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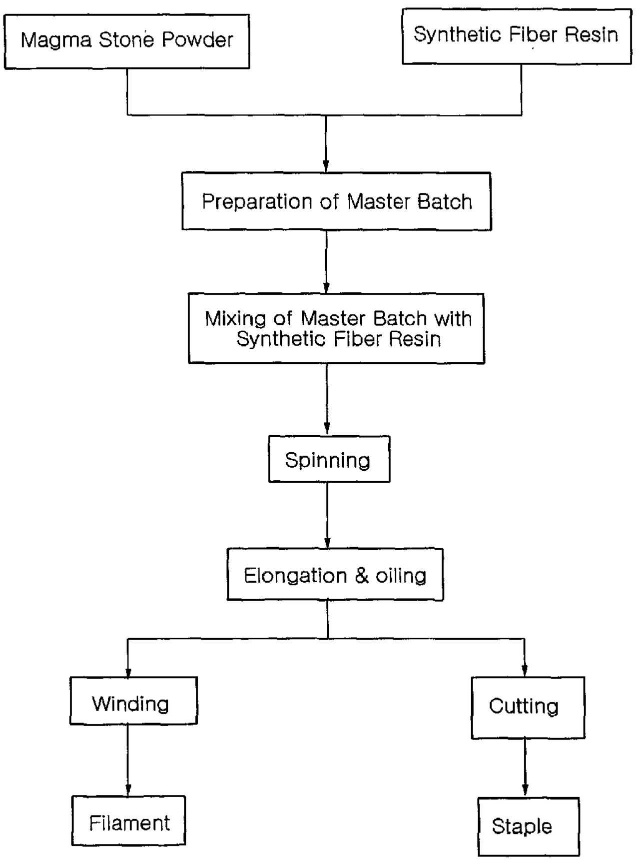
(54) Title: MULTI-FUNCTIONAL FIBER CONTAINING NATURAL MAGMA-STONE AND MANUFACTURING PROCESS FOR THE SAME



(57) Abstract: Provided is a multi-functional fiber comprising 0.5-5 % by weight a magma stone powder with a mean particle size of 0.2-3 μm, composed of 80-85 % by weight of SiO_2, 5-10 % by weight of Al_2O_3, 2-5 % by weight of K_2O, 2-3 % by weight of Na_2O, 1-2 % by weight of CaO, 1-2 % by weight of Fe_2O_3, 0.5-1 % by weight of MgO, 0.1-0.5 % by weight of TiO_2, and 0.01-01 % by weight of MnO. The multi-functional fiber emits anions in an amount of 300-500/cc and far infrared radiation in an emissivity of 85-95 %, as well as exhibiting an antibacterial activity at an efficiency of 98-99 % as measured according to AATCC 6538. Also, provided is a method for manufacturing the multi-functional fiber.

WO 03/056075 A1

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

MULTI-FUNCTIONAL FIBER CONTAINING NATURAL MAGMA-STONE AND MANUFACTURING PROCESS FOR THE SAME

BACKGROUND OF THE INVENTION

1. Field of the invention

The present invention relates to a multi-functional fiber containing natural magma stone and a method for manufacturing the same. More particularly, the present invention is concerned with an improvement in fiber functionalities including emission of anions and far infrared radiation, and antibacterial activity, along with the method.

2. Description of the Prior Art

Found only in specific places of Japan, in the center of which crustal movements have occurred, magma stone, a kind of igneous rock, is composed mainly of silica and alumina in combination with other various minerals as given in Table 1, below.

TABLE 1

Component	Content (wt%)
SiO_2	82.25
Al_2O_3	8.59
Fe_2O_3	1.06
TiO_2	0.33
CaO	1.55
MgO	0.37
K_2O	2.96
Na_2O	2.26
MnO	0.02
Loss	0.61
Total	100.00

Natural magma stone itself, as shown microscopically in Fig. 3, is of finely porous structure, in which minerals are contained. With pores, magma stone shows excellent adsorption and decomposition activities, as well as being applied for deodorization. Additionally, magma stone is useful for growing plants or organisms, thanks to its mineral contents.

