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Method for the preparation of a composite material and articles thereof

Field of the invention

5 The present invention relates to a method of preparing a composite material from mica and an organic polymer, which has increased tensile strength, elasticity and/or reduced thickness. Further, the composite can be used in the manufacture of articles such as gloves, condoms and other related rubber based composite materials.

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Background of the invention

To date, rubber is used for many purposes. One of them is in the manufacture of gloves and condoms. Gloves are useful in many applications. One of the more important functions of gloves is in the medical field. Medical practitioners, to avoid causing infections to their patients and also to prevent themselves from coming into contact with harmful bacteria and viruses, wear gloves. For this reason, there is a need for the gloves to be resistant to tearing and total elimination of "pin-holes". Many gloves are also quite thick for this reason. However, the problem with wearing thick gloves is that it will reduce the sensitivity of the hands, which can pose as a major problem especially for surgeons. A further problem posed by gloves available in the market is that sometimes the inner surfaces tend to stick together, making it really difficult to slip the gloves on and as a result they often tear.

25 Similar problems are also encountered when using condoms. There is a need for condoms to be strong and resistant to avoid tearing, which would defeat its purpose.

Summary of the invention

The present invention addresses the problems above. The invention provides a process for the preparation of a composite material comprising the steps of:

- 5 a) providing mica;
- b) mixing the mica with an organic polymer; and
- c) subjecting the mixture to curing.

According to one aspect of the invention, the organic polymer used is natural
10 and/or synthetic rubber, in particular, rubber latex.

The other key component for the process of the present invention is mica. In particular, the present invention provides for a process comprising mica having a surface electrical potential of $-16 \text{ PCD } \mu\text{eg/Kg}$ or more negative.
15 More in particular, the charge potential is $-48.4 \text{ PCD } \mu\text{eg/Kg}$. A further characteristic of the mica according to the invention is that it has an electrical conductivity of at least 73 mmho/cm . In particular, the electrical conductivity is 92.6 mmho/cm . Yet another feature of the mica of the invention is that it has an average aspect ratio in the range of 15:1 to 500:1. In particular, the
20 average aspect ratio is 40:1. This aspect ratio represents an average of an entire population of mica.

According to a particular aspect, the average particle size of mica is in the range of 0.01 to $30 \text{ } \mu\text{m}$, in particular, $5 \text{ } \mu\text{m}$. The particle size may be
25 reduced by including an additional step in the process of the present invention. The particle size reduction can be achieved by, but not limited to, compression, impact, attrition, rubbing, cutting and/or milling.

A further aspect of the invention is that the chemical composition of mica comprises 50-56% SiO_2 , 32-40% Al_2O_3 , 4-10% K_2O , and optionally impurities such as N_2O (0.3-0.5%), MgO (0.1-0.3%), CaO (0.2-0.5%) and Fe_2O_3 (0.4-1.0%). An example of mica that is suitable for the present invention is sericite.

According to another aspect, the proportion of mica added in step b) is from 1-50% of the total mixture. In particular, 10% of the total mixture is made up of mica. The invention may also comprise of an additional step of adding CaNO_3 to the mixture of step b). The amount of CaNO_3 added is between 0 and 10% of the total volume of the mixture.

A further feature of the present invention is the process of curing that is carried out. It is typically carried out between a temperature of 90-120°C for a period of 20 to 90 minutes.

Another aspect of the present invention is a composite prepared from the process of the present invention. This composite has special characteristics such as a high tensile strength and elasticity. In particular, the tensile strength is 15-25 MPa, the elongation at break is 700-1000 % and the elastic modulus at 100% elongation (M100) is: 0.5-0.9 MPa; at 300% elongation (M300) is: 1.6-2.1 MPa; and at 500% elongation (M500) is: 4.0-4.8 MPa.

A further aspect of the invention is an article of manufacture made of the composite prepared by the process of the present invention. These articles of manufacture comprise of, but are not limited to, gloves and condoms.

