves thus obtained would be particularly uncomfortable for the user to wear and their lack of pliancy would make them unsuitable for following the movements of one's hand and fingers.

BRIEF SUMMARY OF THE INVENTION

[0007] It is an objective of the invention therefore to provide a glove which is pliant and possesses high mechanical strength, in particular as regards puncture and tear resistance, and in which a layer of high-strength fabric is combined with layers of elastomers that are selected for their good mechanical properties.

[0008] This objective is achieved, on the one hand, by using elastomers employed in the form of solutions and, on the other hand, by inserting a layer of an elastomer in the form of aqueous dispersion between the layer of fabric and the layer of elastomers coming from solutions.

[0009] The subject of the invention is therefore a high-strength glove which comprises, from the inside of the glove toward the outside:

[0010] a high-strength fabric layer;

[0011] the fabric layer being covered, over part or all of its surface, with at least one layer of an elastomer chosen from an aqueous dispersion of said elastomer; and

[0012] the elastomer layer being covered, over part or all of its surface, with at least one layer of an elastomer obtained from a solution of said elastomer in one or more organic solvents or in water.

DETAILED DESCRIPTION OF THE INVENTION

[0013] A detailed description of the preferred embodiments and best modes for practicing the invention are discussed herein.

[0014] Within the context of the present invention, the term “elastomer solution” is understood to mean an elastomer in liquid form having only a single continuous phase, as opposed to aqueous elastomer dispersions (or lattices) which are, on a microscopic level, in the form of two separate phases. The aqueous elastomer dispersions that can be used within the context of the present invention are dispersions which can be coagulated, with the aid of coagulants commonly used in the field of elastomers, or aqueous dispersions which are rheologically modified so as to increase their viscosity.

[0015] The expression “inside of the glove” is understood to mean that side of the glove intended to come into contact with the user's hand, whereas the term “outside” of the glove is that side intended to come into contact with the external environment.

[0016] The term “high-strength fabric” is understood to mean a fabric possessing good puncture resistance and tear resistance, these being determined according to the NF EN 388 standard. As regards the level of cut resistance, this depends on the nature of the fabric chosen, on the diameter of the fibers and on the size of the mesh structures of the fabric, if the fibers of the fabric are knitted.

[0017] According to the NF EN 388 standard, the levels of puncture resistance, cut resistance and tear resistance involve different mechanical characteristics, since they correspond to the resistance to mechanical stresses of different types, namely, respectively, resistance to contact with a pointed object, resistance to contact with a cutting object and the ability of a specimen with a notch of not tearing any further from this notch.

[0018] In the gloves according to the invention, the presence of at least one layer of an elastomer, the layer being
obtained from an aqueous dispersion of the elastomer, in an intermediate position between the fabric layer and the elastomer layer(s) obtained from solutions, makes it possible to prevent the elastomer in solution form from penetrating the entire thickness of the fabric layer. Thus, the resulting glove remains plant, while still being made impermeable by elastomer layers obtained from solution.

0019] The high-strength fabric used in the gloves according to the invention consists, for example, of woven or knitted, natural or synthetic fibers selected from high-tensility polyethylene fibers, high-tensility polyester fibers, polyaramid fibers, polyamide fibers, or viscose fibers, or blends of the preceding.

0020] Particularly advantageously, the elastomer obtained from an aqueous dispersion is selected from natural rubber, polychloroprenes, carboxylated nitrile rubbers, polyurethanes, or blends of the preceding.

0021] As regards the elastomer obtained from a solution in one or more organic solvents or in water. The organic solvents can be advantageously selected from polyurethanes, butyl rubbers, chlorosulfonated polyethylene (for example the product sold under the brand name HYPERLON® by DuPont De Nemours, France), or polyvinyl alcohols, or blends of the preceding.

0022] These examples are not however limiting: in general, any elastomer capable of being dissolved in an organic solvent or in water and of forming a film after evaporation of the solution could be used.

0023] In an advantageous embodiment of the glove according to the invention, the latter possesses high chemical resistance, the elastomer obtained from a solution in one or more organic solvents or in water. The organic solvents can be butyl rubbers, chlorosulfonated polyethylene, or polyvinyl alcohols or blends of the preceding.