Besides, magma stone emits a large quantity of anions under various temperature conditions, in comparison with other natural stones and artificial ceramics. Also, magma stone produces large doses of far infrared radiation, with little change in radiation dose even at room temperature. Magma stone is superior to other far-infrared radiators in emissivity of both far infrared radiation and anions. In particular, magma stone shows high emissivity in the wavelength range of 4-14 μm, which is readily absorbed by water and organisms and promotes physiological activity and cell growth in the body, so that it has numerous applications in various fields, including the activation of water molecules and animal and plant cells, deodorization, etc. Moreover, magma stone is highly resistant to strong acid and alkali.

Humans live in an environment of far infrared radiation of various wavelengths. Far infrared radiation is emitted from almost every substances (if they have surface temperatures) which are readily encountered in everyday life, but in a trace amount. Long research resulted in the finding that certain ceramics fit into "substances that efficiently emit far infrared radiation at room temperature in a certain wavelength range beneficial to humans". Since reports of clinical tests show that far infrared radiation in the wavelength range of 7-14 μm positively affect the biorhythm of humans and experimental results show that far infrared radiation vibrates water molecules to activate cells, stimulate capillary vessels to facilitate blood circulation, and increase the supply of the oxygen dissolved in the blood to muscles to aid recovery from fatigue, attention to far infrared radiation has gradually grown among many people. In response to this growing interest, extensive attempts have been made to apply far infrared radiation to health-related industries.

Cations, known to be unfavorable to human health, cause the secretion of excess serotonin and histamine in the body and lower the lung capacity. In contrast, anions function to purify blood by making blood alkaline through the ionization of minerals in blood, and facilitate the interchange of charged substances across cellular membranes. In addition, it is found that anions increase the level of γ-globulin in serum to reinforce the immune system in addition to activating the blood and lymph in the autonomic nervous system. Automobile and indoor anion generators in which anions are generated electrically have been developed in order to purify air, as well as allowing users to take advantage of anion's effects. However, reports from Korean Ginseng and Tobacco Research Institute describes that electrical generation of anions increases the concentration of carbon monoxide in closed spaces, and the ozone generated has negative effects on human bronchi.

Anions are naturally generated in places near waterfalls, pine tree forests, and the seaside at which waves collide against rocks. In the atmosphere of the natural anion sources, anions are present at a density of

3,000-4,000/cc.

Recently, there have been developed fibers that contain anion sources to generate anions. In most cases, however, the number of the anions generated is no more than 200/cc or less. Exception is found in the anion-generating fibers commercially available from Kanebo, Kuraray, Tomus, TAKO and Bofarich, whose anion generation rates are measured to be 500/cc or more. As anion sources in manufactured products, there are used tourmaline or rare earth element powder, which is of piezoelectricity or of low radioactivity.

In daily life, people are exposed to various bacteria that inhabit living environments, as shown in Table 2, below. As a matter of course, it is necessary to control such bacteria. With the increase of human populations, environmental pollution is aggravated, which provides opportunities for bacteria and viruses to spread out of control. In addition, people who live in multi-storied buildings and underground spaces do not receive sufficient sunshine, so that they may be vulnerable to bacteria and viruses.

Microorganisms are also found in clothing. Cloth fibers, in combination with human secretions, including sweat and other effete organic matters, and external contaminants, afford habitats suitable for microorganisms to thrive. While the microorganisms perform their metabolic activities by decomposing organic matters, unpleasant odors may occur. In addition to damaging the fibers, the microorganisms living in clothes have high potentials to cause diseases through contact or infection. Compared with synthetic fibers, bacteria more favorably grow in natural fibers, such as cottons and wool, which tend to be popular with the advance of living standards. When they are introduced to mass residential districts such as multi-storied apartments, or a rainy season, bacteria in clothes grow especially well. Particularly, bacteria in clothes are very dangerous to the elderly, infants and patients. In order to solve the problems, fibers with sanitary functions have long been studied.

TABLE 2

Classification by Bacteria			Classification by Habitat	
Bacteria	Main Habitat	Effects	Habitat	Bacteria
Staphylococcus aureus	Socks, underwear	Intensive excoriational dermatitis, Odor	Socks	S. aureus, B. subtilis, E. coli, P. vulgaris
Bacillus subtilis	Socks, Underwear Sweaters, Trousers	Conjunctivitis		
E. coli	Socks, Underwear Sweaters, Trousers	Ulcer, Odor		
Pseudomonas aeruginosa	Underwear Sweaters, Trousers	Empyema/ Tympanitis	Under-wear	S. aureus, B. subtilis, E. coli, P. aeruginosa, S. pneumoniae
Streptococcus pneumoniae	Underwear, Trousers	Pneumonia		
Proteus vulgaris	Infant diapers, Socks	Infant erosions, Odor		

At present, fine ceramics armed with various functionalities, including emission of far infrared radiation and anions, have been and continue to be developed. These functional fine ceramics have numerous applications in various fields, including construction, fiber, food industries, and etc.