The present invention also covers a method of manufacturing an article using the composite prepared by the process of the invention. For example, the

5 Figure 1 : Structure of sericite

 Figure 2 : Effect of filter loading on thickness of composite. Filter loading
 is defined as the number of parts of mica added per 100 parts
 of rubber, by weight. The unit is phr.

10 Figure 3 : Effect of filter loading on tensile strength. Filter loading
 is defined as the number of parts of mica added per 100 parts
 of rubber, by weight. The unit is phr.

 Figure 4 : Effect of filter loading on elastic modulus at 100%, 200% and
 300% elongation, denoted as M100, M200 and M300
 respectively. Filter loading is defined as the number of parts of
15 mica added per 100 parts of rubber, by weight. The unit is phr.

One aspect of the present invention relates to a process for the preparation of a composite material which has improved mechanical properties. The process comprises the following steps:

- 25

Mica is a generic term applied to a group of complex aluminosilicate minerals having a sheet- or plate- like structure with different composition and physical properties. All mica form flat six-sided monoclinical crystals with a remarkable

cleavage in the direction of large surfaces, which permits them to easily split into optically flat films. Mica possesses some of the most outstanding combinations of chemical, physical, electrical, thermal and mechanical properties, which are not found in many other compounds.

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Particularly suitable for the method of the present invention is mica with a negative surface electrical potential. Surface electrical potential can be measured in many ways by correlation to other measures of charge. For the present invention, the surface electrical potential was obtained by measuring
10 the charge potential (surface charge density) using the Zeta Potential Analyzer manufactured by the Brookhaven Instruments Ltd. UK. However, another way of measuring the charge potential is polyelectrolyte titration with a Particle Charge Detector (PCD) by Mutek Inc.

15 The charge potential for mica that is appropriate for use in the process of the invention is -16 PCD $\mu\text{eg/Kg}$ or more negative. In particular, the charge potential is between -16 and -70 PCD $\mu\text{eg/Kg}$. More in particular, the charge potential is between -30 and -50 PCD $\mu\text{eg/Kg}$. The units for the charge potential refer to micro equivalent per kg of material. The mica compound
20 used in Example 1 and shown in Table 1, and Figures 2 to 4 has a charge potential of -48.4 PCD $\mu\text{eg/Kg}$. A comparison of the charge potential of mica with some other compounds (namely talc, ground calcium carbonate (GCC) and kaoline) is shown in Table 1. Mica has a negative surface charge due to its structure. Mica has a very layered structure as can be seen in Figure 1 with
25 the highly crystalline $\text{Al}_2\text{O}_3\text{-SiO}_2$. The negative charge is due to the substitutions in the mica crystal structure. The substitution of Al^{3+} for Si^{4+} in the tetrahedral sheet and of Mg^{2+} for Al^{3+} in the octahedral sheet both cause the surface of the layer to have a negative charge.

A particularly suitable mica according to the invention is mica with an electrical conductivity of at least 73 mmho/cm. In particular, the electrical conductivity is 73-150 mmho/cm. More in particular, the conductivity is 80-100 mmho/cm. The mica used in Example 1, and shown in Table 1 and Figures 2 to 4 has a conductivity of 92.6 mmho/cm. Electrical conductivity is the reciprocal of the resistivity of a material. The unit for electrical conductivity is siemens per unit length. Another unit of measure is millimhos per unit length. Both measures are equivalent, i.e. 1 mS/cm = 1 mmho/cm. It is measured by a sensor that consists of two metal electrodes exactly 1.0 cm apart and protrude into the mixture of water and compound whose electrical conductivity is to be measured. A constant voltage (V) is applied across the electrodes. An electrical current (I) flows through the water due to this voltage and is proportional to the concentration of dissolved ions in the water - the more ions present, the more conductive the water, resulting in a higher electrical current which is measured electronically. Distilled or deionized water has very few dissolved ions and so there is almost no current flow across the gap (low EC). A comparison of the charge potential of mica with some other compounds (namely talc, ground calcium carbonate (GCC) and kaoline) is shown in Table 1. The instrument used to measure the electrical conductivity for the purposes of the present invention was the ZetaPlus (Brookhaven Instruments Ltd, <http://www.brookhaven.co.uk/products/zeta-potential/colloidal-particles/zetaplus.html>).

