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(54) **ELECTRICAL CABLE WITH ANTIMICROBIAL PROPERTIES**

(57) The invention concerns a cable comprising at least one extruded layer, characterized in that the at least one extruded layer comprises metal particles as anti-

microbial agent, said metal particles being embedded in said at least one extruded layer.

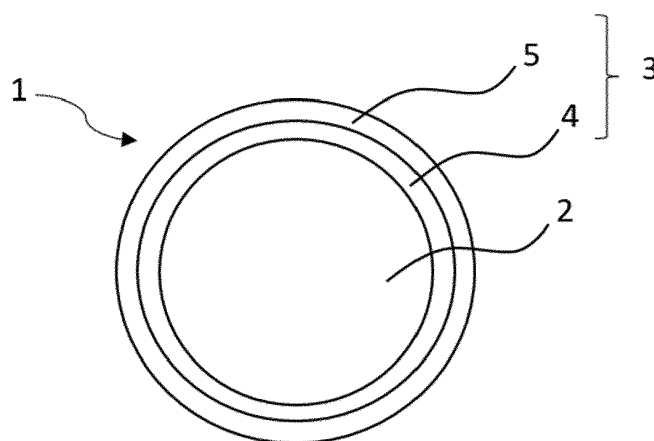


FIG.1

Description

[0001] The invention relates to a cable possessing an extruded layer comprising metal particles as antimicrobial agent.

[0002] Power cable are used in a variety of environments such as outdoor, indoor, submarine or underground environments. In these environments, microorganisms such as bacteria or fungi may growth, mainly at the surface of the cable. Further, in facilities such as in hospital, the cables are exposed to bacteria fungi and virus which may cause diseases when they are manipulated by people. In particular, during installation of such cables, various people manipulate the same cable and may contaminate each other.

[0003] Power cables may be difficult to clean as they may be hardly accessible. Even in the case where the cables are accessible, the cleaning is time consuming and may damage the cable. Therefore, antimicrobial coatings have been developed to avoid or limit the growth of microorganisms on cables.

[0004] Patent application US2015/0090475 discloses a coating for cable based on a liquid composition comprising an antimicrobial additive which is applied to the cable.

[0005] However, such coating is an additional layer applied to the cable which is time consuming and costly. Moreover, such a coating may be damaged by environment conditions, such as sun or humidity, or by frequent manipulations, and may therefore loose its antimicrobial properties overtime.

[0006] There is thus a need to develop cables having antimicrobial properties allowing to avoid the buildup and/or growth of microorganisms, in particular on their surface, despite harsh environment conditions, frequent manipulations and/or the wear overtime.

[0007] It is an object of the present invention to provide a cable comprising at least one extruded layer, characterized in that the at least one extruded layer comprises metal particles as antimicrobial agent, said metal particles being embedded in said at least one extruded layer.

[0008] Thanks to the presence of metal particles, the extruded layer allows to limit or prevent the buildup and/or growth of microorganisms on the cable. The microorganism may be bacteria, viruses, fungi, algae, protozoa, or a mixture thereof.

[0009] The metal particles being embedded in the extruded layer, the antimicrobial action of the metal particles is allowed in the whole thickness of the layer. Therefore, the antimicrobial action of the metal particles is maintained despite the wear overtime of the extruded layer, in particular due to frequent manipulations and harsh environment conditions, and/or damages such as scratching of the surface of the layer. The extruded layer of the present invention is therefore different than prior art coatings which, when damaged, leaves parts of the below layer, which has no antimicrobial properties, uncoated and therefore prone to be contaminated by microorganisms.

[0010] According to an embodiment, the extruded layer may be part of the cable and may have a proper function in addition to its antimicrobial properties. According to this embodiment, the properties of the extruded layer normally present on a cable are improved instead of adding another layer which would be costly and time consuming. The extruder layer is therefore different than a coating layer of the prior art which is added to the cable and has as unique function to protect the cable against microorganisms.