Korean Pat. Appl'n No. 1998-7433 describes a method for preparing multi-functional polyester fibers, in which polyester, in admixture with elvan powder emitting far infrared radiation, is melted and spun to give fibers with antibacterial activity and deodorizing function. The fibers are excellent in terms of antibacterial activity and deodorization and emit far infrared radiation, but nowhere is mentioned anion release.

Antibacterial activity can be provided in fibers as disclosed in Japanese Pat. Laid-Open Publication Nos. Sho. 59-134418 and Sho. 61-17567. According to these references, polyester fibers are coated by spraying with a liquid agent containing either metal oxides, which can chemically associate with odor ingredients, or zirconia, or inorganic zeolite, in which antibacterial metals are substituted for inorganic powder by a master batch process to be dispersed in fibers. However, the coating is not suitable for the clothing products which require washing resistance. Also, the metal particles have difficulty in control of their dispersion and react with polymers, deteriorating the color of the product.

In Japanese Pat. Laid-Open Publication No. Sho. 54-38951, provision of antibacterial activity to fibers is carried out by preparing ion-exchangeable copolymers and treating them with an aqueous solution of copper or silver salt to allow the fibers to have the metal ions at their surfaces. However, this method suffers from the disadvantage that the metal ions react with the polymers to deteriorate the physical properties of polymers, and make poor the workability of post-processes, such as fiber manufacturing processes and dying processes.

SUMMARY OF THE INVENTION

Leading to the present invention, the intensive and thorough research into multi-functional fibers, conducted by the present inventors, resulted in the finding that magma stone shows excellent far infrared radiation properties and releases a large quantity of anions, as well as being superior in terms of physical and chemical properties, and no prior arts employ magma stone in synthetic fibers.

Therefore, it is an object to provide a multi-functional fiber taking advantage of magma stone powder which emits mass quantities of anions and far infrared radiation.

It is another object of the present invention to provide a process for manufacturing a multi-functional fiber.

In accordance with one aspect of the present invention, there is provided a multi-functional synthetic fiber, comprising a synthetic resin and 0.5-5 % by weight of a magma stone powder with a mean particle size of 0.2-3 μm, said magma stone powder comprising 80-85 % by weight of SiO_2, 5-10 % by weight of Al_2O_3, 2-5 % by weight of K_2O, 2-3 % by weight of Na_2O, 1-2 % by weight of CaO, 1-2 % by weight of Fe_2O_3, 0.5-1 % by weight of MgO, 0.1-0.5 % by weight of TiO_2, and 0.01-01 % by weight of MnO.

In accordance with another aspect of the present invention, there is provided a process for manufacturing a multi-functional fiber, comprising the steps of: preparing a master batch by mixing and melting a synthetic resin with 10-25 % by weight of a magma stone powder, said magma stone powder ranging in mean particle size from 0.2 to 3 μm and comprising 80-85 % by weight of SiO_2, 5-10 % by weight of Al_2O_3, 2-5 % by weight of K_2O, 2-3 % by weight of Na_2O, 1-2 % by weight of CaO, 1-2 % by weight of Fe_2O_3, 0.5-1 % by weight of MgO, 0.1-0.5 % by weight of TiO_2, and 0.01-01 % by weight of MnO; mixing the master batch with a synthetic resin chip in such an amount as for the content of the magma stone powder to reach 0.5-5 % by weight based on the total weight of the yarn, melting the mixture, and spinning the meet; drawing the yarn at 80-150 °C to 2-15 deniers; and winding or cutting the drawn yarn.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and other advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a process flow diagram illustrating the manufacture of a multi-functional fiber according to the present invention.

Fig. 2 is a schematic diagram illustrating a spinning apparatus for use in manufacturing a multi-functional fiber according to the present invention.

Fig. 3 is an SEM photograph showing the structure of a magma stone useful in the present invention.

Fig. 4 is an electronic microphotograph showing magma stone powder attached onto the surface of the fiber.

DETAILED DESCRIPTION OF THE INVENTION

Useful in the present invention, magma stone is superior to functional powders such as sericite, talc, elvan, etc., in various functionalities and properties. The properties of magma stone are summarized in Table 3, below.

