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(54) Title: HYDROPHILIC POLYMERIC FIBERS AND A PROCESS FOR PREPARING THE SAME

(57) Abstract: The present disclosure relates to hydrophilic polymeric fibers. The fibers comprise a polyester core and a sheath, wherein the sheath comprises a mixture of a polyelectrolyte and an alkali metal compound or alkaline earth metal compound. The hydrophilic polymeric fibers of the present disclosure can be used as reinforcing fibers for cementitious compositions and in paper making.



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HYDROPHILIC POLYMERIC FIBERS AND A PROCESS FOR PREPARING THE SAME

FIELD

The present disclosure relates to polymeric fibers.

5 BACKGROUND

Fibers have been used to reinforce cement concrete. A few examples of reinforcing fibers are cellulose, bleached cellulose, Polyacrylonitrile (PAN) fibers, Poly-(vinyl alcohol) (PVOH) fibers, glass wool, rock wool and asbestos fibers.

Asbestos fibers are known for their excellent reinforcing properties and their dispersibility in wet cement. However, due to increasing health concerns they are being replaced by other safer materials.

However, almost all of these fibers either lack good reinforcing strength or proper wettability in a wet cement matrix due to their poor hydrophilicity which results in poor strength of the resultant concrete.

15 Hence, there is a need to find fibers that have good hydrophilicity, good reinforcing strength, good dispersibility and that are safe for workers.

OBJECTS

Some of the objects of the present disclosure, which at least one embodiment herein satisfies, are as follows.

20 It is an object of the present disclosure to ameliorate one or more problems of the prior art or to at least provide a useful alternative.

An object of the present disclosure is to provide fibers having good hydrophilicity and thus good wettability.

Another object of the present disclosure is to provide fibers that have good reinforcing strength, and good dispersibility.

Other objects and advantages of the present disclosure will be more apparent from the following description, which is not intended to limit the scope of the present disclosure.

SUMMARY

Hydrophilic polymeric fibers of the present disclosure comprise a polyester core and a sheath.

- 5 The sheath comprises a mixture of a polyelectrolyte and at least one base selected from a group of reagents consisting of alkali metal compounds and alkaline earth metal compounds. The mixture is having viscosity in the range of 5 cP to 50 cP.

Typically, the mass ratio of the mixture coated on the polyester fibers to the total mass of the hydrophilic polyester fibers is in the range of 0.01wt% to 5wt%.

- 10 The polyester core can comprise at least one polyester selected from the group consisting of polyethylene terephthalate (PET), polybutylene terephthalate (PBT), polytrimethylene terephthalate (PTT), polytrimethylene naphthalate (PTN), polytrimethylene isophthalate (PTI), polybutylene naphthalate (PBN), polyethylene naphthalate (PEN), and vectran.

- The polyelectrolyte can be at least one selected from the group consisting of polyacrylamide, 15 chitosan, isinglass, guar gum, alginates and polydiallyldimethylammonium chloride (polyDADMAC).

In a particular embodiment, the polyelectrolyte is polyacrylamide.

In a particular embodiment, the at least one base is sodium carbonate.

- Typically, mass ratio of the at least one polyelectrolyte to the at least one base is in the range 20 of 1:0.5 to 1:5.

- A process for preparing the hydrophilic polymeric fibers of the present disclosure comprises the following steps. A predetermined quantity of at least one base is mixed in a polar fluid medium to obtain a suspension and a predetermined quantity of a polyelectrolyte is slowly added to the suspension under stirring at a predetermined speed, at a predetermined 25 temperature, for a predetermined time, followed by cooling to obtain a mixture. The mixture is applied to tows of polyester fibers. The excess mixture is squeezed out, followed by curing the polyester fibers coated with the mixture for a predetermined time period to obtain the hydrophilic polymeric fibers of the present disclosure.

In a particular embodiment, the polar fluid medium is water.

In the step of slowly adding a polyelectrolyte to the suspension, the predetermined temperature is in the range of 50 °C to 60 °C, the predetermined stirring speed is in the range of 50 rpm to 400 rpm, the predetermined time period in the range of 30 min to 3 hours, and
5 the cooling temperature is in the range of 20 °C to 35 °C.

The curing of the polyester fibers coated with the mixture is carried out for a time period in the range of 1 minute to 90 minutes.