[0011] According to this embodiment, the extruded layer may be chosen among an insulating layer, a semiconducting layer, and jacket and/or a filler. Advantageously, the extruded layer having antimicrobial properties is a layer also used for the functioning of the cable and there is thus no need to cover the cable with an additional layer, such as a coating layer.

[0012] According to a preferred embodiment, the extruded layer is the outermost layer of the cable. According to this embodiment, the extruder layer avoids the buildup and/or growth of microorganisms mainly on the surface layer of the cable (i.e. the outermost layer), the interior of the cable being less exposed to microorganisms.

[0013] According to an embodiment, the extruder layer may comprise metal particles homogeneously spread in the whole thickness of said extruded layer.

[0014] According to another embodiment, the extruded layer may comprise an inner layer which does not comprise any metal particles, said inner layer being surrounded by a skin layer comprising metal particles, the inner layer and the skin layer being formed by coextrusion. According to this embodiment, the inner layer and the skin layer may have the same function and/or the same composition except the presence of metal particles.

[0015] According to an embodiment, the thickness of the extruded layer may range from 0.001 mm (millimeters) to 3 cm (centimeters), preferably from 0.05 mm to 1,5 cm, more preferably from 0,05 to 5 mm, and even more preferably from 0,07 mm to 2 mm. According to this embodiment, the metal particles may be homogeneously spread in the whole thickness of the extruded layer, and not only on the surface thereof. Advantageously, in the case where the extruded layer, and in particular the surface thereof, is damaged or scratched, the extruder layer still possesses antimicrobial properties.

Metal particles

[0016] According to another embodiment, the metal particles may be chosen among particles of copper, silver, mercury, antimony, lead, bismuth, cadmium, zinc, thallium, chromium and one of their mixtures. In the present invention, a metal

particle is a particle of said metal or a particle of a derivative of said metal. A derivative of a metal may be an alloy, an oxide or an ion of said metal, preferably an ion.

[0017] According to a preferred embodiment, the metal particles may be particles of silver or copper. According to a most preferred embodiment, the metal may be particles of copper.

[0018] The metal particles themselves possess antimicrobial properties which are maintained while the particles are embedded in the extruded layer. The extruder layer therefore possesses antimicrobial properties in its whole thickness and also on its surface. Consequently, microorganisms cannot build up and/or growth in contact with any part of the extruded layer.

[0019] According to an embodiment, the quantity of particles in the extruded layer may range from 200 to 40 000 ppm, preferably from 500 to 20 000 ppm, more preferably from 1 000 ppm to 10 000 ppm, and even more preferably 3 000 ppm to 10 000 ppm. Such quantity of metal particles allows the extruded layer to possess optimized antimicrobial properties without its other properties such as electric conductivity, elongation, fire resistance and/or tensile strength..., being affected.

[0020] In the present invention, the term "metal particle" is intended to mean an elementary particle. A collection of elementary particles may be an agglomerate or aggregate of elementary particles, depending on the dimensions.

[0021] According to a preferred embodiment, the metal particles may be microparticles or nanoparticles. In particular, at least one of the dimensions of the metal particles of the invention may be of nanometric size or micrometric size (10^{-9} meter and 10^{-6} meter respectively).

[0022] In particular, the size of the particles may range from 1 nm to 1 000 μm , preferably from 100 nm to 500 μm , more preferably from 500 nm to 100 μm , and even more preferably from 800 nm to 50 μm .

[0023] When considering several metal particles according to the invention, the term "dimension" is intended to mean the number-average dimension of all the metal particles of a given population, this dimension conventionally being determined by methods well known to those skilled in the art.

[0024] The size of metal particles according to the invention can be for example determined by microscopy, in particular by scanning electron microscopy (MEB) or by transmission electron microscopy (MET). More particularly, the size of the metal particles can be determined by MET on at least about twenty images, by preparation of samples of the filling compound type comprising said metal particles, at approximately -140°C with thicknesses of approximately 100 nm, the samples then being positioned on a copper support for the observation by MET. This preparation technique is referred to as cryo-ultramicrotomy.

