ABSTRACT

Outer protective shell is made from a sheet or plate of rigid polymer. It has a plurality of partial incisions suitable for imparting to the said shell a degree of overall flexibility, and local rigidity, and also breathability.
FIELD OF THE INVENTION

The invention relates firstly to a protective shell combining anti-abrasion, anti-perforation and anti-tear properties, and also flexibility, for adapting it to the outer shape of an object to be protected or to the morphology of the wearer of a garment, in addition to the various movements he is likely to make for the practice of a physical, sports or industrial activity in particular.

The invention also relates to a protective cover provided with such a shell, in particular for all types of objects liable to require such protection, and in particular office equipment, such as a laptop computer, PDA, etc., or sports equipment, such as for example a snowboard, a float (sailboard, surfboard), etc.

It further relates to a protective garment provided with such a shell, but also with other elements, in particular impact damping elements, the garments being more particularly suitable for use in the area of sports and leisure activities, but also in the industrial world, in the area of safety and transportation.

BACKGROUND OF THE INVENTION

The incorporation of protective or damping elements in garments is a recurrent concern. In fact, a number of sports or leisure practices generate impacts and blows, such as in particular, but not being complete, skiing, ice hockey, riding, cycling, etc.

One of the areas that conventionally needs protection due to its vulnerability and the consequences resulting from such impacts is the vertebral column. Thus, with regard to skiing and more particularly to downhill skiing, the official regulations henceforth demand the wearing of a protective shell extending substantially along the whole vertebral column, and worn under the outer garment for protection against cold, adverse weather, etc.

The wearing of such a protective shell is also mandatory in the practice of cross-country motorcycling, riding contests, for the same purpose.

While the protective elements no doubt perform the function assigned to them, they are on the other hand a hindrance to the user due partly to the intrinsic rigidity of the protective shell, and also to the additional thickness that they produce, thereby liable, even partially, to limit the movement of the user’s limbs, in particular their arms, or the different back bends required by the practice concerned. In fact, these protective elements conventionally consist of relatively thick impact damping elements.

SUMMARY OF THE INVENTION

It is the object of the present invention to propose, firstly, a protective shell having the advantage of offering properties of rigidity, in order to prevent abrasion in case of fall and/or sliding, against perforations and tears, and of flexibility, to permit its maximum possible adaptation to the shape of the object to be protected or to the morphology of the user and to the movement of his members or of parts of his body.

The invention also relates to the garment incorporating such a shell, the garment further being provided with damping elements, in particular. It also relates to a protective cover for any type of object incorporating such a shell.

Accordingly, the invention relates firstly to an outer protective shell characterized in that it is made from a sheet or plate of rigid polymer, and in that it has a plurality of partial incisions suitable for defining substantially jointed motifs, for imparting to the shell a degree of overall flexibility, and local rigidity for distributing the impact and resistance to abrasion and to tearing.

In other words, the invention consists in proposing a shell basically consisting of a rigid material, of limited thickness, whereof the partial incisions made in its thickness according to particular motifs enable it to confer the desired flexibility, the overall cohesion being preserved thanks to the bridges or nodes of material preserved between the incisions, these bridges of material being more or less narrow, hence more or less flexible, according to the base material.

According to the invention, the material of the shell may be a conventional polymer (Acrylate Butadiene Styrene—ABS, polycarbonate, polypropylene etc), or a composite, particularly having a thermoplastic matrix. In the latter case, such a material may be based on woven polypropylene fibres, embedded in a matrix also made from polypropylene, and such as for example sold by Lankhorst under the registered trademark Pure®, which is particularly apt for this application.
Thus, the use of fibrous composites that resist tearing particularly well provides a protective cover that clearly performs the essential functions assigned to it, that is anti-abrasive, anti-perforation, anti-tear, due to the use of woven fibres, further serving to distribute the energy in case of impact, and owing to a higher bending modulus than pure thermoplastics. Moreover, the more or less large dimensions of the nodes of material present between the incisions can be adjusted according to the type of polymer used, particularly of a fibrous nature to adapt the flexibility and strength of the shell to the area to be protected and/or to the intended activity.

Thus, in order to protect the vertebral column, larger nodes can be used, for obtaining a more rigid and thereby more protective shell. No doubt, the flexibility is thereby affected, at least partly, but for a relatively plane area to be protected, the back in this case, this reduction of flexibility is not prohibitive. On the other hand, if the area to be protected consists of a joint, elbow or knee for example, the nodes used are smaller, in order to confer the requisite flexibility to the shell.

According to the invention, such a shell is “breathing”, due to the incisions made therein.

It has a very low density, typically lower than 0.8 g/cm³ if, for example, it is made from Pure® type self-reinforced polypropylene.