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Table 1: Table showing the charge potential and electrical conductivity of some compounds

	Mica	Talc	GCC	Kaoline
Charge potential (PCD $\mu\text{eg/Kg}$)	-48.4	-15.7	-1.9	-1.1
Conductivity (mmho/cm)	92.6	48.3	44.8	72.5

- 5 The mica used in the present invention may be obtained in the form of particles or may be reduced in the form of particles. Therefore, another particular aspect of the present invention is that the average particle size of mica is between 0.01 to 30 μm . In particular, the average particle size is 1-15 μm . More in particular, the average particle size is 3-10 μm . Even more in particular, the size is 5 μm .

The present invention further comprises an additional step of reducing the average particle size of mica by compression, impact, attrition, rubbing, cutting and/or milling. The term size reduction as used herein refers to any
 15 suitable way in which particles of solids are cut or broken into smaller pieces. In general, compression is used for coarse, medium, or fine products; attrition yields very fine products from soft, nonabrasive materials. Cutting gives a definite particle size and sometimes a definite shape, with few or no fines. Sometimes, size reduction results from the attrition of a particle by one or
 20 more other particles or from intense shear in the supporting fluid.

Some examples of size reduction equipment include crushers, grinders, ultrafine grinders, and cutting machines. Crushers do the heavy work of breaking large pieces of solid material into small lumps. Grinders reduce
 25 crushed feed to powder. An ultrafine grinder accepts feed particles no larger than 6 mm; the product size is typically 1 to 50 μm . Cutters give particles of definite shape and size, 2 to 10 mm in length.

- According to a further aspect, the mica of the invention may have an average aspect ratio from 15:1 to 500:1. In particular, the average aspect ratio is from 20:1 to 50:1. Even more in particular, the average aspect ratio is 40:1. Aspect ratio is defined as the ratio of the diameter of the particle to the thickness. Average aspect ratio refers to the average of an entire population of mica. In a situation where the particle is not uniform, the aspect ratio is obtained by measuring the largest diameter of the particle to the thickness.
- Any mica of any composition suitable for the purpose of the present invention may be used. According to a particular aspect, the composition of the mica comprises 50-55% SiO_2 , 32-40% Al_2O_3 , 4-10% K_2O , and optionally impurities. In particular, the composition of SiO_2 is 52%, that of Al_2O_3 is 35% and that of K_2O is 6%. The other impurities are MgO (0.1-0.3%), N_2O (0.3-0.5%), CaO (0.2-0.5%), Fe_2O_3 (0.4-1.0%, preferably 0.7%). The mica described in the Example 1 is natural mica. However, any synthetic mica having the characteristics of the mica according to the invention is within the scope of the present invention.
- According to another aspect, the type of mica that may be used is sericite. However, any type of mica that is suitable for use in the present invention is acceptable. Sericite may consist of finely grounded mineral particulates which have a pearl lustrous appearance. It is also known as potash-mica. Sericite is a much softer form of mica and it is therefore much easier to grind it into a smaller particulate size. Another feature of sericite that makes it suitable for the present invention is that it consists of about 3000 or more layers of aluminium oxide and silica oxide complex with a very specific molecular alignment. As a result of this, sericite has a highly negative surface charge.

