

**COMPOSITE MATERIALS CAPABLE OF ABSORBING
AN AQUEOUS LIQUID**

5 The present invention relates to the industry of multilayer composites capable of absorbing an aqueous liquid and of swelling, and in particular to two-layer composites and to the articles containing them, such as power cables and hygiene articles.

10 The composites to which the invention relates can be used in various industries. In particular in the industry of power cables, for telephony and optical fibers, and in the industry of hygiene articles for babies, for adult incontinence and for feminine hygiene.

15 The cables comprise at least three distinct parts which are, going from the center to the outside:

- a conducting core,
- an absorbent composite capable of swelling,
- an insulating external layer.

20 Absorbent composites are known and widely used in the cable industry. For this application, they are introduced into the cable to ensure that it is sealed upon accidental water ingress. This is because, when water penetrates the cable following damage to the external layer, the composite absorbs this liquid and, 25 by swelling, prevents the water from propagating.

The composites used in cables are generally based on an absorbent substance in powder form, held between two layers of nonwoven material. Such a 30 composite, called a three-layer absorbent composite, is known and widely described.

For example, EP 0,188,959 describes power cables containing composite materials based on a water-swella-
ble powder, such as modified acrylic polymers, 35 grafted starches, polyacrylamides and carboxymethyl-cellulose, contained between two layers of nonwoven material. Said powder is fixed to the nonwoven by a water-soluble binder.

The three-layer absorbent composites described above pose the problem of the effectiveness of the absorbent powder. This is because the latter remains contained between two layers of nonwoven and cannot
5 swell freely. In addition, empty spaces remain in the cable, into which the water can spread. Consequently, the amount of water that the powder can absorb remains limited. This problem is partly solved by EP 0,378,940 which describes composite materials for cables,
10 comprising a water-swellaable powder and a hot-melt adhesive powder, the powders being sandwiched between a flat support and a partly water-soluble support. On contact with water, the water-soluble support partly dissolves, giving the powder a certain freedom, so that
15 the powder rapidly expands, forming a bulge, and thus prevents the water from propagating. However, despite the presence of the water-soluble support, the freedom of the powder remains partial and its effectiveness limited.

20 The Applicant has now found that this problem can be solved by the use of a two-layer absorbent composite in the cables. This is because the Applicant has found that the freedom of the powder to expand and its effectiveness can be increased by omitting the
25 external layer of the absorbent composite, that is to say by replacing the nonwoven/absorbent powder/nonwoven three-layer composite with a nonwoven/absorbent powder two-layer composite.

The Applicant has also discovered that it is
30 possible to further increase the freedom of the absorbent powder to expand by controlling its distribution and the amount fixed to the nonwoven. This is because the Applicant has found that, when the absorbent powder is distributed at discrete points over
35 the nonwoven and preferably in the form of a monolayer, its freedom to expand and its effectiveness are increased. As, under these conditions, the absorbent powder particles are no longer trapped and form

channels between them which thus facilitate the flow of the liquid and its absorption by the powder.

The first subject of the invention is an absorbent composite capable of swelling, characterized
5 in that said composite consists of two layers: a flexible support based on nonwoven material and at least one absorbent powder fixed to said support by means of a hot-melt adhesive.

In general, the mass of the adhesive is from 2
10 to 100 g per m² of nonwoven and the mass of the absorbent powder is from 5 to 300 g per m².

The nonwoven materials used in the cable industry are generally thermally or chemically bonded nonwoven polyesters, and polyolefins such as
15 polypropylene. These materials may possibly be filled so as to become semiconductors.

The preferred nonwovens for carrying out the invention are polyesters, characterized by a smooth surface and a weight of 10 to 100 g/m², or else filled
20 polyesters having a weight of 50 to 300 g/m².

In general, hot-melt adhesive should be understood to mean a compound consisting of a polymer, of a resin, of an oil or wax and of various additives. The adhesives according to the invention are those
25 described by WO 97/12007.

By way of indication, the adhesives used for implementing the invention are especially self-adhering or non-self-adhering hot-melt adhesives having a melting point close to 150°C and a melt flow index of
30 between 0.5 and 1000. They generally consist of polymers. Among these, polymers based on ethylene and an alkyl acrylate occupy a privileged position. In general, the alkyl acrylate is chosen from methyl acrylate, butyl acrylate and 2-ethylhexyl acrylate.

35 It is also possible, as hot-melt adhesive, to use ethylene-vinyl acetate copolymers or styrene-butadiene-styrene copolymers, or else reactive adhesives such as polyurethanes.

