(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 364 582 A1**

(12) **EUROPEAN PATENT APPLICATION published in accordance with Art. 158(3) EPC**

(21) Application number: **88906069.5**

(51) Int. Cl.[5]: **D06M 11/00 , D06M 1/00**

(22) Date of filing: **06.07.88**

(86) International application number:
PCT/JP88/00676

(87) International publication number:
WO 89/09304 (05.10.89 89/24)

(30) Priority: **28.03.88 JP 73712/88**

(43) Date of publication of application:
25.04.90 Bulletin 90/17

(84) Designated Contracting States:
AT BE CH FR IT LI LU NL SE

(71) Applicant: **KABUSHIKI KAISHA J.F. CORPORATION**
1-3, Shinjuku 3-chome, Shinjuku-ku
Tokyo 160(JP)

Applicant: **NAKAMURA, Masahiro**
710-3, Shimada-machi, Ashikaga-shi
Tochigi 326-03(JP)

(72) Inventor: **NAKAMURA, Masahiro**
710-3, Shimada-machi Ashikaga-shi
Tochigi 326-03(JP)
Inventor: **MUTO, Nobukazu**
1057, Sugikubo Ebina-shi
Kanagawa 243(JP)
Inventor: **INUI, Tetsurou 3630-6, Oaza Kanmaki**
Kanmaki-cho
Kitakatsuragi-gun
Nara 639-02(JP)

(74) Representative: **Dawson, Elizabeth Ann et al**
A.A. THORNTON & CO. Northumberland House 303-306 High Holborn
London WC1V 7LE(GB)

EP 0 364 582 A1

(54) **CERAMIC-CONTAINING FIBER AND PROCESS FOR PREPARING THE SAME.**

(57) A vegetable fiber is swelled with an organic solvent or an aqueous solvent into a cylindrical form and then immersed in an aqueous treating solution containing fine particles of ceramic to cause them to penetrate into expanded micropores of the vegetable fiber, thereby properly and selectively combining the properties of ceramic with the properties inherent in the vegetable fiber itself to prepare a vegetable fiber having excellent stability and versatility.

SPECIFICATION

Ceramic-containing Fiber and the Process for Preparing the Same

TECHNICAL FIELD

The present invention relates to ceramic-containing fiber wherein characteristic features belonging to finely divided ceramic particles are suitably selected and applied to vegetable fiber without damaging essential characteristic features thereof and a process for preparing the same. More particularly, the invention relates to ceramic-containing fiber which can maintain the above described characteristic features for a long period of time and an easy process for preparing the same which comprises immersing fiber in a prescribed processing solution which has been heated and pressurized, and solid-dissolving finely divided ceramic particles into minute pores involved in the resulting swelled monofilaments of said fiber.

TECHNICAL BACKGROUND

It has been conventionally known that quality of textile goods depends upon that of vegetable fiber from which the corresponding textile good is manufactured, so that fiber must be selected on the basis of characteristic features involved in the fiber dependent upon functions and applications of the objective textile goods.

For example, cotton which is one of vegetable fiber is most widely used in the world as fiber for clothing, and the

production thereof holds a majority of the whole fiber for clothing.

Such a cotton fiber is produced as a result of gradually long and narrow growth of an epidermal cell of a cotton seed, so that a vestige of protoplasm remains as a vacuole at the central portion of a sufficiently matured cotton fiber. Cotton fiber which had been reaped becomes flat and intertwined as a result of drying the same.

Thus, since cotton fiber having such characteristic features involves said vacuole, then it results in favourable heat retaining property and touch, whilst such twist makes intense intertwinment among fibers to effect favourable spinning. Accordingly, cotton possesses very good properties as fiber for clothing. On one hand, with development of recent petrochemical industry, consumption of synthetic fiber increases, and under these circumstances, synthetic fiber exhibits beautiful appearance peculiar thereto, moderate elasticity and strength while satisfying a demand corresponding to consumption of such synthetic fiber.

On the other hand, such trial for affording characteristics of ceramics to fiber in order to extend applications and functions of fiber which have been limited to peculiar properties of the fiber itself by adding characteristic features involved in the other fiber to the very individual fiber.