Any organic polymer known in the art, or developed in future, which may be mixed with mica for the preparation of the composite material of the invention, may be used and is within the scope of the present invention. For example, the organic polymer may be natural and/or synthetic rubber, in particular, rubber latex. Natural rubber comes from rubber trees. Rubber trees are either native trees (those that grow naturally) or hybrid trees that have been organised in a rubber plantation. Latex output is usually much greater from hybrid rubber trees. Latex is the white, milky liquid that flows from the tree when the tree bark is scored or shaved and flows into a collection device that is attached to the tree.

Increasingly, many kinds of synthetic rubber are being produced. For example, synthetic rubber comprises of polyisoprene, polyurethane, polybutadiene, emulsion-styrene butadiene rubber, acrylonitrile-butadiene rubber, polystyrene, polyacrylate, epoxide resins. For the purposes of the present invention, any suitable synthetic rubber can be used. There are various methods describing how to make synthetic rubber (US Patents 6,673,871 and 6,613,838 herein incorporated by reference). Polyisoprene is one of the most preferred polymers due to its chemical similarity to natural rubber as well as its physical properties such as feel, softness, modulus, elongation and tensile strength (as described in US Patent Application 20020173563, herein incorporated by reference).

The mica and organic polymer are mixed in step b) of the process of the invention. After mixing, the mica particles penetrate the emulsion organic polymer micelle and form a stable mixture. In particular, a mica particulate/rubber polymer mixture is obtained. The high negative surface energy of the mica pulls the rubber polymer chains containing the unsaturated double bonds towards the mica and form a tight seamless interface between the two components. Through the transfer of surface charge, the mica is then

able to promote further cross-linking (i.e. additional polymerisation) for the rubber polymer. This results in a bigger molecule being formed with a higher degree of cross-linking.

5 As a particular embodiment, the proportion of mica added in step b) is from 1-50% of the total mixture. In particular, from 3-15% and more in particular, 10%. In addition to mica and organic polymer, the process may further comprise a step of adding calcium nitrate, CaNO_3 to the mixture of step b). The CaNO_3 acts as a coagulant, which converts the liquid organic polymer
10 into a wet-gel. In particular, the amount of CaNO_3 added is between 0 and 10% of the volume of the total mixture. Calcium nitrate is a good source of multivalent cationic ions. However, any other metal salt which is suitable for use for the present invention may be used. These include, but are not limited to, aluminium nitrates, calcium chloride, zinc nitrate, magnesium nitrate,
15 magnesium chloride and the like.

The method of the invention further comprises subjecting the mixture of step b) to curing. This step is carried out at any suitable or standard temperature for the curing process. For example, step c) of the method of the invention is
20 carried out at a temperature between 90 and 120°C for a period of 20-90 minutes. During the curing stage, the mica particles get embedded inside the polymer matrix and therefore become a part of the entity of the polymer and form a composite. It should be noted that the mica added is not affected by the thermal processing as mica can resist high temperatures of 600 to 900°C,
25 depending on the type of mica. Further, mica has a low heat conductivity and excellent thermal stability and therefore it may be exposed to high temperatures without showing any noticeable effect.

Curing is also known as vulcanisation. Curing produces chemical links
30 between loosely coiled polymeric chains and renders the organic polymer

impervious to moderate heat and cold. In the case where the organic polymer is rubber, various other compounds are added during the curing process. The additional compounds that need to be added would be known to someone skilled in the field of rubber processing. For example, hard rubber is cured
5 rubber in which 30% to 50% of sulphur has been mixed before heating; soft rubber usually contains less than 5% of sulphur. After the sulphur and rubber (and usually an organic accelerator, e.g., an aniline compound, to shorten the time or lower the heat necessary for curing) are mixed, the compound is usually placed in moulds and subjected to heat and pressure. The heat may
10 be applied directly by steam, by steam-heated moulds, by hot air, or by hot water. Curing can also be accomplished with certain peroxides, gamma radiation, and several other organic compounds. The finished product is not sticky-like raw rubber, does not harden with cold or soften much except with great heat, is elastic, springing back into shape when deformed instead of
15 remaining deformed as unvulcanized rubber does, is highly resistant to abrasion and to gasoline and most chemicals, and is a good insulator against electricity and heat (Fred Ignatz-Hoover, *Review of vulcanization chemistry*, Rubber World, 8/1/1999).