BRIEF DESCRIPTION OF ACCOMPANYING DRAWING

The hydrophilic polymeric fibers of the present disclosure will now be described with the
10 help of the accompanying drawing, in which:

Figure 1 illustrates a comparison between tows of hydrophilic polymeric fibers of the present disclosure (B and C) and prior art hydrophilic polyester fibers (A) in terms of their interaction with wet cement; and

Figure 2 illustrates a comparison between the hydrophilic polymeric fibers of the present
15 disclosure (B and C) and prior art hydrophilic polyester fibers (A) in terms of their interaction with cement, observed under an optical microscope.

DETAILED DESCRIPTION

Asbestos fibers are known for their excellent reinforcing properties and their dispersibility in cement, however they are being replaced by other fibers due to increasing health concerns
20 that asbestos fibers pose to the workers. Other fibers replacing asbestos fibers have not been found to be satisfactory in cement reinforcing applications owing to their poor wettability in the wet cement matrix and/or poor reinforcing properties. This poor wettability in wet cement is a direct result of the poor hydrophilicity of the reinforcing fibers.

The present disclosure, therefore, envisages polymeric fibers that have good hydrophilicity
25 and, in turn, good wettability in a wet cement matrix. The fibers of the present disclosure have good reinforcing strength, good dispersibility in cement compositions, and are safe for workers.

In accordance with one aspect of the present disclosure, hydrophilic polymeric fibers are provided. Polyester fibers, per se, do not have good hydrophilicity, thus resulting in poor dispersibility in cement compositions. The present disclosure envisages hydrophilic polymeric fibers that have a polyester core, and a sheath. The sheath comprises a mixture of a
5 polyelectrolyte and at least one base selected from a group of reagents consisting of alkali metal compounds and alkaline earth metal compounds. The fibers of the present disclosure have higher hydrophilicity as compared to the fibers of the prior art and hence, better dispersibility and wettability in wet cement. The mixture has a viscosity in the range of 5 cP to 50 cP.

- 10 The mass ratio of the mixture coated on the polyester core to the total mass of the hydrophilic polymeric fibers is in the range of 0.01 wt% to 5 wt%.

The polyester core comprises at least one polyester selected from the group consisting of polyethylene terephthalate (PET), polybutylene terephthalate (PBT), polytrimethylene terephthalate (PTT), polytrimethylene naphthalate (PTN), polytrimethylene isophthalate
15 (PTI), polybutylene naphthalate (PBN), polyethylene naphthalate (PEN), and vectran.

The at least one polyelectrolyte is selected from the group consisting of polyacrylamide, chitosan, isinglass, guar gum, alginates, and polydiallyldimethylammonium chloride (polyDADMAC).

In one embodiment the at least one polyelectrolyte is polyacrylamide.

- 20 Typically, the alkali metal and the alkaline earth metal of the at least one base is selected from the group consisting of lithium (Li), sodium (Na), potassium (K), rubidium (Rb), caesium (Cs), francium (Fr) beryllium (Be), magnesium (Mg), calcium (Ca), strontium (Sr), barium (Ba) and radium (Ra).

In a particular embodiment, the at least one base is sodium carbonate.

- 25 The mass ratio of the amount of the at least one polyelectrolyte to the at least one base is in the range of 1:0.5 to 1:5.

In a particular embodiment, the mass ratio of the at least one polyelectrolyte to the at least one base is 1:2.

In an embodiment, the mass ratio of the mixture to the total mass of hydrophilic polymeric fibers is in the range of 0.01 wt% to 5 wt%.

In accordance with another aspect of the present disclosure, a process for preparing the hydrophilic polymeric fibers of the present disclosure is disclosed herein. A predetermined quantity of at least one base is mixed in a polar fluid medium to obtain a suspension. A predetermined quantity of at least one polyelectrolyte is slowly added to the suspension under stirring at a predetermined speed, at a predetermined temperature, for a predetermined time period, followed by cooling to obtain a mixture. The mixture is applied to tows of polyester fibers. The excess mixture is squeezed out, followed by curing the polyester fibers coated with the mixture for a predetermined time period to obtain the hydrophilic polymeric fibers of the present disclosure.

In a particular embodiment, the polar fluid medium is water.