Finally, it is relatively inexpensive, due to the use of an economical material, and due to its preparation by a processing method, in this case cutting (using a cutting die, laser or water jet) requiring little or no investment in moulds.

The motifs of the incisions may equally well be geometric and repetitive, such as triangles or other circles, or “morphological”, that is optimized to match the area to be protected. In both cases, the aim is to optimize the cutting operation and also the flexibility.

The invention further relates to protective garments, more particularly intended for the practice of sports and leisure activities. These comprise a number of areas considered to be vulnerable to blows and impacts, the areas being provided with a protective shell of the type described above.

According to a first embodiment of the invention, this garment consists of a pull-over, a sweatshirt or a jacket and the vulnerable areas essentially consist of the vertebral column, the shoulders and the elbows, or even the arms, the forearms and the pectorals.

According to another embodiment, this garment consists of a pair of trousers and the vulnerable area consists essentially of the hips, the coccyx, the knees and the tibias.

In all cases, the protective shell is joined to a damping layer at the vulnerable areas.

This advantageously consists of a polymer foam (polyethylene base, EVA, polypropylene, polyurethane, etc.), naturally aerated (like for example open cell foams or porous foams, such as marketed for example by Brock), or micro-perforated by means of a passage between perforating calender rolls or by flat punching.

The damping layer may also consist of a three-dimensional mesh, referred to, in the area concerned, as 3D mesh (textile or plastic polymer) having Z fibres (that is oriented along the direction perpendicular to the surface of the fabric) procuring good compressive strength while preserving flexibility and breathability.

Finally, and advantageously, the entire garment comprises a biometric comfort and hygiene layer, which may also be made from 3D mesh of the abovementioned type (polymer textile having Z fibres to space the outer fabrics and improve the comfort and breathability performance) associated with heat-regulating or water-repellent fabrics (polyester, polyamide, polypropylene base, etc.) such as sold by DuPont de Nemours under the registered trademark Coolmax®, by Nike under the registered trademark Dri-fit® or by Adidas under the registered trademark Climalite®, or also of low density open cell foam, advantageously viscoelastic.

BRIEF DESCRIPTION OF THE DRAWINGS

The manner in which the invention can be implemented and the advantages thereof will appear more clearly from the exemplary embodiment that follows, provided for information and non-limiting, in conjunction with the appended figures.

FIG. 1 shows a schematic cross section of the modelling of the structure according to the invention, more particularly intended for use for a garment.

FIG. 2 is a similar view to FIG. 1, intended to illustrate the flexibility of the structure.

FIG. 3 is a schematic view of FIG. 1, intended to illustrate the flexibility of the structure.

FIG. 4 is a schematic view showing a method for joining the structure of the invention to a garment.

FIG. 5 is a schematic view showing particular areas of the garment in order to visualize the protective shell according to the invention.

FIG. 6 is a schematic representation of the structure of the invention, in its application to a protective cover for a laptop computer.

FIG. 7 is a schematic illustration of another embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

The description that follows is more particularly focused on a garment. However, it must be clearly understood that this application is not limiting to the present invention, and that any use of the specific shell of the invention, particularly for the preparation of protective covers, for example for information technology tools, or for sports articles, is covered by the invention.

As already stated, FIG. 1 is intended to model the object of the present invention. The structure of a protective garment according to the invention is therefore shown in a schematic view.

Directly above a protective area with which it is provided, and starting with the face of the garment in contact with the user’s skin or with an undergarment, the garment first comprises a hygiene layer (1), then a biomechanic comfort layer (2), the two layers possibly only constituting a single one.

Conventionally, these hygiene and biomechanic comfort layers consist of technical textiles, particularly of the three-dimensional textile type (3D mesh). As already stated, such textiles have Z fibres procuring good compressive strength while preserving flexibility and breathability.

These textiles are further advantageously joined to heat-regulating or water-repellent fabrics (polyester, polyamide, polypropylene base, etc.). Such fabrics are sold for example by DuPont de Nemours under the registered trademark Coolmax®, by Nike under the registered trademark Dri-fit® or by Adidas under the registered trademark Climalite®.

These biomechanic comfort (2) and hygiene (1) layers may also consist of a low density open cell foam, advantageously viscoelastic.
They are intended to perform a number of functions, including firstly, biometric comfort through the use of the volume textile or the low density open cell foam.

In doing so, they provide the necessary softness and drain the air and sweat. They are further intended to confer hygiene to the garment, thanks to the use of breathing or micro-encapsulated materials.