[0025] At least one of the metal particles, or more particularly the metal particles included in the extruded layer, can have:

- an aspect ratio substantially equal to 1: the term "isodimensional metal particle" is then used, or
- an aspect ratio greater than 1, preferably of at least 10, and preferably of at least 100.

[0026] In the present invention, the aspect ratio is typically the ratio between the largest dimension of a metal particle (such as for example the length of a metal particle when it is of the lamellar or cylindrical type) and the smallest dimension of the metal particle (such as for example the thickness of a metal particle of the lamellar type, or the diameter of a metal particle of the cylindrical type).

Polymeric matrix

[0027] The extruded layer may comprise a polymeric composition wherein the metal particles are embedded.

[0028] According to an embodiment, the polymeric composition may comprise one or more polymers chosen among polyethylene (PE); very low-density polyethylene (VLDPE); low-density polyethylene (LDPE); medium-density polyethylene (MDPE); high-density polyethylene (HDPE); ethylene propylene rubber (EPR); ethylene propylene diene monomer rubber (EPDM); polyvinyl chloride (PVC); polyurethane (PU); chlorinated polyethylene (CPE); polyamide (PA); polypropylene (PP); ethylene-vinyl ester copolymer such as a copolymer ethylene-vinyl acetate (EVA); ethylene-acrylate copolymer such as ethylene-butyl acrylate copolymer (EBA) or ethylene-methyl acrylate copolymer (EMA); an ethylene-alpha-olefin copolymer such as ethylene-octene copolymer (EOC) or ethylene-butene copolymer (EBP); fluoropolymers, in particular chosen among polytetrafluoroethylene (PTFE), fluorinated ethylene propylene copolymer (FEP); and one of their mixtures.

[0029] According to a preferred embodiment, the polymeric composition may comprise at least one polymer chosen among polyethylene (PE), ethylene-vinyl acetate (EVA), polyvinyl chloride (PVC), polyurethane (PU), chlorinated polyethylene (CPE), ethylene butyl acrylate (EBA), ethylene propylene rubber (EPR), polyamide (PA), polypropylene (PP), and one of their mixtures.

[0030] The polymeric composition can typically additionally comprise additives well known to a person skilled in the art, in particular in an amount of 0.1 to 20% by weight in the polymer composition (with respect to the total weight of the polymer composition). Mention may be made, for example, of:

- protective agents, such as antioxidants, UV stabilizers, agents for combating copper or agents for combating water treeing,
- processing aids, such as plasticizers, lubricants, oils, waxes or paraffins,
- compatibilizing agents,
- 5 - coupling agents, such as silane-based compounds,
- scorch retardants,
- pigments,
- crosslinking catalysts,
- crosslinking coagents, such as triallyl cyanurates,
- 10 - anti-rats additives,
- and one of their mixtures.

Cable

15 **[0031]** The cable of the invention may be any cable having at least one extruded layer such as a power cable (low voltage, medium voltage or high voltage), an optic fiber cable, a building wire and cable, a flexible cord, a portable mining cables, or the like.

[0032] In particular, the cable may be any cable comprising a conductor and an extruded insulation layer and/or jacketing layer.

20 **[0033]** According to an embodiment, the conductor may be a mono-conductor such as a metal wire, or a multiconductor such as a plurality of metal wires which may be twisted or not. The metal may be for example copper, aluminum, steel or stainless steel.

[0034] According to another embodiment, the conductor may be an optical fiber or a plurality of optical fibers.

[0035] According to an embodiment, the cable is a power cable comprising an elongated conductor.

Process

[0036] It is another object of the present to provide a process to manufacture the cable according to the invention, the process comprising:

- mixing metal particles and a first composition to form a second composition wherein the metal particles are embedded, and
- forming the extruded layer by extrusion of said second composition.

35 **[0037]** Advantageously, the process is similar to the process classically used to manufacture an extruded layer despite the presence of metal particles.

[0038] According to an embodiment, the constituent compounds of the polymer composition of the invention (polymer(s), additives, ...) can be mixed, in particular with the polymer material in the molten state, in order to obtain the first composition in the form of a homogeneous mixture.