In the step of slowly adding at least one polyelectrolyte to the suspension, the predetermined temperature is in the range of 50 °C to 60 °C, the predetermined stirring speed is in the range of 50 rpm to 400 rpm, the predetermined time period is in the range of 30 min to 3 hours; and said cooling temperature is in the range of 20 °C to 35 °C.

In an embodiment, the mixture is applied by spraying on tows of polyester fibers. The spraying technique comprises two sets of nozzles arranged in a way that the fiber coating formulation is sprayed on the tows of polyester fibers from above and below. The amount of the fiber coating formulation applied on the tows is 0.01wt% to 5wt%, preferably, 0.4wt%, of the total mass of the hydrophilic polyester fibers.

In an embodiment, the step of curing is carried out by passing the polyester fibers coated with the mixture, onto a relaxer for a period of 5 min to 30 min.

In an embodiment, the hydrophilic polymeric fibers of the present disclosure are sent to a cutter to cut them into predetermined short lengths to obtain hydrophilic polymeric short fibers.

In an embodiment, the predetermined short lengths of the hydrophilic polymeric short fibers are in the range of 0.4 mm to 190 mm. Typically, for concrete related applications the lengths of hydrophilic polymeric short fibers can be in the range of 0.4 mm to 26 mm, whereas for

the other applications such as paper, carpet, and/or diapers the lengths of hydrophilic polymeric short fibers can be in the range of 0.4 mm to 190 mm.

Typically, the denier of the polyester fibers used in the present disclosure is in the range of 0.6D to 12D.

5 In an embodiment, the denier of the polyester fibers used in the present disclosure is 1.5D.

In an embodiment, the hydrophilic polymeric short fibers of the present disclosure are used as reinforcing agents that can be mixed with cementitious compositions for preparing concrete articles. Conventionally, for concrete structures, asbestos fibers are used as reinforcing agents. The hydrophilic polymeric short fibers can be used to partly replace the conventional
10 asbestos fibers as reinforcing agents.

The hydrophilic polymeric short fibers of the present disclosure have better affinity for wet cement as compared to the hydrophilic fibers of the prior art. The polyelectrolyte coated on the polyester fibers has a resonance charge distribution in the functional group in the side chain, like, $-\text{CO}-\text{NH}_2$ in case of polyacrylamide. This generates a charged pole in each
15 repeating unit, especially, when the pH is greater than 7. This charged pole in the repeating units of the polyelectrolyte reacts with the cations released from the cement forming metallic bond between the metal cations and the anions in the side chains of the polyelectrolyte resulting in a certain degree of complexation. The polyelectrolyte material on the surface of the polymeric fibers increases flocculation of the cement particles, which is further enhanced
20 by the interaction of the functional groups with Ca^{++} ions produced by cement hydration. The polyelectrolyte coated on polyester fibers, thus, forms a complex with the cement particles and binds with it. This is the reason for an increased affinity of the hydrophilic polyester fibers of the present disclosure towards wet cement. This improves the flexural strength, flexural toughness, and bond strength and abrasion resistance of the reinforced concrete
25 structures. This also reduces the crushing ratio, permeability and contractility of the reinforced concrete. The hydrophilic polymeric short fibers of the present disclosure impart high compactness to produce high strength cement concrete.

The hydrophilic fibers in the prior art do not possess this metallic bond with the cement particles, due to which their adherence to cement is poorer as compared to the hydrophilic
30 polymeric fibers of the present disclosure.

In yet another aspect of the present disclosure, a fiber-reinforced cementitious composition employing the hydrophilic polymeric short fibers of the present disclosure as cement reinforcements is disclosed herein. The fiber-reinforced cementitious composition comprises:

- (a) cement;
- 5 (b) optionally, at least one supplementary cementitious material;
- (c) aggregate;
- (d) asbestos fibers in an amount in the range of 2% to 10% by weight of the cement;
- (e) hydrophilic polymeric short fibers in an amount in the range of 0.5% to 2% by weight of the cement;
- 10 (f) optionally, at least one additive, individually, in an amount in the range of 1% to 30% by weight of the cement; and
- (g) water in an amount in the range of 500% to 800% by weight of the cement.

In an embodiment, the cement is Portland cement.

15 The supplementary cementitious material can be at least one selected from the group consisting of natural or artificial pozzolans, fly ash, lime fillers, burnt shale, quartz dust, silica dust, ground granulated blast furnace slag, color pigments and hard ground waste. In an embodiment, fly ash and lime fillers are used as supplementary cementitious material.