20 According to another aspect, the invention provides a composite prepared by the process described above. The composite can be further cured or cross-linked. The composite prepared has many advantageous physical qualities such as improved tensile strength and/or elasticity. In addition to this, the composite is also very thin (Figure 2). The improvement in tensile strength
25 can be seen in Figure 3. Filter loading refers to the amount of mica added (in parts) per 100 parts of rubber by weight, denoted by the units 'phr'. This has been defined in US Patent Application 20040069388, herein incorporated by reference. The elastic modulus has also increased as a result of the addition of mica, as can be seen from Figure 4. These characteristics are shown
30 because the load bearing effect of the organic polymer (i.e. rubber) is now

shared with the mica particles incorporated in the polymer. The equipment used in measuring the tensile strength is the conventional INSTRON Material test systems, manufactured by Wilsons Instruments Instron Corporation, Canton, Ma. USA.

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Tensile strength is an important characteristic for a material that is going to be stretched or comes under tension. The tensile strength of a material is the maximum amount of tensile stress that can be applied to it before it ceases to be elastic. To measure tensile strength, a sample of the polymer to be measured is stretched using a machine such as Instron. This machine clamps each end of the sample and stretches the sample. While the sample is being stretched, the machine measures the amount of force (F) that it is exerting. The force being exerted on the sample is then divided by the cross-sectional area (A) of the sample to give the stress (σ).

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$$\frac{F}{A} = \sigma$$

The amount of force exerted is increased until the sample breaks. The stress needed to break the sample is the tensile strength of the material.

Elongation is another important characteristic, which in many cases complements the information provided by the tensile strength. Tensile strength only provides information regarding the amount of stress needed to break something. On the other hand, elongation is a type of deformation, deformation being a change in shape to anything that undergoes stress. Elongation is usually measured in terms of a percentage, where the length of the polymer sample after it is stretched (L) is divided by the original length (L_o) of the sample and then multiplied by 100.

25

$$\frac{L}{L_o} \times 100 = \%elongation$$

Another type of measure is the elastic modulus. The elastic modulus measures how well a material can resist deformation. It is calculated by dividing the stress by the elongation.

5 The composite of the present invention has a tensile strength preferably of 15-25 MPa, elongation at break preferably of 700-1000% and elastic modulus preferably of 0.5-0.9 MPa at 100% elongation (M100), 1.6-2.1 MPa at 300% elongation (M300) and 4.0-4.8 MPa at 500% elongation (M500).

According to another aspect, the present invention provides articles of manufacture made of the composite prepared by the process of the invention.
10 The articles of manufacture can be rubber gloves or condoms. However, the composite can be used for manufacturing any article that needs to be strong and/or elastic. It will also be advantageous in the production of thin-walled articles.

The present invention also provides a method of manufacturing an article
15 using the composite prepared by the process described above. In particular, the method of manufacturing gloves and/or condoms. However, the composite may be used in any suitable method for the production of an article of manufacture, in which the article needs to be strong, elastic and/or thin. For example, the method according to this embodiment includes the methods
20 described by US Patents 4,817,593; 6,673,404; US Patent Application 20030216701, herein incorporated by reference.

The articles of the invention are particularly advantageous compared to similar articles known in the art such as gloves and condoms. For example,
25 gloves and condoms that are made from the composite material prepared by the method of the present invention are more able to withstand stress as its tensile strength is higher. The articles of the invention can also be stretched to a large extent without tearing. Another advantage is that the resulting gloves

and condoms that are made are thin. This increases sensitivity, which is important especially in the case of gloves worn by medical practitioners. Also, even though the resulting articles are thin, they are still able to withstand stress and be stretched without tearing. Further, the problem of the inner
5 surfaces of gloves sticking together, making it difficult to put the gloves on, is also overcome as gloves made using the composite material prepared from the process of the invention do not have sticky inner surfaces and have a smooth texture.