TABLE 3

Property	Specification
Far IR Radiation Dose	High Peak with little change at RT
Far IR Radiation Emissivity	Higher than other artificial ceramics
Anion Release	300/cc or more, 3,000/cc or more at friction
Main Components	Silica, Alumina
Deodorization	Effective for ammonia or aromatic Cpds.
Structure	Porous with fine pores
Chemical Resistance	Resistant to strong acid and alkali
Solubility	No elution of heavy metals in water

The present invention pertains to a multi-functional fiber characterized by containing magma stone with a particle size of 0.2-3 μm in an amount of 0.5-5 % by weight based on the total weight of the fiber. The magma stone comprises 80-85 % by weight of SiO_2, 5-10 % by weight of Al_2O_3, 2-5 % by weight of K_2O, 2-3 % by weight of Na_2O, 1-2 % by weight of CaO, 1-2 % by weight of Fe_2O_3, 0.5-1 % by weight of MgO, 0.1-0.5 % by weight of TiO_2, and 0.01-01 % by weight of MnO.

Any resin, if it can be subjected to melting-spinning to fibers, may be compatible with magma stone. Examples of useful resin in the present invention, but not limitative, include polyester, polypropylene, polyamide, acryl, polyurethane, viscoserayon, and polytrimethyleneterephthalate.

By the presence of natural magma stone powder on its surface, the multi-functional fiber of the present invention functions to emit anions at a density of 300-500/cc and far infrared radiation at an emissivity of 85-95 % and shows antibacterial activity at an inhibition efficiency of 98-99 %.

It is found that magma stone has little influence on physical properties of the synthetic fiber product.

The magma stone powder useful in the present invention is 3 μm or less in particle size and comprises 80-85 % by weight of SiO_2, 5-10 % by weight of Al_2O_3, 2-5 % by weight of K_2O, 2-3 % by weight of Na_2O, 1-2 % by weight of CaO, 1-2 % by weight of Fe_2O_3, 0.5-1 % by weight of MgO, 0.1-0.5 % by weight of TiO_2, and 0.01-01 % by weight of MnO. With the composition, the magma stone powder shows high emissivity of far infrared radiation in the wavelength band of 4-14 μm, which is readily absorbed into water and organisms and promotes human physiological activities and cell growth. Besides, the magma stone is of porous structure such that it has the function of antibacterial activity and deodorization.

Depending on the purposes and functions of the fiber finally obtained, the content of the magma stone powder is on the order of 0.5-5 % by weight based on the total weight of the fiber, and preferably on the order of 2-4 % by weight.

In accordance with the present invention, additional antibacterial agents may be used in order to endow the fiber with more potent antibacterial activity. To this end, silver-based inorganic matters or silver salts may be used. In this regard, for example, silver (Ag) ions may be attached into pores of zeolite or hydroapetite. The amount of the antibacterial agent may be in the range of 0.1-1 % by weight based on the total weight of the fiber, and preferably in the range of 0.3-0.5 % by weight, in consideration of antibacterial effects and economic aspects.

Also, a coupling agent may be used to improve the bonding force at the boundary between the synthetic resin and the functional powder including ceramic particles. Suitable is a silane-based coupling agent. It may be used in an amount of 0.01-1 % by weight based on the total weight of the fiber, and preferably in an amount of 0.3-0.5 % by weight. The silane-based coupling agent acts to bind the magma stone powder less than 3 μm in particle size to the synthetic resin, with the prevention of the increase of particle size attributed to aggregation of the powder. As a result, the fiber produced is not poor in tensile strength and an improvement can be brought about in the dispersibility of the powder in the synthetic resin.

Other additives may be provided for improving properties of the fiber. For instance, a drape improver selected from among sericite, talc, and a mixture thereof may be used in an amount of 0.1-0.3 % by weight based on the total weight of the fiber.

Generally, application of various functional components to fibers or fiber products resorts to a process of coating the components onto fibers or fiber products by use of a binder or a process of spinning a mixture of the components and fiber component. The coating method using a binder is disadvantageous not only because the coating causes a decrease in the drape property of the gray cloth, but also because the functional components are so poorly attached onto the fiber or fiber products as to readily depart therefrom with washing, thereby their functions being lowered. Thus, it is preferred that the functional components are mixed with a resin to give a master batch from which fibers are prepared by melt-spinning.