40 **[0039]** The metal particles and the first composition are then mixed to form the second composition wherein the metal particles are embedded homogeneously.

[0040] The temperature within the mixer can be sufficient to obtain the second polymer composition in the molten state but is limited in order to prevent the crosslinking of the polymer composition. The homogeneous mixture is then granulated by techniques well known to a person skilled in the art. These granules can subsequently feed an extruder in order to form the extruded layer as a tube, as a layer surrounding a conductor, or as a plate.

[0041] The composition at the extruder outlet may be crosslinked or noncrosslinked.

45 **[0042]** In the case where the cable is a power cable, there is thus obtained, at the extruder outlet, a layer extruded around said elongated electrical conductor which may or may not be directly in physical contact with said elongated electrical conductor.

[0043] Of course, the types of processing in the invention are in no way limiting and can be adapted by a person skilled in the art according to the polymer material used.

[0044] Other features and advantages will become apparent during the course of the following description, given solely by way of nonlimiting example and made with reference to the attached drawings in which:

- Figure 1 is a schematic cross-sectional view of a cable according to an embodiment of the invention.

55 **[0045]** For clarity reasons, only essential elements necessary to the comprehension of the invention will be represented

schematically and without respecting the scale.

[0046] As illustrated on figure 1, a cable 1 comprises a conductor 2 surrounded by an insulating layer 3, said insulating layer comprising an inner layer 4 and a skin layer 5.

[0047] The conductor 2 is a mono-conductor made of copper having a section of 1.5 mm².

[0048] The inner layer 4 and the skin layer 5 have the same polymeric composition which comprises 100% of EVA and differ in that the skin layer 5 comprise 5000 ppm of copper particles commercialized by PlastiCopper under the reference NanoCu PCZ001. The inner layer 4 has a thickness of 0.70 mm and the skin layer 5 has a thickness of 0.03 mm.

[0049] The inner layer 4 and the skin layer 5 are coextruded at a temperature which ranges from 130°C to 170°C, the speed of extrusion for the inner layer 4 ranging from 30 to 50 rpm and the speed of extrusion for the skin layer 5 ranging from 5 to 20 rpm. The speed of line during extrusion process ranges from 100 m/min to 800 m/min.

[0050] Cable 1 corresponds to a cable of type H07Z1-K-having a cross-section of 1.5 mm². Insulating layer 3 is prepared with a EVA composition commercialized by VICOM under the reference CF-410-3S.

Examples

Example 1 : Test regarding cable 1 properties

[0051] Test were performed on the following cables:

- Cable 1;
- Cable 2 which is a cable of type H07Z1-K-having a cross-section of 1.5 mm² and having an insulating layer prepared with a composition commercialized by Cabopol under the reference HZ02DE (comparative example); and
- Cable 3 which is a cable of type H07Z1-K-having a cross-section of 1.5 mm² and having an insulating layer prepared with a composition commercialized by VICOM under the reference CF-410-3S (comparative example).

[0052] The results of the tests are reported in table 1.

Table 1

Test	Features	Requirement	2	3	1
Dimensional control	Insulation thickness, minimum (mm)	0.5	0.76	0.79	0.76
	External diameter, range (mm)	2.8-3.4	3.1	3.1	3.1
Insulation resistance at 70°C	Resistance, minimum (MΩ*km)	0.01	12.4	13.7	12.5
Cold impact test (-15°C)	Shall show no cracks		ok	ok	ok
Test for vertical flame propagation for a single cable	Flame application time	See 5.4.2	60s	60s	60s
	Distance between the lower edge of the top support and the onset of charring, minimum (mm)	50	370	390	375
	Distance between the lower edge of the top support and the lower part of charring, minimum (mm)	540	475	475	490
Test for vertical flame spread (category C)	Flame application time	20 min			
	Flame spread, maximum (m)	2.5	1.2	0.8	0.8
Acid gas generation	pH, minimum	4.3	6.5	6.5	5.9
	Conductivity, maximum (μS/mm)	10	1.0	0.8	0.8

[0053] As indicated by the tests reported in table 1, the presence of copper particles in the insulating layer does not affect the physical properties of cable1 compared to equivalent commercialized cable.