Furthermore, these biometric and hygiene layers are intended to be lightweight, this property being obtained by the use of the volume textile or the low density open cell foam, and to be flexible, that is to be able to perfectly match the user’s morphology, statically or dynamically. This layer is therefore naturally supple.

Finally, a damping capacity is conferred on these layers, conferring the damping function performed by the actual damping layer described below in greater detail. The volume textile used, or the low density foam, participates in this damping function.

With reference to FIG. 1, this biometric comfort and hygiene layer is joined to an actual damping layer (3). In the present case, the latter layer is shown in the model by a layer having a much greater thickness than that of the other layers (1, 2). Furthermore, and advantageously, this damping layer is simply inserted between the comfort and hygiene layer, and the protective shell (4) described below in greater detail. In doing so, greater flexibility of the garment is procured at these particular areas, due to the preservation of the sliding capacity of the layers with regard to one another.

In the present case, this damping layer (3), thus intended as its name indicates to absorb the impacts and blows, consists advantageously of a polymer foam. This layer may be naturally aerated by virtue of its method of fabrication or of its constituents. In fact, polymerization which gives rise to foaming serves to obtain open cells, which allow the air to pass through. For other foams, such as those sold by Brock, they consist of the aggregation of closed beads, the air flowing between the beads. Finally, the foam may be micro-perforated by means of a passage between the perforating calender rolls (mass production) or by flat punching (small-scale production).

Due to the available possibility of air flow, this damping layer (3) is also a breathing layer.

Another possibility for this damping layer is to use a volume textile (3D textile or plastic mesh) having Z fibres procuring good compressive strength by preserving the flexibility and breathability.

Furthermore, this damping foam (3), like the 3D mesh, is lightweight, having a density typically between 30 and 60 g/l, and flexible, inherent in its nature.

Finally, due to its nature and its method of production, it is relatively inexpensive to produce.

It should be noted that it is also possible to use other damping materials (gels, silicones, viscoelastic polymers, etc.) even if they do not offer the same lightness and flexibility, like for example viscoelastic silicone gums which stiffen according to the mechanical loading rate.

The specific zones of the garment according to the invention are further provided with an outer shell (4), having both properties of local rigidity and overall flexibility. It may be fixed to the edges of the garments by stitching, welding or bonding (see FIG. 3). By virtue of its fastening mode, particularly in the side zones of installation of the shell, the latter is capable of sliding with regard to the underlying damping layer (3). Moreover, the damping layer is itself capable of sliding with regard to the biometric comfort and hygiene layers.

In the present case, and according to the invention, this outer shell (4) consists of a pure thermoplastic or preferably composite polymeric material, particularly having a thermoplastic matrix. According to one advantageous feature, woven polypropylene fibres are used, embedded in a matrix also made from polypropylene. Such a material is sold under the trademark Pure®.

According to one feature of the invention, this outer shell (4) has incisions (5), regular or not, according to an optimized motif, triangles in the present case, making it possible primarily to confer on the shell the flexibility required for the adaptation thereof, on the one hand to the user’s morphology and on the other to his movements occurring in the practice of the activity in question.

Moreover, it should be observed that this shell is made from sheets or plates prepared from such a material, making it processable with the same technical processing means as textiles (patternning, cutting, stitching, welding, bonding, etc.) without necessarily requiring thermoforming, thermo-compression or injection tools.

The use of such a composite with a thermoplastic matrix also serves to confer on this shell the essential properties assigned to it, that is, to prevent abrasion, perforation, tearing likely to occur during impacts or during sliding on an abrasive surface, such as snow, ice, road surfacing, etc. These anti-abrasion, anti-perforation, anti-tearing properties are made possible by the use of woven fibres constituting the material. Polypropylene fibres are also non-aggressive in case of breakage, contrary to glass or carbon fibres, offering them an additional advantage, particularly in terms of comfort and safety.

Furthermore, the use of such a composite serves to have a much higher bending modulus than pure thermoplastic materials. In doing so, the use of such an outer shell serves to better distribute the energy and hence the impact of the collisions likely to occur therein.

The incisions made confer a breathing character on the shell. The breathing character of the structure is symbolized by upward arrows in FIG. 1.

Moreover, according to the type of polymer used, these incisions (5) may be more or less large. Thus, with a pure thermoplastic, the incision density is lower and/or the thickness of the constituent sheet or plate is higher.

As a corollary, with a composite thermoplastic, the incision density may be higher, with a lower plate thickness, due to the presence of the woven polymer fibres.

Moreover, the particular choice of the material constituting the shell, and in particular self-reinforced polypropylene, in addition to the presence of these incisions, serves to have a material with a density lower than 0.5 g/cm² and thereby to confer on this shell the requisite lightness related to the intended application with regard to garments.