With reference to Fig. 1, there is shown a process diagram illustrating the preparation of multi-functional fibers containing magma stone powder. As illustrated, natural magma stone powder is mixed with a synthetic fiber resin to give a master batch chip which is then combined with a pure synthetic fiber resin chip in consideration of a controlled ratio of the magma stone weight to the total weight. In this regard, a fiber-manufacturing system may be used whose structure is schematically illustrated in Fig. 2. For example, the master batch is extruded from an extruder 1 and melted, along with pure synthetic fiber resin and additives introduced through a feeder 2, in a barrel heater 3. Then, with the aid of a gear pump 4, the molten matter is drawn to a spinner through which yarns are spun. They are elongated by an elongation godet 6, followed by winding the yarns through a heat treatment godet 7 in the case of filaments or cutting the yarns in the case of staples.

The fibers thus obtained are weaved, textured or processed into cloth for use in clothing, bedclothes, and interior decoration.

By way of example, a natural magma stone powder with a mean particle size of 0.2-3 μm, which emits mass quantities of anions and far infrared radiation and comprises 80-85 % by weight of SiO_2, 5-10 % by weight of Al_2O_3, 2-5 % by weight of K_2O, 2-3 % by weight of Na_2O, 1-2 % by weight of CaO, 1-2 % by weight of Fe_2O_3, 0.5-1 % by weight of MgO, 0.1-0.5 % by weight of TiO_2, and 0.01-01 % by weight of MnO, is melted in an amount of 10-25 % by weight with a synthetic fiber resin to prepare a master batch. Then, the master batch is mixed with a synthetic fiber resin in such an amount as for the magma stone powder content to reach 0.5-5 % by weight based on the total weight of the mixture. It is melted at 170-290 °C and spun through a spinneret.

If necessary, antibacterial agents, coupling agents, drape improvers and other additives may be added upon the preparation of the master batch or the mixing of the master batch and the synthetic fiber resin chip.

The yarns are elongated at 80-150 °C by use of an elongation godet and immediately wound around a roll to give a filament fiber. Alternatively, the elongated yarn is cut into a desired length for staple fibers.

Turning to Fig. 4, there is an electronic microphotograph showing the fiber obtained. As seen in the electronic microphotograph, the magma stone particles are attached onto the surface of the fiber.

Having generally described this invention, a further understanding can be obtained by reference to certain specific examples which are provided herein for purposes of illustration only and are not intended to be limiting unless otherwise specified.

EXAMPLE 1

Preparation of Master Batch

A magma stone powder 1 µm or less in mean particle size, comprising the composition of Table 1, was mixed in an amount of 10 %`by weight with a pure polyester chip and the mixture was melted to prepare a master batch chip.

Mixing of Master Batch and Pure Chip

The master batch and a pure polyester chip were mixed in such controlled manners as for the magma stone powder to reach 1, 2 and 3 % by weight based on the total weight of the mixtures, respectively.

Spinning

Using the spinning apparatus of Fig. 2, the mixtures were spun at 290 °C to produce filaments with a fineness of 5 deniers.

EXAMPLES 2 TO 4

The fibers with magma stone contents of 1, 2 and 3 % by weight obtained in Example 1 were measured for how many anions were generated therefrom, with the aid of a portable "Air Ion Counter" commercially available from Alpha Lab. Inc.

Measurements for the numbers of anions generated from three multi-functional polyester fibers with different contents of the magma stone powder of Example 1 are summarized in the following table.

	Example 2	Example 3	Example 4
Content of Magma Stone powder (wt%)	1wt%	2wt%	3wt%
No. of Anions (/cc)	700	1,000	1,200

EXAMPLE 5 TO 7

The fibers with magma stone contents of 1, 2 and 3 % by weight obtained in Example 1 were measured for far infrared emissivity. The far infrared emissivity was defined as an area ratio of the emission powder of a sample to that of an ideal black body, as measured by an FT-IR spectrometer at 40 °C.

Measurements for the emissivity of the three multi-functional polyester fibers with different contents of the magma stone powder of Example 1 are summarized in the following table.

	Example 5	Example 6	Example 7
Magma Stone Powder Content(wt%)	1wt%	2wt%	3wt%
Far IR Emissvity	0.87	0.89	0.904

EXAMPLES 8 TO 10

The fibers with magma stone contents of 1, 2 and 3 % by weight obtained in Example 1 were measured for antibacterial activity, according to AATCC 6538.