10 Having now generally described the invention, the same will be more readily understood through reference to the following examples, which are provided by way of illustration, and are not intended to be limiting of the present invention.

15

Examples

Example 1

Mica, which was manufactured by Sunshine Mineral Co., Taiwan, R.O.C. was
20 used in the "Donging" (coagulation bath) process. In particular, the mica that was used for this example was sericite. It had a charge potential of -48.4 PCD $\mu\text{eg/Kg}$ and an electrical conductivity of 92.6 mmho/cm. Further, the average aspect ratio of the sericite particle was 40:1, based on a population of sericite particles. Mica was used to form a composite at the surface of the
25 glove (vs. in the bulk of the latex rubber). The effects of the addition of mica were to cure the latex so that the rubber surface would not be adhesive or sticky, yet be smooth.

In this example, powdered 5 μ m mica was used in the coagulation bath. The bath was made of water and contained chemicals, in particular calcium nitrate. Calcium nitrate is a coagulant and is used because it is a cheap source of multivalent cationic ions (in this case is calcium), but other metal salts such as aluminium nitrate, calcium chloride, zinc nitrate can also be used. The concentration of calcium nitrate in the bath was 10%.

Several coagulant formulations were prepared by varying the amount of the mica. These formulations are shown in Table 2.

Table 2: Different formulations prepared for glove making

Formulation	Calcium Nitrate (g)	Mica (g)	Water (g)
1	10	0	90
2	10	10	80
3	10	20	70
4	10	30	60

15 *Experimental Procedure*

Cleaned formers, made of ceramic in the shape of a hand glove, were dipped into the prepared bath containing calcium nitrate and mica. Following this, the formers were dried in the oven at 90°C for approximately 20-30 min. However, the drying time may vary depending on the type of mica used, and may even extend to 60 min in some cases. After drying, the formers were dipped into a procured natural rubber latex mixture to form films. The resulting films were dried in the oven between 90 and 110°C for various drying times. The reason for having various drying times is to ensure that the surface of the former is well prepared for accepting the coating of the latex (or pick-up).

Tensile test was then carried out on the dried films by pulling dumb bell shaped specimens, cut from the films, at 500 mm/min using the tensile testing machine (Instron). From the results of the test, tensile properties were evaluated. The results are shown in Tables 3 to 6.

5

The following conditions were employed:

Drying Times (minutes): 20, 30, 40, 50, 60

Drying Temperature : 110°C

Filler loading (phr) : 0, 10, 20, 30

10 The units phr stand for the parts of mica added per 100 parts of rubber.

Table 3: Results showing the properties of composite with 0 phr added (Formulation 1 of Table 2)

Drying Time (minutes)	Tensile Strength (Mpa)	Elongation at Break (%)	M100 (MPa)	M300 (MPa)	M500 (MPa)
20	22.234	1297.4	0.8035	1.1782	2.0950
30	24.723	1262.3	0.7982	1.1891	2.1465
40	22.495	1270.3	0.7573	1.4101	2.3068
50	22.470	1269.6	0.7466	1.2228	2.0209
60	21.272	1205.5	0.4889	1.0268	1.9476

15 **Table 4: Results showing the properties of composite with 10 phr added (Formulation 2 of Table 2)**

Drying Time (minutes)	Tensile Strength (Mpa)	Elongation at Break (%)	M100 (MPa)	M300 (MPa)	M500 (MPa)
20	25.455	1219.9	0.4888	1.2885	2.1712
30	24.723	1214.2	0.6397	1.3026	2.2683
40	25.603	1248.6	0.7298	1.4568	2.2384
50	24.902	1246.2	0.6260	1.3642	2.1742
60	24.450	1242.6	0.6406	1.2710	2.1528