Example 2: Antibacterial tests and antiviral test on plates having the same composition of skin laver 5Preparation of samples of polymeric composition with copper particles

[0054] The samples are plates prepared by melting a polymeric composition of EVA commercialized by VICOM under the reference CF-410-3S and mixing said composition with copper particles in a hot mill. The obtained composition is cooled down in plate shape.

[0055] The plates are a square of 4 cm on a side and having a thickness of 2 mm.

[0056] Two types of copper particles have been tested:

- copper particles A which are metallic microparticles commercialized by ADITOP under the reference MB Antimicrobiano9900, and
- copper particles B are commercialized by Plasticopper under the reference NanoCu PCZ001.

[0057] The size of copper particles A and B is in the range of 1 to 20 μm .

[0058] In all the samples, the polymer composition is identical and the samples differ by the type and amount of copper particles.

[0059] In samples 1, 2, 3, the polymer composition comprises respectively 1000 ppm, 3000 ppm and 5000 ppm of copper particles A.

[0060] In samples 4, 5, 6, the polymer composition comprises respectively 3000 ppm, 5000 ppm and 10000 ppm of copper particles B.

[0061] In sample 7 (control), the polymer composition does not comprise any metal particles.

Evaluation of the antimicrobial properties of the samples 1 to 7

[0062] Antibacterial activity of sample 1 to 7 was evaluated using the standard method ISO 22196 using E. Coli ATCC 25922 as microorganisms.

[0063] Samples 1 to 7 were placed in contact with 0.4 milliliters of a standard inoculum of E. Coli ATCC 25922 during 0, 3 and 24 hours at 35°C under aerobic atmosphere. A standard inoculum has a concentration of 5.0×10^5 UFC/ml, the culture medium being agar Conkey. The results obtained are presented in Table 2

Table 2

Sample	Exposition time (h)	UFC/cm ²	Log10	Activity A value ⁽¹⁾	Reduction %
control	0	2 E+03	3.3	-	
	3	8 E+02	2.9	-	
	24	1 E+05	5.0	-	
1	3	6 E+02	2.8	0.4	-
	24	5 E+03	3.7	2.3	95.0
2	3	2 E+02	2.3	0.4	-
	24	5 E+03	3.7	2.3	95.7
3	3	4 E+02	2.6	0.4	-
	24	2 E+03	3.3	2.7	97.9
4	3	8 E+02	2.9	0.1	-
	24	2 E+03	3.2	2.8	98.4
5	3	8 E+02	2.9	0.0	-
	24	3 E+01	1.4	4.6	99.9
6	3	2 E+02	2.3	0.7	-
	24	6 E+00	0.8	5.2	99.9
(1) A = F - G, with F = bacterial proliferation in the control (Log10) and G = bacterial proliferation in the experiment (Log10)					

[0064] The results presented in table 2 show that after 24h in contact with the samples 1 to 6 the bacteria are almost totally eliminated.

Evaluation of the antiviral properties of the EVA samples 5

[0065] Evaluation of antiviral properties of sample 5 was performed using method ISO 21702 using Betacoronavirus Human 1 (OC43), at 20°C in HTC-8 cells. The calculation of mortality was performed using Spearman Karber method.

[0066] An aliquote of 400 µL of virus (106 PFU) was spread on the surface of sample 5 and the surface was then covered by a polyethylene protection film. The aliquote was left in contact with the sample for 12h hours and then neutralized with 4 mL of SCDLP and retrieved in a tube Eppendorf (Solution A). The solution A was then diluted seven times (10^{-1} to 10^{-7}) to give seven sample of virus A1 to A7.

[0067] Seven culture cells (HTC-8) were then inoculated with virus samples A1 to A7 and the cytopathic cell lysis was then evaluated for each sample.