The aggregate can comprise at least one of sand and gravel.

20 The additive, when added, can be at least one selected from the group consisting of set accelerators, hardening accelerators, dispersants, fluid loss additives, gel strength modifiers, latex systems, light-weight additives, retarders, weighting agents, plasticizers, super plasticizers, water reducing agents, viscosity modifying agents, air-entraining agents, corrosion inhibitors, foaming agents, pumping agents, workability enhancing agents, shrinkage reducers, curing agents, surface improving agents and agents to control alkali-silica
25 reaction.

In accordance with still another aspect of the present disclosure, there is provided a process for preparing a fiber-reinforced cementitious composition.

Predetermined quantities of hydrophilic polymeric short fibers of the present disclosure and asbestos fibers are dispersed in water to obtain a dispersion. The dispersion is gradually

added to cement, aggregate, water, optionally at least one supplementary cementitious material and optionally at least one additive to obtain the fiber-reinforced cementitious composition.

5 The fiber-reinforced cementitious composition of the present disclosure can be used to prepare articles, typically for use in the construction industry. A process for preparing an article using the fiber-reinforced cementitious composition of the present disclosure is also envisaged herein. The fiber-reinforced cementitious composition of the present disclosure is molded using a mold under pressure to obtain a molded mass. The molded mass is then allowed to cure to form the article.

10 In another embodiment, the hydrophilic polymeric short fibers of the present disclosure are used as reinforcing agents as a part replacement for asbestos fibers in the preparation of fiber cement sheets or gypsum boards.

In another embodiment of the present disclosure, the hydrophilic fibers of the present disclosure can be used as a secondary reinforcing agent in concrete. This can help in reducing
15 early age crack formation, the number of weakened planes and the tendency for future crack formation. It also prevents micro shrinkage cracks that may get developed during hydration, making the concrete structure/concrete article inherently stronger. The modulus of elasticity of such fiber reinforced concrete (FRC) is higher in comparison to the modulus of elasticity of only concrete or mortar binder. This FRC also helps in increasing the flexural strength of
20 the concrete article.

In still another aspect, the hydrophilic polymeric short fibers of the present disclosure can be used as reinforcing agents for paper.

The polyelectrolyte on the surface of the hydrophilic polymeric short fibers increases the dispersibility of the short fibers in water. The dispersing action of the polymeric short fibers
25 helps to reduce the pulp flocculation which, in turn, improves paper formation. The hydrophilic polymeric short fibers can be used in both hand-made and machine-made processes for preparing paper.

The present disclosure is further described in the light of the following laboratory experiments which are set forth for illustration purpose only and not to be construed for

limiting the scope of the disclosure. The following experiments can be scaled up to industrial/commercial scale and the results obtained can be extrapolated for industrial scale.

5 EXPERIMENTS

Experiment 1: Preparation of hydrophilic polymeric fibers of the present disclosure

Na₂CO₃ (0.2 g) was mixed in 40 mL water contained in a vessel to form a suspension (0.5% solution). Polyacrylamide (0.1 g) (Percol 2305) was slowly added in parts to the above suspension with continuous stirring at a speed of 300 rpm, at 60° C for 1 hour, and was
10 allowed to cool over 1 hour to obtain a mixture (referred to as RTH-2C). Viscosity of this mixture was found to be 35.1 cP (using Brookfield SP# 1, at 100 rpm and 30° C). This coating mixture (RTH-2C), was sprayed over a 25 g PET fiber tow. The excess mixture was squeezed out and the coated fibers were kept on a relaxer for 15 min. Thereafter, the coated fibers were taken to a cutter to cut them to short fibers which are referred to as polymeric
15 short fibers (RTH-2C fibers).

Experiment 2: Comparision of the properties of hydrophilic polymeric fibers

The polymeric short fibers of Experiment 1 (RTH-2C fibers) were compared for cement wettability with commercially available PET fibers (R3S fibers).