Table 5: Results showing the properties of composite with 20 phr added (Formulation 3 of Table 2)

Drying Time (minutes)	Tensile Strength (Mpa)	Elongation at Break (%)	M100 (MPa)	M300 (MPa)	M500 (MPa)
20	23.094	1148.4	0.7098	1.3710	2.4819
30	21.227	1154.1	0.4979	1.2972	2.2620
40	18.721	1115.6	0.5581	1.1824	2.2414
50	20.216	1145.4	0.3979	1.2413	2.4117
60	20.539	1191.2	0.4414	1.1835	2.1682

Table 6: Results showing the properties of composite with 30 phr added (Formulation 4 of Table 2)

Drying Time (minutes)	Tensile Strength (Mpa)	Elongation at Break (%)	M100 (MPa)	M300 (MPa)	M500 (MPa)
20	17.971	1197.6	0.4325	1.2210	2.4236
30	16.353	1292.5	0.5194	1.1844	2.0063
40	15.482	1293.7	0.6562	1.3010	2.1540
50	15.541	1297.4	0.5557	1.1320	1.9532
60	15.544	1243.1	0.4431	1.1601	2.0010

M100, M200 and M300 refer to the elastic modulus at 100%, 200% and 300% elongation respectively.

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From the results obtained, it can be seen that mica can be used in coagulant formulation. The tensile strength of the films produced from the coagulant containing 10 phr mica is the highest and the tensile strength decreases with increasing mica content, because the mica only covers the surface of the films. Further, this observation suggests that mica is reinforcing filler as its tensile strength is higher than that compared to no mica being added (Table 3). Another observation is that the elongation at break remains more or less the same regardless of the mica content. Preferably, for gloves a low elongation is not good and too high an elastic modulus at 300% elongation

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makes the gloves too rigid. Results showed that the properties are not substantially affected by drying time.

Also, by using the mica not only is the wetting, detachment of films from
5 formers and strength improved, but the resulting films also have a smooth surface so that no additional coating is necessary. Thus by using the mica the glove manufacturers can save time and cut the costs.

Claims

1. A process for the preparation of a composite material comprising the steps of:
 - a) providing mica;
 - 5 b) mixing the mica with an organic polymer; and
 - c) subjecting the mixture to curing.
2. The process of claim 1, wherein the organic polymer is natural and/or synthetic rubber.
3. The process of claim 2, wherein the rubber is rubber latex.
- 10 4. The process of claims 2-3, wherein the synthetic rubber is polyisoprene, polyurethane, polybutadiene, emulsion-styrene butadiene rubber, acrylonitrile-butadiene rubber, polystyrene, polyacrylates and epoxide resins.
5. The process of claims 1-4, wherein the mica is sericite.
- 15 6. The process of claims 1-5, wherein the mica has a negative surface electrical potential measured by charge potential of $-16 \text{ PCD } \mu\text{eg/Kg}$ or more negative.
7. The process of claim 6, wherein the charge potential is -16 to $-70 \text{ PCD } \mu\text{eg/Kg}$.
- 20 8. The process of claims 6-7, wherein the charge potential is -30 to $-50 \text{ PCD } \mu\text{eg/Kg}$.
9. The process of claims 6-8, wherein the charge potential is $-48.4 \text{ PCD } \mu\text{eg/Kg}$.