Measurements of the antibacterial activity of the three multi-functional polyester fibers with different contents of the magma stone powder of Example 1 are summarized in the following table.

	Example 8	Example 9	Example 10
Magma Stone Powder Content(wt%)	1wt%	2wt%	3wt%
Antibacterial Activity	98	99	99

The multi-functional fiber of the present invention using magma stone powder, as described hereinbefore, emits both far infrared radiation and anions, beneficial to the body, as well as exhibiting excellent antibacterial activity without the aid of additional antibacterial agents. If necessary, additives, including antibacterial agents, drape improvers, coupling agents for bonding the magma stone powder to the synthetic resin, etc., may be added to the multi-functional fiber under the condition that they do not deteriorate physical properties and radioactivity of the fiber. When the fiber is of a filament, it may be used for cloths requiring antibacterial activity, pleasant texture and washing fastness, and interior decorating uses. As for staple fibers, they may be applied to, for example, fillers for bedclothes, and non-woven fabrics.

The present invention has been described in an illustrative manner, and it is to be understood that the terminology used is intended to be in the nature of description rather than of limitation. Many modifications and variations of the present invention are possible in light of the above teachings. Therefore, it is to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A multi-functional synthetic fiber, comprising a synthetic resin and 0.5-5 % by weight of a magma stone powder with a mean particle size of 0.2-3 μm, said magma stone powder comprising 80-85 % by weight of SiO_2, 5-10 % by weight of Al_2O_3, 2-5 % by weight of K_2O, 2-3 % by weight of Na_2O, 1-2 % by weight of CaO, 1-2 % by weight of Fe_2O_3, 0.5-1 % by weight of MgO, 0.1-0.5 % by weight of TiO_2, and 0.01-01 % by weight of MnO.

2. The multi-functional fiber as set forth in claim 1, wherein the fiber emits anions in an amount of 300-500/cc and far infrared radiation in an emissivity of 85-95 %, and shows an antibacterial activity with an efficiency of 98-99 % as measured according to AATCC 6538.

3. The multi-functional fiber as set forth in claim 1 or 2, wherein the synthetic resin is melt-spun to a fiber.

4. The multi-functional fiber as set forth in claim 3, wherein the synthetic resin is selected from the group consisting of polyester, polypropylene, polyamide, acryl, polyurethane, viscose rayon, and polytrimethylene terephthalate.

5. The multi-functional fiber as set forth in claim 1, further comprising an antibacterial agent in an amount of 0.1-1 % by weight, said antibacterial agent being selected from among silver-based inorganics and silver salts.

6. The multi-functional fiber as set forth in claim 1, further comprising a silane-based coupling agent in an amount of 0.01-1 % by weight.

7. The multi-functional fiber as set forth in claim 1, further comprising a drape improver in an amount of 0.1-0.3 % by weight, said drape improver being selected from among sericite and talc.

8. A process for manufacturing a multi-functional fiber, comprising the steps of:

preparing a master batch by mixing and melting a synthetic resin with 10-25 % by weight of a magma stone powder, said magma stone powder ranging in mean particle size from 0.2 to 3 μm and comprising 80-85 % by weight of SiO_2, 5-10 % by weight of Al_2O_3, 2-5 % by weight of K_2O, 2-3 % by weight of Na_2O, 1-2 % by weight of CaO, 1-2 % by weight of Fe_2O_3, 0.5-1 % by weight of MgO, 0.1-0.5 % by weight of TiO_2, and 0.01-01 % by weight of MnO;

mixing the master batch with a synthetic resin chip in such an amount as for the content of the magma stone powder to reach 0.5-5 % by weight based on the total weight of the yarn, melting the mixture, and spinning the melt;

drawing the yarn at 80-150 °C to 2-15 deniers; and

winding or cutting the drawn yarn.

9. The method as set forth in claim 8, wherein an additive selected from the group consisting of an antibacterial agent, a drape improver, a coupling agent, and combinations thereof is added in the preparation step of the master batch.