The short fibers from Experiment 1 and R3S fibers, were separately, mixed with a cement
20 composition and allowed to dry followed by repeatedly washing with water. The fibers were compared for wet cement wettability. **Figure 1** illustrates this comparison between the RTH-2C fibers (of the present disclosure) and the R3S fibers (of the prior art). 'A' illustrates R3S fibers, which can be clearly seen as not being wetted with cement composition adequately. 'B' illustrates RTH-2C fibers (i.e. hydrophilic polymeric short fibers of the present
25 disclosure) whereas 'C' illustrates a tow of RTH-2C fibers (i.e. hydrophilic polymeric fibers of the present disclosure). It is clearly evident from **Figure 1** that 'B' and 'C' are wetted by the cement composition to a very high degree as compared to 'A'.

Figure 2, 'A', 'B' and 'C', also illustrate the interaction with cement of R3S fibers ('A') and RTH-2C fibers ('B' and 'C') as observed under an optical microscope.

It is clearly evident from the images that the RTH-2C fibers (of the present disclosure) show better interaction with cement as compared to commercially available hydrophilic PET fibers (R3S fibers).

Experiment 3: Preparation of a cement composition using the hydrophilic polymeric fibers of the present disclosure

The short fibers from Experiment 1 (RTH-2C fibers) were taken along with asbestos fibers for reinforcing a cement slab. The control cement composition (experiment 3a) used for the slab was: 54% of Ordinary Portland Cement (OPC), 35.5% of fly ash (FA), 9% of asbestos fibers (AF), and 1.5% of cellulosic pulp (CP). In experiments 3b–3d, 0.5% of asbestos fibers of the control cement composition were replaced by commercially available polyester fibers (R3S fibers), PVA coated polyester fibers (RTH-1 fibers) and polymeric short fibers of the present disclosure (RTH-2C fibers) respectively. Keeping the other constituents fixed, the resultant cement compositions were molded into slabs. These slabs were compared for modulus of rupture. Table 1 provides a comparison of the Modulus of Rupture of the slabs prepared using these compositions:

Table 1: A comparison of Modulus of Rupture of slabs made of different compositions

Expt. No.	Sample	Density in g/cm^3	Modulus of Rupture in Kg/cm^2	% Improvement with respect to R3S fibers of expt. 3b
3a (control)	100% AF	1.4	175	NA
3b (prior art)	R3S + AF (0.5% + 99.5%)	1.4	145	NA
3c (prior art)	RTH-1 + AF (0.5% + 99.5%)	1.4	148.7	2.55
3d (present)	RTH-2C + AF	1.4	173.2	19.45

disclosure)	(0.5% + 99.5%)			
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AF: Asbestos Fibers.

R3S: Commercially available PET fibers.

RTH-1: PVA coated polyester fibers.

RTH-2C: Hydrophilic Polymeric Fiber of the present disclosure.

- 5 From **Table 1**, it can be seen that in experiment 3b, the modulus of rupture of the (R3S + AF) fibers decreases considerably as compared to the control (expt. 3a) containing only asbestos fibers. Further, in experiment 3c, the modulus of rupture of (RTH-1 + AF) fibers improved by 2.5% in comparison with (R3S + AF) sample, but is still considerably less as compared to the asbestos fibers. Furthermore, in experiment 3d, the modulus of rupture of the (RTH-2C + AF) fibers remarkably improved by 19.3% in comparison with (R3S + AF) sample, and is almost as good as the asbestos fibers, resulting in higher hydrophilicity, thereby leading to higher wettability of the polymeric short fibers of the present disclosure in wet cement matrix.

15 In experiments (3e-3g), 75% RTH-2C fibers (of the present disclosure) were mixed with 25% R3S fibers and the combination was used to replace 0.5% of asbestos fibers of the control cement composition to construct a cement slab. Other such cement slabs were prepared with RTH-1 fibers and RTH-2H fibers, each mixed with R3S fibers in the same proportions and the respective mixtures partly replacing asbestos fibers. These slabs were compared with a slab reinforced with a mixture of RTH-2C fibers and asbestos fibers. The modulus of rupture properties are as summarized in Table 2 below:

20 **Table 2: Comparison of Modulus of Rupture of slabs made of compositions with R3S fibers in combination with other fibers**

Expt. No.	Fiber description	Density (g/cc)	Modulus of Rupture (Kg/cm ²)	% Improvement with respect to R3S
3e	(75% RTH-1 + 25% R3S) + AF (0.5% + 99.5%)	1.40	157	8.2
3f	(75% RTH-2C + 25% R3S) + AF (0.5% + 99.5%)	1.40	168.7	16.4

AF:	3g	100% RTH-2C + AF (0.5% + 99.5%)	1.40	173.2	19.3
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Asbestos Fibers.