0024] Butyl rubbers make it possible in fact to obtain a glove impermeable to gases, whereas chlorosulfonated polyethylenes and polyvinyl alcohols give the glove excellent impermeability to liquids (water, oils, solvents). Any other elastomer in solution exhibiting chemical resistance properties could also be used.

0025] In general, the expression “glove with high chemical resistance” is understood to mean a glove allowing the handling of products with which the user must avoid any contact, for example products which attack the skin or contact with which is dangerous (for example corrosive chemicals).

0026] The total thickness of the elastomer layers in the glove according to the invention can be between 0.1 and 1 mm, preferably between 0.1 and 0.6 mm.

0027] The glove according to the invention, whatever the nature of the elastomeric layers, advantageously possesses a puncture resistance of at least 150 N and a tear strength of at least 75 N, these being measured according to the NF EN 388 standard (i.e. according to that standard, a level 4 of puncture resistance and a tear strength).

0028] The subject of the invention is also a process for manufacturing the glove as defined above. The process can comprise the following steps:

0029] a) clothing a mold with a high-strength fabric layer;

0030] b) dipping the mold/high-strength fabric assembly into one or more aqueous dispersions of elastomers, the elastomers being identical or different;

0031] c) dipping the mold/high-strength fabric/elastomer assembly obtained after the previous step into one or more solutions of elastomers, the elastomers being identical or different, in one or more organic solvents or in water; and then

0032] d) removing the glove by slipping it off the mold.

0033] In this process, the aqueous elastomer dispersions, the elastomer solutions and the high-strength fabric are as defined above with regard to the glove according to the invention.

0034] Between steps b) and c) of the process defined above, it is also possible to carry out a step of crosslinking the elastomer layer obtained from step b). This is because crosslinking the elastomer advantageously makes it possible to increase its chemical resistance to solvents which will be used during step c).

0035] The process according to the invention alleviates the shortcomings of the prior art in that it makes it possible to produce, by the technique of dipping a fabric into an elastomer bath, a plant glove comprising a fabric covered with elastomer layers coming from solutions of said elastomers.

0036] Hitherto, no method had been known which allowed an elastomer in solution form to be combined with a fabric without coating all of the fibers of the fabric. The novel succession of steps in the process according to the invention makes it possible to limit the interpenetration between the elastomer in solution form and the fabric when these two materials are brought into contact with one another during step c) of the process. This is because step b) of dipping the fabric into an elastomer in the form of an aqueous dispersion makes it possible to make the surface of the fabric impermeable and to prevent all of the meshes of the fabric being coated with the elastomer in solution during step c) of the process. The fabric therefore remains plant and retains its mechanical properties. This makes it possible to obtain a glove which is very plant and comfortable to wear, these being essential properties so that the user can carry out meticulous tasks while still being able to perform very accurate movements.

0037] The process according to the invention can advantageously include, between steps a) and b), a step a’) of immersing the mold/high-strength fabric assembly in a bath of a coagulant, followed by partially drying said assembly. Coagulants suitable for aqueous elastomer dispersions are well known to those skilled in the art.

0038] According to one advantageous method of implementing the process according to the invention, the process includes, between step c) and d), a step c’) of drying the mold/high-strength fabric/elastomer assembly obtained after step c).

0039] Step b) can optionally include only a single operation of dipping the mold/high-strength fabric assembly into an aqueous elastomer dispersion.
As regards step c) of the process according to the invention, this may include, depending on the desired final thickness of the elastomer, between 1 and 20, preferably between 1 and 8, operations of dipping the mold/high-strength fabric/elastomer assembly obtained after step b) into one or more elastomer solutions, said elastomers being identical or different, in one or more organic solvents or in water. In this case, each elastomer layer is dried, at least partially, before the next dipping operation is carried out.

The subject of the invention is also the use of the glove defined above for handling objects with which there is a risk of cutting, puncturing or tearing.

The subject of the invention is also the use of a high-strength glove exhibiting high chemical resistance, as defined above, for handling dangerous chemicals, such as corrosive chemicals.

Apart from the foregoing provisions, the invention also includes other provisions which will become apparent from the following description, which refers to detailed examples of how gloves according to the invention are manufactured. However, it should be clearly understood that these examples are given merely by way of illustrating the subject matter of the invention, these in no way constituting any restriction.