[0068] The results of the control viral recuperation is presented in table 1. This control corresponds to sample A1 to A7 left 12 hours on plate of EVA which do not comprise any copper nanoparticles.

Table 3

Virus sample	% Mortality t = 0h	% Mortality t = 12h
Control cells	-	-
A1	0%	91.2%
A2	0%	92.5%
A3	0%	92.5%
A4	1%	73.7%
A5	1%	73.6%
A6	3%	74.3%
A7	0%	70.6%
TCDI 50/100µL	-	$10^{6.19}$
TCDI 50/surface	-	$10^{6.79}$

[0069] The results of cellular mortality when sample A1 to A7 was left 12 hours on sample 5 according to the invention, i.e. a sample comprising copper particles, are presented in table 2.

Table 4

Virus sample	% Mortality t = 0h	% Mortality t = 12h
Control cells	-	-
A1	1%	90.6%
A2	1%	75.0%
A3	0%	29.2%
A4	0%	24.8%
A5	0%	7.9%
A6	0%	7.7%
A7	2%	6.5%
TCDI 50/100µL	-	$10^{2.92}$
TCDI 50/surface	-	$10^{3.52}$

[0070] According to norm ISO 21702, the value X of (TCDI 50/100µL - TCDI 50/surface) should be of at least 3.52 to show a reduction of viral load of 99.9%.

[0071] In the test with the sample according to the invention, the value X is of 3.27 which indicates that the viral load was reduced of more than 99.9% after 12 hours on the sample of the invention.

[0072] Therefore, the invention allows to obtain a cable having antimicrobial properties while maintaining optimized physical and electrical properties of said cable.

Claims

1. A cable comprising at least one extruded layer, **characterized in that** the at least one extruded layer comprises metal particles as antimicrobial agent, said metal particles being embedded in said at least one extruded layer.
2. The cable according to claim 1, **characterized in that** the metal particles are chosen among particles of copper, silver, mercury, antimony, lead, bismuth, cadmium, zinc, thallium, chromium, and one of their mixtures.
3. The cable according to claim 1 or 2, **characterized in that** the metal particles are copper particles.
4. The cable according to one of the preceding claims, **characterized in that** the quantity of metal particles in the extruded layer ranges from 200 to 40000 ppm, preferably from 500 to 15000 ppm, preferably from 1000 ppm to 10000 ppm.
5. The cable according to one of the preceding claims, **characterized in that** the metal particles are microparticles or nanoparticles.
6. The cable according to one of the preceding claims, **characterized in that** the size of the metal particles ranges from 1 nm to 1000 μm , preferably from 100 nm to 500 μm , and more preferably from 500 nm to 100 μm .
7. The cable according to one of the preceding claims, **characterized in that** the extruded layer comprises a polymeric matrix wherein the metal particles are embedded.
8. The cable according to claim 7, **characterized in that** the polymeric matrix comprises at least one polymer chosen among polyethylene (PE), ethylene-vinyl acetate (EVA), polyvinyl chloride (PVC), polyurethane (PU), chlorinated polyethylene (CPE), ethylene butyl acrylate (EBA), ethylene propylene rubber (EPR), polyamide (PA), and one of their mixtures.
9. The cable according to one of the preceding claims, **characterized in that** the extruded layer is the outermost layer.
10. The cable according to one of the preceding claims, **characterized in that** the extruded layer is chosen among an insulating layer, a semiconducting layer, and jacket.
11. The cable according to one of the preceding claims, **characterized in that** said cable is a power cable, an optic fiber cable, a building wire and cable, a flexible cord or a portable mining cable.
12. The cable according to one of the preceding claims, **characterized in that** said cable is a power cable comprising an elongated conductor surrounded by the extruded layer.
13. The cable according to one of the preceding claims, **characterized in that** the extruded layer have a thickness ranging from 0.001 mm to 3 cm.
14. A process to manufacture the cable according to claims 1 to 13, **characterized in that** it comprises:
 - mixing metal particles and a first composition to form a second composition wherein the metal particles are embedded, and
 - forming the extruded layer by extrusion of said second composition.
15. The process of claim 14, **characterized in that** the extruded layer is performed around an elongated conductor.