R3S: Commercially available PET fibers.

RTH-1: PVA coated polyester fibers.

5 RTH-2C: Hydrophilic Polymeric Fiber of the present disclosure.

From the above experimental observations and results, it can be seen that in experiment 3g, 19.3% improvement in modulus of rupture of (RTH-2C +AF) fibers is higher than the improvement in modulus of rupture achieved using(R3S + RTH-1 + AF) fibers of experiment 3e, and (RTH-2C + R3S + AF) fibers of experiment 3f, for cement reinforcement.

10 From the modulus of rupture values, it can be inferred that the hydrophilic polymeric fibers of the present disclosure have a better hydrophilicity and hence, better wettability in wet cement matrix as compared to the fibers in the prior art. Hence, they have good dispersibility in cement compositions and in turn, good reinforcing strength. They are, thus, a suitable substitute to asbestos fibers, at least, partially.

15 **Experiment 4: Preparation of paper formulation using the hydrophilic polymeric fibers of the present disclosure**

The hydrophilic polymeric short fibers of the present disclosure were used as reinforcing agents in paper-making. The control sample for paper making was 100% cellulosic pulp. Polymeric short fibers of Experiment 1 (RTH-2C fibers) were used as a reinforcing material for paper. The resultant paper was compared with the control sample and paper with R3S fibers used as reinforcing material. The tensile strength of the paper prepared using RTH-2C fibers as reinforcing agents decreased in comparison with the control sample and the R3S fibers reinforced paper. However, elongation (%) of the paper prepared using RTH-2C fibers as reinforcing agents increased considerably in comparison with elongation (%) of the control sample and the R3S fibers reinforced paper.

Table 3 compares the tensile strength and elongation properties of the control sample, R3S paper sample and RTH-2C paper sample.

Table 3: Comparison of tensile strength and elongation of the control sample paper and the papers with R3S fibers and RTH-2C fibers as reinforcing agents

Sr. No.	Sample No.	Tensile Strength (lb/in)	Elongation (%)
1	Control sample - 100% Cellulosic Pulp	5.38	1.6
2	R3S fibers + Cellulosic Pulp (0.5% + 99.5%)	5.34	1.9
3	RTH-2C + Cellulosic Pulp (0.5% + 99.5%)	5.13	2.5

AF: Asbestos Fibers.

R3S: Commercially available PET fibers.

RTH-1: PVA coated polyester fibers.

RTH-2C: Hydrophilic Polymeric Fiber of the present disclosure.

- 10 From Table 3, it can be seen that the tensile strength of the paper reinforced with RTH-2C fibers was slightly lower than the tensile strength of the control sample paper reinforced with R3S fibers. However, elongation (%) of the paper reinforced with RTH-2C fibers was better than the elongation (%) of the control sample paper reinforced with R3S fibers. Thus, the paper reinforced with RTH-2C fibers is more stretchable than the control sample paper reinforced with R3S fibers.
- 15

Though the tensile strength of the paper reinforced with RTH-2C fibers was lower than the tensile strength of the control sample paper reinforced with R3S fibers, the elongation (%) of the paper reinforced with RTH-2C fibers was better than the elongation (%) of the control sample paper reinforced with R3S fibers.

This shows that the hydrophilic polymeric short fibers of the present disclosure can be conveniently used in the process of paper making as reinforcing agents for paper.

TECHNICAL ADVANCES AND ECONOMICAL SIGNIFICANCE

The present disclosure described herein above has several technical advantages including, but
5 not limited to, the realization of hydrophilic polymeric fibers that:

- have good hydrophilicity;
- can, at least, partly replace asbestos fibers for cement reinforcement;
- can be used as a reinforcing material in paper making;
- have good reinforcing strength and good dispersibility in cement compositions and
10 paper compositions; and
- are safe, during manufacturing, for workers.

The foregoing description of the specific embodiments so fully reveals the general nature of the embodiments herein that others can, by applying current knowledge, readily modify
15 and/or adapt for various applications such specific embodiments without departing from the generic concept, and, therefore, such adaptations and modifications should and are intended to be comprehended within the meaning and range of equivalents of the disclosed embodiments. It is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation. Therefore, while the embodiments herein
20 have been described in terms of preferred embodiments, those skilled in the art will recognize that the embodiments herein can be practiced with modification within the spirit and scope of the embodiments as described herein.