EXAMPLE

Manufacture of a High-Strength Glove According to the Invention

A glove according to the invention, comprising a high-strength fabric layer covered with a polyurethane layer obtained from an aqueous dispersion and then with a polyurethane layer obtained from a solution in an organic solvent, was obtained by the following process.

A mold, conventionally made of porcelain, having the shape and dimensions of a hand was used. This mold was firstly clothed with a high-strength fabric, for example over that part of the mold corresponding to the user’s hand or over the entire surface of the mold. The high-strength fabric used in this case was DYNEEMA® (a high-tenacity polyethylene fabric sold by DSM).

The mold/high-strength fabric assembly was immersed in a bath of coagulant, such as a bath of calcium nitrate. It was partially dried and then dipped into an aqueous dispersion of a polyurethane, for 30 seconds to 3 minutes for example.

However, it should be clearly understood that the choice of the elastomer in aqueous dispersion form had to be made in accordance with that of the elastomer in solution form that had to be used subsequently, so as to prevent the elastomer layer obtained from the aqueous dispersion from being attacked by or reacting with the solution of the elastomer in solution form.

The mold/high-strength fabric assembly was dipped into the aqueous polyurethane dispersion so as to immerse the entire fabric in the aqueous dispersion. The dipping could also be carried out so as to immerse only part of the fabric in the aqueous elastomer dispersion: for example, if the fabric was presented both on that part of the mold corresponding to the user’s hand and on that part of the mold corresponding to his forearm, it is possible to immerse, in the aqueous elastomer dispersion, only that part of the fabric corresponding to the user’s hand.

This operation allows the surface of the high-strength fabric to be covered with a uniform polyurethane film of very small thickness (negligible thickness compared with the apparent thickness of the fabric layer, which is generally between 0.5 and 3 mm). The fact that the polyurethane was used in the form of an aqueous dispersion prevented the elastomer from penetrating all the way into the thickness of the fabric, since the polyurethane coagulated at the surface of the fabric. The meshes of the fabric were therefore made impermeable by the elastomer without being completely included in this elastomer, the fabric therefore remaining pliant.

The mold/high-strength fabric/polyurethane assembly obtained after these steps was dried in an oven at a temperature of between 20 and 100°C (preferably 70°C) and for a time of between 5 and 60 minutes (preferably for 30 minutes), the temperature and the time both being chosen according to the type of polyurethane used.

Next, several operations of dipping the mold into a solution of polyurethane in an organic solvent, such as N,N-dimethylacetamide, dimethylformamide or tetra-hydrofuran, or into a mixture of several organic solvents, were carried out. The number of dipping operations carried out depended on the desired polyurethane thickness.

Any polyurethane known to those skilled in the art capable of being dissolved in an organic solvent and of forming a film after evaporation of the solvent could be used. As examples, mention may be made of an aromatic or aliphatic, polyester or polyether type polyurethane. However, these examples are not restricted and, apart from the solubility characteristics and the film-forming properties described above, any polyurethane possessing a modulus at 20% elongation of less than 3 MPa, a modulus at 100% elongation of less than 7 MPa, a tensile strength of greater than 20 MPa and an elongation at break of greater than 400% could be used.

During each dipping operation, the mold was kept for between 3 and 30 minutes, preferably 10 minutes, in the polyurethane solution. Each polyurethane layer obtained on the mold was partially dried, for example, in an oven at a temperature of between 20 and 130°C, preferably 60°C, and for a time of between 1 and 300 minutes, preferably 60 minutes, before the mold was again dipped into the polyurethane solution. The temperatures and times indicated here depend on the solvent for the polyurethane and on the type of polyurethane used.

The polyurethane layer thus obtained on the mold, after dipping the mold several times into the polyurethane solution, was then fully dried, for example in an oven at a temperature of between 20 and 130°C (preferably 80°C) and for a time of between 2 and 24 hours (preferably for 5 hours), the temperature and the time both being chosen according to the solvent and the type of polyurethane used.

After cooling, the glove was removed from the mold by slipping it thereoff. A glove was obtained which possessed excellent abrasion resistance (abrasion resistance of level 4 according to the NF EN 388 standard) and which was perfectly impermeable (within the meaning of the NF EN 374-2 standard).
In the example of manufacturing a high-strength glove that has just been described, it was also possible to use elastomers other than polyurethane. For example, instead of a polyurethane, it will be possible to use an elastomer, in solution form, possessing chemical resistance properties, especially to the chemicals described above. Thus a high-strength glove with high chemical resistance is obtained.