Advantageously, an ethylene-vinyl acetate copolymer characterized by an acetate content of 10 to 45% by weight is used.

5 The adhesive is deposited on the nonwoven with the aid of an etched roll as described later. It partly or completely covers the surface of the nonwoven. When it is desired to give the absorbent powder the maximum freedom to expand, the surface area covered by the adhesive is from 10% to 80% of the total surface area
10 of the nonwoven and represents from 2 to 100 g per m² of nonwoven.

The absorbent powder according to the invention is a natural or industrial powder. It is homogeneous and has a fine particle size.

15 It is generally chosen from the group consisting of modified acrylic polymers, grafted starches, polyacrylamides and cellulose derivatives such as carboxymethylcellulose.

The preferred absorbent powder according to the
20 invention is a powder based on a partially neutralized and crosslinked polyacrylic acid denoted hereafter by SAP. It is characterized by a particle size less than 800 µm and a degree of absorption, of an aqueous solution containing 0.9% NaCl, possibly as high as
25 100 g per g of SAP. This powder may be obtained by various processes, such as those described by FR 2,710,342 and FR 2,732,973.

The absorbent powder must cover at least the entire surface of the adhesive.

30 The amount of powder fixed to the nonwoven is from 5 to 300 g per m² of nonwoven.

The composites of the invention as described above may be used in all applications involving an absorbent powder. By way of indication, mention may be
35 made of power cables, diaper pants for babies, sanitary napkins for adult incontinence and for feminine hygiene.

In general, in these applications, the absorbent powder is trapped between two layers of nonwoven material.

5 The Applicant has discovered that replacing such a system with the two-layer composites of the invention provides, as described above, a certain number of advantages, such as effectiveness of the powder and reduction in the cost.

10 One of the ways of producing the two-layer absorbent composite is the following:

The layer of nonwoven is placed between two rolls, one of them having a smooth surface and the other an etched surface. The nonwoven is moved by the rotation of the rolls. The hot-melt adhesive is melted
15 in a tank placed in direct contact with the etched roll. Thus, the molten adhesive touches the surface of the roll. The latter, by rotating, entrains the molten adhesive and deposits it on the nonwoven. Next, the absorbent powder is sprinkled over the adhesive-coated
20 nonwoven. The etched patterns on the roll control the amount of adhesive deposited on the nonwoven and the area covered, and consequently the amount of absorbent powder fixed.

To improve the effectiveness of the process
25 described above, the following improvements A and B may be applied, together or separately.

- Improvement A

In order to increase the open time of the adhesives (and therefore to allow better adhesion of
30 the absorbent powder (SAP) to the nonwoven), an infra-red (IR) cell may be installed on the trial rig before the SAP is deposited. The key parameter is the temperature released by the IR cell at the composite. The optimum temperature is at approximately 30°C above
35 the softening point of the adhesive.

- Improvement B

A calendering step was added to the trial rig, this having the effect of markedly reducing the dusting of the hot-melt composites.

The calendering consists in making the composite pass between two heated stainless steel rolls while exerting above a pressure: the heat of the rolls allows the adhesive to react and the pressure exerted simultaneously allows the SAP particles to penetrate the spots of adhesive. The SAP is thus better attached to the nonwoven and the natural dusting of the composite is eliminated.

The various key parameters of this improvement are:

- the temperature of the rolls

In this case, the adhesive must be softened but not excessively, in order not to make it diffuse through the nonwoven due to the effect of the pressure exerted by the rolls. An optimum temperature of about 50°C was adopted within the framework of the trials carried out.

- the pressure exerted by the rolls on the composite

Two pressures were studied: 1.403 and 2.105 t.

The composite thus prepared is characterized in the following manner:

- Amount of adhesive

The amount of adhesive is determined by weighing during the manufacture of the composite.

- Amount of absorbent powder (SAP)

The amount of SAP is determined by weighing during the manufacture of the composite.

It may also be determined on the final product by a sodium assay, the SAP (crosslinked acrylic acid-sodium acrylate copolymer) contains a fixed amount of sodium imposed by the degree of neutralization.

Thus, determining, by a specific electrode, the amount of sodium in the composite after extraction and knowing the sodium content of the powder allow the amount of SAP present in the composite to be determined.

- Performance

What is of most interest is to determine the level of swelling of the SAP, measured in the following manner: 0.1 g of SAP is introduced into a container on which a lid is placed. This lid is pierced with holes
5 so as to allow a liquid to pass through it. Next, 100 ml of distilled water are poured in, thereby causing the SAP to swell.

The displacement of the lid (due to the swelling of the SAP) gives a level of swelling in mm.
10 What is of interest is the level of swelling at 1 minute and 3 minutes.