For instance, there have been such fiber wherein the fiber is immersed in a ceramic particle solution containing a

binder to adhesive bond said ceramic particles on the surface of the fiber, or such textile which is obtained by either blending fiber to which is adhesive bonded the particles or twisting and uniting the ceramic fiber.

However, such synthetic fiber as described above wherein ceramic particles are merely adhesive bonded to the surface of the fiber, so that characteristic features of the ceramic particles could not be maintained for a long period of time dependent upon use and applications for products manufactured from said fiber. Even in mix-spun or twisted union cloth, such cloth could not maintain essential property of union cloth due to differences in stretchability and the like of both of the fiber.

Furthermore, since a variety of high-molecular weight compounds are applied to fiber, the characteristic features of the very high-molecular weight material are actualized so that essential characteristic features such as heat retaining property and hygroscopic property belonging to cotton fiber are damaged.

DISCLOSURE OF THE INVENTION

Namely, according to the present invention, minute pores involved in vegetable fiber are allowed to swell by the use of an organic solvent or an aqueous solvent, and then the fiber is immersed in a prescribed processing solution which has been heated and pressurized, and ceramic fine particles are caused to

exist among minute pores involved in the swollen monofilament fiber.

Thus, characteristic features such as heat insulating properties, water absorption properties and the like involved in ceramic fine particles are suitably selected therefrom and added to those of fiber in question without damaging characteristic features which have been involved therein originally. In addition, the fiber containing the above described characteristic features improved may be manufactured by a simple manner.

BEST MODE FOR EMBODYING THE INVENTION

An embodiment of the present invention will be described in detail hereinbelow.

It is to be noted that the present fiber and the process for preparing the same will be particularly described in connection with cotton among vegetable fiber as its major component. As described above, a cotton fiber has a vacuole in its cross section so that it makes heat retaining property and touch of the fiber better, besides twist in monofilament makes intense intertwinment among such monofilaments. As is explained, in cotton fiber, arrangement of crystallite of monofilament is spiral along major axis of fiber on which minute pores appear in turned and twisted form. The present invention utilizes such characteristic features as described above. In this connection, said minute pores are filled with ceramic

finely divided particles, said minute pores existing as its non-crystalline region in a crystalline region where an arrangement of crystallite which forms said monofilament is regular and the non-crystalline region where the arrangement is irregular.

In general, although the minute pore has a size of 5 - 10 angstrom, when the fiber is immersed in a prescribed solvent, a diameter of the pore expands to 40 - 100 angstrom. Accordingly, the fiber can be filled with ceramic finely divided particles having an average particle diameter of 60 angstrom using with this invention.

In view of the above, according to the present process, dinitrogen tetroxide is allowed to contain in an organic solvent such as dimetylformamide, N-methyl-2-pyrrolidone and the like, or cotton fiber is subjected to swell by the use of an aqueous solvent such as aqueous cupricammonium, aqueous alkali and the like which is commonly known in a cylindrical form. Either the cotton fiber swelled is filled with ceramic in water, or the cotton fiber swelled is subjected to liquid current treatment in a sealed pressure vessel containing aqueous solution involving said solvent or aqueous solvent to which is added ceramic having an average particle diameter of 60 angstrom at a temperature of from 90 to 110^{o}C under a pressure of from 4 to 6 kg/cm^{2}.

Thereafter when the ceramic remaining and deposited on the surface of the cotton fiber is washed and then dried, the minute pores swelled and filled shrink, whereby the cotton fiber can introduce the finely divided ceramic thereinto.

According to the present process, when a dyestuff or a bleaching agent is added to a processing solution in said sealed

vessel, cotton fiber to be processed can be bleached or dyed at the same time of filling the cotton fiber with ceramic.

Since the resulting cotton fiber contains a ceramic having a very high porosity (e.g. 90% or more) as a result of solid solution of ceramic, such cotton fiber is excellent in heat insulating property. More specifically, a thread containing a solid such as porous silica ceramic of the present invention and gas does not only make small the heat transfer by conduction which propagates through the fiber itself, but also heat transmission between the fiber and the space as well as radiation heat transfer, so that the resulting thread has a very excellent heat insulating property and clothes and the like made from such cotton fiber do not absorb the heat from the outside.