Likewise, it would be possible to dip the mold into several solutions of different elastomers in succession and thus combine the advantageous properties of several elastomers. This will be the case, for example, if the mold were to be dipped several times into a solution of a butyl rubber (elastomer impermeable to gases) and then several times into a solution of a chlorosulphonated polyethylene (an elastomer impermeable to liquids).

As is apparent from the foregoing, the invention is in no way limited to its embodiments, methods of implementation and of application that have been more explicitly described; on the contrary, it embraces all variants thereof which may fall within the competence of a person skilled in the art, without departing either from the context or the scope of the present invention.

What is claimed:

1. A high-strength glove which comprises, from the inside of the glove toward the outside:
   a high-strength fabric layer;
   said fabric layer being covered, over part or all of its surface, with at least one layer of an elastomer obtained from an aqueous dispersion of said elastomer; and
   said elastomer layer being covered, over part or all of its surface, with at least one layer of an elastomer obtained from a solution of said elastomer in one or more organic solvents or in water.

2. The glove as claimed in claim 1, characterized in that said high-strength fabric consists of woven or knitted, natural or synthetic fibers selected from high-tenacity polyethylene fibers, high-tenacity polyester fibers, polyaramid fibers, polyamide fibers, viscose fibers and blends thereof.

3. The glove as claimed in claim 1 or claim 2, characterized in that said elastomer obtained from an aqueous dispersion is selected from the group consisting of natural rubber, polychloroprene, carboxylated nitrile rubbers, polyurethanes and blends thereof.

4. The glove as claimed in any one of the preceding claims, characterized in that said elastomer obtained from a solution in one or more organic solvents or in water is selected from the group consisting of polyurethanes, butyl rubbers, chlorosulphonated polyurethanes, polyvinyl alcohols and blends thereof.

5. The glove as claimed in any one of claims 1 to 3, characterized in that it possesses a high chemical resistance and in that said elastomer obtained from a solution in one or more organic solvents or in water is selected from the group consisting of butyl rubbers, chlorosulphonated polyethylene, polyvinyl alcohols and blends thereof.

6. The glove as claimed in any one of the preceding claims, characterized in that the total thickness of the elastomer layers is between 0.1 and 1 mm, preferably between 0.1 and 0.6 mm.

7. The glove as claimed in any one of the preceding claims, characterized in that it has a puncture resistance of at least 150 N.

8. The glove as claimed in any one of the preceding claims, characterized in that it has a trouser tear strength of at least 75 N.

9. A process for manufacturing the glove as defined any one of the preceding claims, characterized in that it comprises the following steps:
   a) clothing a mold with a high-strength fabric layer;
   b) dipping the mold/high-strength fabric assembly into one or more aqueous dispersions of elastomers, said elastomers being identical or different;
   c) dipping the mold/high-strength fabric/elastomer assembly obtained after the previous step into one or more solutions of elastomers, said elastomers being identical or different, in one or more organic solvents or in water; and then
   d) removing the glove by slipping it off the mold.

10. The process as claimed in claim 9, characterized in that it includes, between steps a) and b), a step a') of immersing the mold/high-strength fabric assembly in a bath of a coagulant, followed by partial drying of said assembly.

11. The process as claimed in claim 9 or claim 10, characterized in that it includes, between steps c) and d), a step c') of drying the mold/high-strength fabric/elastomer assembly obtained after step c).

12. The process as claimed in any one of claims 9 to 11, characterized in that step b) includes only a single operation of dipping the mold/high-strength fabric assembly into an aqueous elastomer dispersion.

13. The process as claimed in any one of claims 9 to 12, characterized in that step c) comprises between 1 and 20, preferably between 1 and 8, operations of dipping the mold/high-strength fabric/elastomer assembly obtained after step b) into one or more solutions of elastomers, said elastomers being identical or different, in one or more organic solvents or in water.

14. The use of the glove as claimed in any one of claims 1 to 8 for handling objects entailing a risk of cutting, puncturing or tearing.

15. The use of a glove as claimed in claim 5 for handling dangerous chemicals, such as corrosive chemicals.