Amended claims in accordance with Rule 137(2) EPC.

1. A cable comprising at least one extruded layer, **characterized in that** the at least one extruded layer comprises metal particles as antimicrobial agent, said metal particles being embedded in said at least one extruded layer, the size of meta particles ranging from 100 nm to 1000 μ m.
2. The cable according to claim 1, **characterized in that** the metal particles are chosen among particles of copper, silver, mercury, antimony, lead, bismuth, cadmium, zinc, thallium, chromium, and one of their mixtures.
3. The cable according to claim 1 or 2, **characterized in that** the metal particles are copper particles.
4. The cable according to one of the preceding claims, **characterized in that** the quantity of metal particles in the extruded layer ranges from 200 to 40000 ppm, preferably from 500 to 15000 ppm, preferably from 1000 ppm to 10000 ppm.
5. The cable according to one of the preceding claims, **characterized in that** the metal particles are microparticles or nanoparticles.
6. The cable according to one of the preceding claims, **characterized in that** the size of the metal particles ranges from 100 nm to 500 μ m, and more preferably from 500 nm to 100 μ m.
7. The cable according to one of the preceding claims, **characterized in that** the extruded layer comprises a polymeric matrix wherein the metal particles are embedded.
8. The cable according to claim 7, **characterized in that** the polymeric matrix comprises at least one polymer chosen among polyethylene (PE), ethylene-vinyl acetate (EVA), polyvinyl chloride (PVC), polyurethane (PU), chlorinated polyethylene (CPE), ethylene butyl acrylate (EBA), ethylene propylene rubber (EPR), polyamide (PA), and one of their mixtures.
9. The cable according to one of the preceding claims, **characterized in that** the extruded layer is the outermost layer.
10. The cable according to one of the preceding claims, **characterized in that** the extruded layer is chosen among an insulating layer, a semiconducting layer, and jacket.
11. The cable according to one of the preceding claims, **characterized in that** said cable is a power cable, an optic fiber cable, a building wire and cable, a flexible cord or a portable mining cable.
12. The cable according to one of the receding claims, **characterized in that** said cable is a power cable comprising an elongated conductor surrounded by the extruded layer.
13. The cable according to one of the preceding claims, **characterized in that** the extruded layer have a thickness ranging from 0.001 mm to 3 cm.
14. A process to manufacture the cable according to claims 1 to 13, **characterized in that** it comprises:
 - mixing metal particles and a first composition to form a second composition wherein the metal particles are embedded, and
 - forming the extruded layer by extrusion of said second composition.
15. The process of claim 14, **characterized in that** the extruded layer is performed around an elongated conductor.

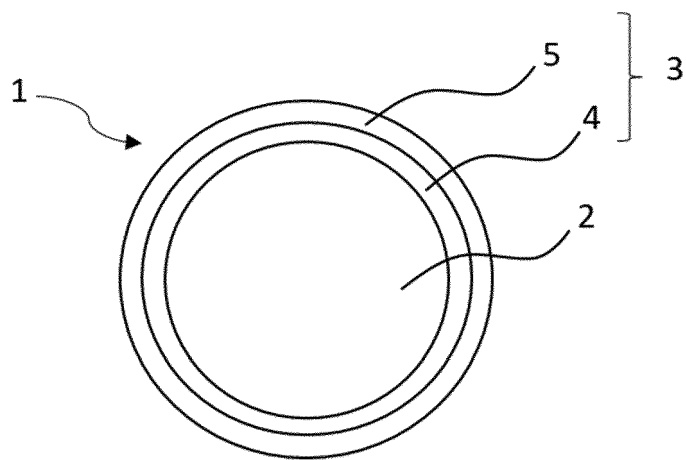


FIG.1



EUROPEAN SEARCH REPORT

Application Number
EP 21 30 5562

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 21 September 2021	Examiner Lehnert, Andreas
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

 1
EPO FORM 1503 03.02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 21 30 5562

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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