Furthermore, a ceramic having a high porosity absorbs easily moisture due to capillary action of the pores so that the resulting cotton fiber is sensitive to hygroscopicity from the outside, and the ceramic existing in the interior of said minute pores absorbs moisture, in turns, the moisture is rapidly absorbed up to a split hole inside the cotton fiber, whereby a moisture content of the cotton fiber itself is elevated. This moisture content functions to adapt to the external atmosphere as a natural characteristic feature of cotton, i.e. when the environment dries, the moisture is released to the surface of the cotton fiber, whereby environmental adaptability is added to characteristic features of cotton.

As described above, underwear made from the ceramic cotton has superior water absorption properties to those of conventional cotton manufactured goods.

Furthermore, since ceramic has a crystalline structure of cubic or hexagonal system type and the like, when a part of the ceramic existing in a minute pore protrudes from the surface of the cotton, coefficient of friction thereof becomes larger than that of original cotton as a whole, and as a result, the touch of such cotton becomes like hemp.

Moreover, ceramic exhibits various characteristic features dependent upon ingredients thereof. In this connection, translucent ceramic being transparent in infrared region exhibits high selective absorption with respect to infrared rays. For instance, when a metallic oxide (MgO ceramics, SiO_2 ceramics, Al_2O_3 ceramics or the like) is allowed to exist in fiber, an article to be warmed (for example, human body and the like) is irradiated with far infrared rays (25 - 10 μm) being a kind of electromagnetic wave and exhibiting high thermal action from the outer environment through said translucent ceramic as thermal energy.

Accordingly, when such cotton fiber containing the present ceramic exists on the surface of a human body, it is possible to absorb outer thermal energy.

INDUSTRIAL APPLICABILITY

As described above, the ceramic-containing fiber and the process for preparing the same according to the present

invention may add characteristic features such as heat insulating absorptive effect, divergent effect as well as filtering effect which are peculiar to ceramic to vegetable fiber which is supplied in a comparatively large amount among natural fiber. Moreover, the process for the preparation according to the present invention is useful for preparing the fiber having additional characteristic features, and particularly it is suitable for solid-dissolving ceramic finely divided particles in vegetable fiber.

CLAIMS

(1) Ceramic-containing fiber characterized by comprising vegetable fiber, minute pores contained in said fiber, and closed finely divided ceramic particles having a prescribed particle diameter which have been poured in said minute pores which had been expanded by swelling said fiber.

(2) Ceramic-containing fiber as claimed in claim 1 wherein said vegetable fiber is cotton or hemp.

(3) A process for preparing ceramic-containing fiber characterized by:

allowing vegetable fiber to swell by the use of an organic solvent or an aqueous solvent in a cylindrical form;

then, immersing said fiber in an aqueous processing solution with which have been admixed finely divided ceramic particles;

heating and pressurizing the processing solution in which said fiber has been immersed, thereafter pouring the finely divided ceramic particles into expanded minute pores contained in said fiber; and

drying the resulting fiber after washing the same.

(4) A process for preparing ceramic-containing fiber as claimed in claim 3 wherein said organic solvent is dimethyl-formamide or N-methyl-2-pyrrolidone containing dinitrogen tetroxide.

(5) A process for preparing ceramic-containing fiber as claimed in claim 3 wherein said aqueous solvent is aqueous cuprammonium or aqueous alkali.

(6) A process for preparing ceramic-containing fiber as claimed in claim 3 wherein said aqueous processing solution with which have been admixed said finely divided ceramic particles is a solution containing a bleaching agent and/or a dyestuff.

INTERNATIONAL SEARCH REPORT

International Application No PCT/JP88/00676

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl[4] D06M11/00, 1/00

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC	D06M11/00-11/18, 1/00-1/24

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

Jitsuyo Shinan Koho 1971 - 1988
Kokai Jitsuyo Shinan Koho 1971 - 1988

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
Y	JP, A, 63-42970 (Kensen Kabushiki Kaisha) 24 February 1988 (24. 02. 88) (Family: none)	1-6
A	JP, A, 52-18999 (France Bed Co., Ltd.) 12 February 1977 (12. 02. 77) (Family: none)	3-6

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
August 1, 1988 (01. 08. 88)	August 22, 1988 (22. 08. 88)
International Searching Authority	**Signature of Authorized Officer**
Japanese Patent Office	