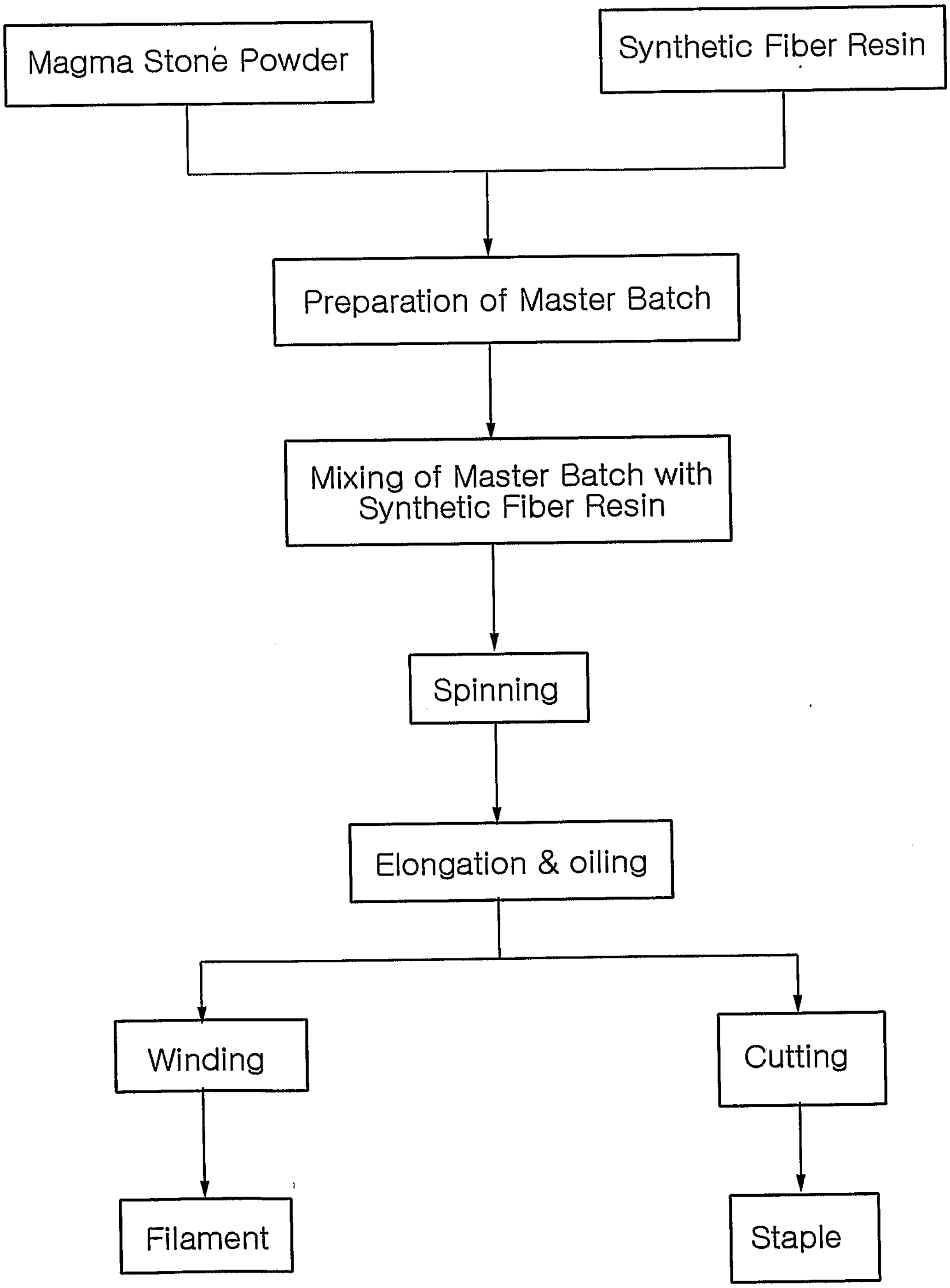
Magma Stone Powder
Synthetic Fiber Resin
Preparation of Master Batch
Mixing of Master Batch with Synthetic Fiber Resin
Spinning
Elongation & oiling
Winding
Cutting
Filament
Staple