Examples 1 to 6

The composites of Examples 1 to 6 are prepared and characterized as described above.

15 • The products used for producing these examples are:

- nonwoven: either a thermally bonded polyester having a weight of 40 g per m², denoted hereafter by PE I, or a polyester filled with carbon black, having a
20 weight of 65 g/m² denoted hereafter by PE II;

- adhesive of the hot-melt self-adhering type containing 100% active material. It is in the form of self-protected blocks. Its softening point lies between 71 and 81°C. Its liquid form allows constant deposition
25 on the etched roll and homogeneous transfer onto the nonwoven. It essentially consists of a copolymer of the ethylene-vinyl acetate type.

- Superabsorbent powder

The SAPs used are:

30 - individual, non-agglomerated beads having an optimized particle size centered on 280 µm (these being denoted hereafter by TAC 45),

- "cauliflower" beads characterized by a degree of absorption of 70 g/g (these being denoted hereafter
35 by S 35),

- agglomerated beads having a diameter of 450 µm and a degree of absorption of 65 g/g (these being denoted by D 60).

• To produce these examples, two etched rolls were used. One roll, termed A, allows a 25% coverage and an 8 g per m² deposition of adhesive while the other roll, termed B, allows a 19% coverage and a 4.5 g per m² deposition of adhesive.

The following table summarizes the characteristics and the performance of the composites prepared.

Example N°	1	2	3	4	5	6
Nonwoven	PE I	PE I	PE I	PE I	PE II	PE II
Etched roll	A	B	A	A	A	A
SAP used	D 60	D 60	S 35	TAC 45	D 60	S 35
SAP fixed, in g/m ²	182	214	60	63	183	51
1 min. swelling in mm	18.3	17.5	18.1	16	18.2	18.2
3 min. swelling in mm	18.9	18.6	18.1	18.3	19.2	18.2

Example 7

Quantification of the dusting of these composites

The improvement provided by the calendering with regard to the dusting of the composites was quantified using the following test:

Operating method: the surface of the composite (10 cm x 7 cm) is swept with a 3 bar jet of air at a distance of 5 cm. The loss of mass of the composite (representing the SAP which is detached) is determined by weighing.

The results obtained on the composite of Example 1 are combined in the table below.

Sweep time (s)	% loss with respect to the initial mass of the composite	
	Noncalendered composite	Calendered composite (2.105 t)
30	0.05	0.02
60	0.07	0.03
120	0.11	0.03

The calendering therefore markedly improves the retention of the SAP on the nonwoven and practically negligible dusting is observed if the composite is subjected to a 3 bar air jet.



CLAIMS

1. Composite material capable of absorbing an aqueous liquid and of swelling, characterized in that
5 said composite is a two-layer composite containing:
 - a flexible support of nonwoven material,
 - from 5 to 300 g per m² of nonwoven of an absorbent powder fixed to the nonwoven by means of a self-adhering hot-melt adhesive.
- 10 2. Composite according to Claim 1, characterized in that the absorbent powder covers from 10 to 80% of the total area of the nonwoven.
3. Composite according to Claim 1 or 2, characterized in that the absorbent powder is chosen
15 from the group consisting of modified acrylic polymers, such as partially neutralized and crosslinked polyacrylic acid, grafted starches, polyacrylamides and cellulose derivatives, such as carboxymethylcellulose.
4. Composite according to Claim 3, characterized
20 in that the absorbent powder is partially neutralized and crosslinked polyacrylic acid.
5. Composite according to any one of Claims 1 to 4, characterized in that the nonwoven material is a thermally or chemically bonded polyester or a
25 polyolefin such as polypropylene.
6. Composite according to one of Claims 1 to 5, characterized in that the self-adhering hot-melt adhesive is chosen from the group containing:
 - ethylene-vinyl acetate copolymers
 - 30 - styrene-butadiene-styrene copolymers
 - reactive adhesive such as polyurethanes
 - adhesives based on polymers obtained from ethylene and an alkyl acrylate such as methyl acrylate, butyl acrylate or 2-ethylhexyl acrylate.
- 35 7. Composite according to Claim 6, characterized in that the self-adhering hot-melt adhesive is an ethylene-vinyl acetate copolymer.





8. Electrical power or telecommunication cable, characterized in that it contains an absorbent two-layer composite according to one of Claims 1 to 7.

9. Hygiene article such as diaper pants, napkins
5 for adult incontinence and feminine hygiene, characterized in that it contains an absorbent two-layer composite according to one of Claims 1 to 7.

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