10. The process of claims 1-10, wherein the mica has an electrical conductivity of at least 73 mmho/cm.
11. The process of claim 10, wherein the electrical conductivity is 73-150 mmho/cm.
- 5 12. The process of claims 10-11, wherein the electrical conductivity is 80-100 mmho/cm.
13. The process of claims 10-12, wherein the electrical conductivity is 92.6 mmho/cm.
- 10 14. The process of claims 1-13, wherein the mica has an average particle size of 0.01-30 μ m.
15. The process of claim 14, wherein the average particle size is 1-15 μ m.
16. The process of claims 14-15, wherein the average particle size is 3-10 μ m.
- 15 17. The process of claims 14-16, wherein the average particle size is 5 μ m.
18. The process of claims 1-17, further comprising a step of reducing the average particle size of mica by compression, impact, attrition, rubbing, cutting and/or milling.
- 20 19. The process of claims 1-18, wherein the average aspect ratio of a mica particle is from 15:1 to 500:1.
20. The process of claims 19, wherein the minimum aspect ratio of a mica particle is from 20:1 to 50:1.

21. The process of claims 19-20, wherein the minimum aspect ratio of a mica particle is 40:1.
22. The process of claims 1-21, wherein the mica has a chemical composition comprising: 50-56% SiO_2 , 32-40% Al_2O_3 , 4-10% K_2O .
- 5 23. The process of claim 22, wherein the mica further comprises impurities.
24. The process of claim 23, wherein the impurities comprises at least one of 0.1-0.3% MgO , 0.3-0.5% N_2O , 0.2-0.5% CaO and 0.4-1.0% Fe_2O_3 .
25. The process of claim 22-24, wherein the SiO_2 composition in mica is 52%.
- 10 26. The process of claims 22-25, wherein the Al_2O_3 composition in mica is 35%.
27. The process of claims 22-26, wherein the K_2O composition in mica is 6%.
- 15 28. The process of claims 1-27, further comprising the step of adding CaNO_3 to the mixture of step b).
29. The process of claim 28, wherein the amount of CaNO_3 is 0-10% of the total volume of the mixture.
30. The process of claims 1-29, wherein during the mixing of step b) the proportion of mica in the total mixture is from 1-50%.
- 20 31. The process of claim 30, wherein the proportion is from 3-15%.
32. The process of claims 30-31, wherein the proportion is 10%.
33. The process of claims 1-32, wherein the curing of step c) is carried out at a temperature between 90-120°C.

34. The process of claims 1-33, wherein the curing of step c) is carried out for 20-90 minutes.
35. A composite prepared according to any one of claims 1-34.
- 5 36. The composite of claim 35, wherein the composite has a tensile strength of 15-25 MPa.
37. The composite of claims 35-36, wherein the composite has an elongation of 700-1000%.
38. The composite of claims 35-37, wherein the composite has an elastic modulus of 0.5-0.9 MPa at 100% elongation (M100), 1.6-2.1 MPa at
10 300% elongation (M300) and 4.0-4.8 MPa at 500% elongation (M500).
39. A composite made of mica and organic polymer.
40. The composite of claim 39, wherein the composite has a tensile strength of 15-25 MPa.
41. The composite of claims 39-40, wherein the composite has an
15 elongation of 700-1000%.
42. The composite of claims 39-41, wherein the composite has an elastic modulus of 0.5-0.9 MPa at 100% elongation (M100), 1.6-2.1 MPa at 300% elongation (M300) and 4.0-4.8 MPa at 500% elongation (M500).
43. The composite of claims 39-42, wherein the organic polymer is natural
20 and/or synthetic rubber.
44. The composite of claim 43, wherein the rubber is rubber latex.
45. The composite of claims 39-44, wherein mica is sericite.

- 46. The composite of claims 39-45, wherein mica has a negative surface electrical potential measured by charge potential of $-16 \text{ PCD } \mu\text{eg/Kg}$ or more negative, and/or an electrical conductivity of at least 73 mmho/cm.
- 5 47. The composite of claims 35-46, wherein the composite can be further cured or cross-linked.
- 48. An article of manufacture made of the composite of claims 35-47.
- 49. The article of claim 48, wherein the article is a glove.
- 50. The article of claim 48, wherein the article is a condom.
- 10 51. A method of manufacturing an article using the composite of claims 35-50.