FIG. 1

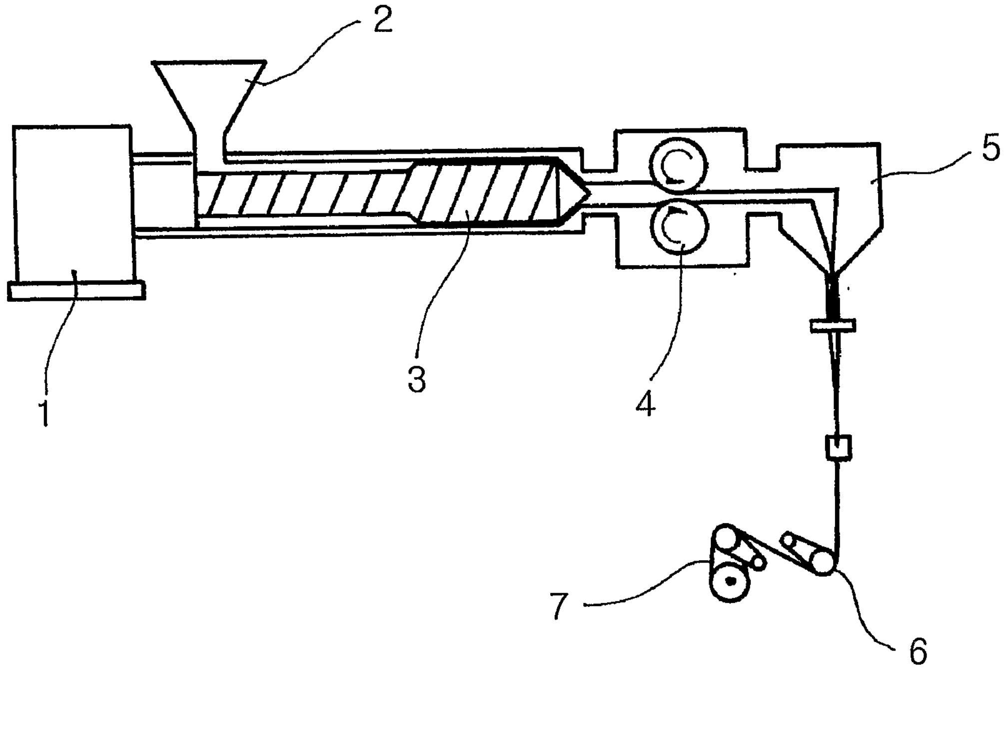

FIG. 2

FIG. 3

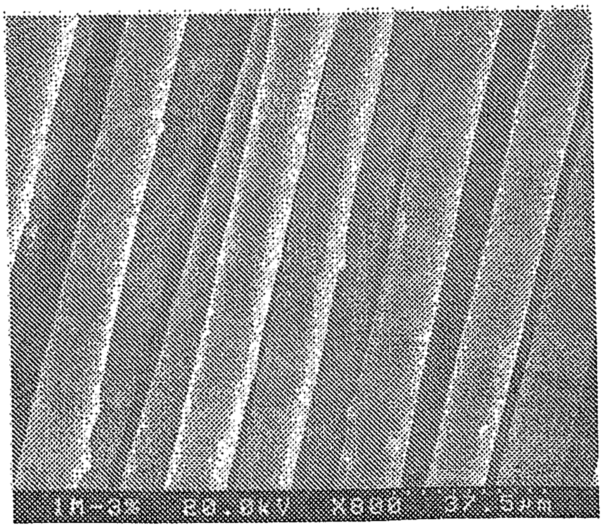

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR 02/01256

CLASSIFICATION OF SUBJECT MATTER

IPC[7]: D01F 1/10, 2/06, 6/06, 6/60, 6/62, 6/70

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC[7]: D01F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DEPATISNET, EPODOC, PAJ, WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 01 314723 A (KURARAY CO. LTD.) 19 December 1989 (19.12.89) (abstract) World Patent Index [online]. London, U.K.: Derwent Publications, Ltd. [retrieved on 2002-10-09]. Retrieved from: EPOQUE WPI Database. DW199005, Accession No. 1990-034980 *abstract.*	1,3,4,8
A	JP 57 129861 A (DAIWA SPINNING CO. LTD.) 12 August 1982 (12.08.82) (abstract) World Patent Index [online]. London, U.K.: Derwent Publications, Ltd. [retrieved on 2002-10-09]. Retrieved from: EPOQUE WPI Database. DW198238, Accession No. 1982-79743E *abstract.*	1,3,4

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
9 October 2002 (09.10.2002)	23 October 2002 (23.10.2002)
Name and mailing adress of the ISA/AT Austrian Patent Office Kohlmarkt 8-10; A-1014 Vienna Facsimile No. 1/53424/535	Authorized officer WEIGERSTORFER K. Telephone No. 1/53424/221

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR 02/01256

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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Information on patent family members

International application No.
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US A 6149855	21-11-2000	none	