FIG. 2 shows the flexible character of the complete structure, in addition to the propensity of the outer shell (4) to slide easily on any type of coating, and symbolized by the arrow.

Obviously, the various zones of installation or incorporation of the outer shell and the damping material, and in general, the entire structure described in relation to FIGS. 1 and 2, depends on the intended use of the garment in question.
FIG. 4, for example shows the back of a T-shirt having a plurality of protective zones (6, 7) according to the invention, arranged directly above the vertebral column, having a more or less large shape and area according to the location.

These installation zones may obviously be in a plurality and, for example, may particularly be located at the most exposed areas, and more particularly the shoulders and the collar-bone, the exterior of the arms, particularly the elbow, the arm and the forearm, and also at the pectorals.

It is accordingly clear that due to the choice of the material constituting the shell, apart from its structure, and particularly its incisions according to appropriate motifs, such a garment is naturally supple, favouring its use for many applications.

According to an alternative of the invention shown in relation to FIG. 6, more particularly intended for a garment application, the outer shell (4) is bonded to a prestretched elastic support, of the textile or foam type (8).

Whereas the support (8) is kept stretched, and after the bonding, the incisions in the shell (4) are made as described above, while taking care to avoid leaving any bridge or node between the incisions thereby made.

The stretching of the support (8) is then stopped, and due to its elasticity, it shrinks, and thereby, owing to the incisions made in the shell, causing the formation of scales (9), independent from one another, and capable of partially overlapping. This contributes to the optimization of the protective nature of the shell, and furthermore, the flexibility of the final structure is increased.

Furthermore, the invention also relates to protective covers using the outer protective shell described above. Such a cover can be used for all types of object.

FIG. 5 accordingly shows the implementation of the principle of the invention adapted to a laptop computer (10). In the present case, this protective cover comprises an outer shell (4) on its outer surface, for example of the same type as that described in relation to FIGS. 1 to 4.

This outer shell (4) is joined to a damping layer (3), also of the same type as that described above.

In this application also, the breathing character of these various layers can be appreciated. Thus, when the object to be protected consists of a surfboard, a pair of skis, etc., in short, an element that may be wet when introduced into the cover, this breathing character serves to remove the moisture rapidly, and thereby increase the life of the object in question.

In the case of information technology hardware (PDA, notebook, etc.), the breathing character is appreciated insofar as it serves to remove the heat generated by this type of apparatus.

1. An outer protective shell comprising a sheet or plate of rigid polymer, wherein the sheet or plate has a plurality of partial incisions suitable for defining substantially jointed motifs, imparting said shell with a degree of overall flexibility, local rigidity, and breathability.

2. The outer protective shell according to claim 1, wherein the sheet or plate is made from a thermoplastic.

3. The outer protective shell according to claim 2, wherein said thermoplastic is selected from the group consisting of ABS (Acrylate Butadiene Styrene), polycarbonate, and polypropylene.

4. The outer protective shell according to claim 1, wherein the sheet or plate is made from a self-reinforced thermoplastic composite, said composite consisting of woven polypropylene fibres embedded in a polypropylene resin.

5. The outer protective shell according to claim 1, wherein the motifs have a repetitive geometric or morphological shape.

6. A garment comprising a number of protective zones that protect vulnerable areas against blows and impacts, wherein at least part of said zones is provided with an outer protective shell according to claim 1.

7. The garment according to claim 6, wherein the vulnerable areas comprise at least one of a vertebral column, shoulders, elbows, arms, forearms, pectorals, hips, a coccyx, knees, and tibia.

8. The garment according to claim 6, wherein the outer protective shell is joined to a damping layer.

9. The garment according to claim 8, wherein the damping layer consists of either a polymer form, which is naturally aerated or micro-perforated, or a 3D mesh, which is aerated.

10. The garment according to claim 8, further comprising a biometric comfort and hygiene layer.

11. The garment according to claim 10, wherein said biometric comfort and hygiene layer is made either of a 3D mesh joined to breathing meshes, or of low density open cell foam.

12. The garment according to claim 10, wherein the outer shell is joined to the garment by welding, bonding or stitching.

13. The garment according to claim 10, wherein the outer protective shell is capable of sliding with regard to the damping layer, said damping layer being itself capable of sliding with regard to the biometric comfort and hygiene layers.

14. The garment according to claim 6, wherein the outer protective layer is bonded to an elastic support, and defines a plurality of scales independent from one another.

15. A protective cover for an object, wherein on at least part of the surfaces defining it, the protective cover comprises an outer protective shell according to claim 1.

16. The protective cover for an object according to claim 15, wherein the outer protective shell is joined to a damping layer.

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