Throughout this specification the word “comprise”, or variations such as “comprises” or “comprising”, will be understood to imply the inclusion of a stated element, integer or step,
25 or group of elements, integers or steps, but not the exclusion of any other element, integer or step, or group of elements, integers or steps.

The use of the expression “at least” or “at least one” suggests the use of one or more elements or ingredients or quantities, as the use may be in the embodiment of the disclosure to achieve one or more of the desired objects or results.

Any discussion of documents, acts, materials, devices, articles or the like that has been included in this specification is solely for the purpose of providing a context for the disclosure. It is not to be taken as an admission that any or all of these matters form a part of the prior art base or were common general knowledge in the field relevant to the disclosure as
5 it existed anywhere before the priority date of this application.

The numerical values mentioned for the various physical parameters, dimensions or quantities are only approximations and it is envisaged that the values higher/lower than the numerical values assigned to the parameters, dimensions or quantities fall within the scope of the disclosure, unless there is a statement in the specification specific to the contrary.

10 While considerable emphasis has been placed herein on the components and component parts of the preferred embodiments, it will be appreciated that many embodiments can be made and that many changes can be made in the preferred embodiments without departing from the principles of the disclosure. These and other changes in the preferred embodiment as well as other embodiments of the disclosure will be apparent to those skilled in the art from the
15 disclosure herein, whereby it is to be distinctly understood that the foregoing descriptive matter is to be interpreted merely as illustrative of the disclosure and not as a limitation.

CLAIMS:

1. Hydrophilic polymeric fibers, having a polyester core and a sheath, said sheath comprising a mixture of a polyelectrolyte and at least one base selected from a group of reagents consisting of alkali metal compounds and alkaline earth metal compounds;
5 wherein said mixture is having viscosity in the range of 5 cP to 50 cP.
2. The fibers as claimed in claim 1, wherein the mass ratio of said mixture to the total mass of said hydrophilic polymeric fibers is in the range of 0.01wt% to 5wt%.
- 10 3. The fibers as claimed in claim 1, wherein said polyester core comprises at least one polyester selected from the group consisting of polyethylene terephthalate (PET), polybutylene terephthalate (PBT), polytrimethylene terephthalate (PTT), polytrimethylene naphthalate (PTN), polytrimethylene isophthalate (PTI), polybutylene naphthalate (PBN), polyethylene naphthalate (PEN), and vectran.
- 15 4. The fibers as claimed in claim 1, wherein said polyelectrolyte is at least one selected from the group consisting of polyacrylamide, chitosan, isinglass, guar gum, alginates, and polydiallyldimethylammonium chloride (polyDADMAC).
- 20 5. The fibers as claimed in claim 1, wherein said polyelectrolyte is polyacrylamide.
6. The fibers as claimed in claim 1, wherein said base is sodium carbonate.
7. The fibers as claimed in claim 1, wherein the mass ratio of the amount of said
25 polyelectrolyte to said at least one base is in the range of 1:0.5 to 1:5.
8. A process for preparing hydrophilic polymeric fibers, said process comprising the
30 following steps:
 - (a) mixing a predetermined quantity of at least one base in a polar fluid medium to obtain a suspension and slowly adding a predetermined quantity of a polyelectrolyte to said suspension under stirring at a predetermined speed, at a predetermined temperature, for a predetermined time period, followed by cooling
35 to obtain a mixture having viscosity in the range of 5 cP to 50 cP;

- (b) applying said mixture to tows of polyester fibers; and
- (c) squeezing out the excess mixture, followed by curing the polyester fibers coated with the mixture for a predetermined time period to obtain said hydrophilic polymeric fibers.

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9. The process as claimed in claim 8, wherein said polar fluid medium is water.

10. The process as claimed in claim 8, wherein in step (a), said predetermined temperature is in the range of 50 °C to 60 °C, said predetermined stirring speed is in the range of 50 rpm to 400 rpm, said predetermined time period is in the range of 30 min to 3 hours, and said cooling temperature is in the range of 20 °C to 35 °C.

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11. The process as claimed in claim 8, wherein said curing in step (c) is carried out for a time period in the range of 1 minute to 90 minutes.

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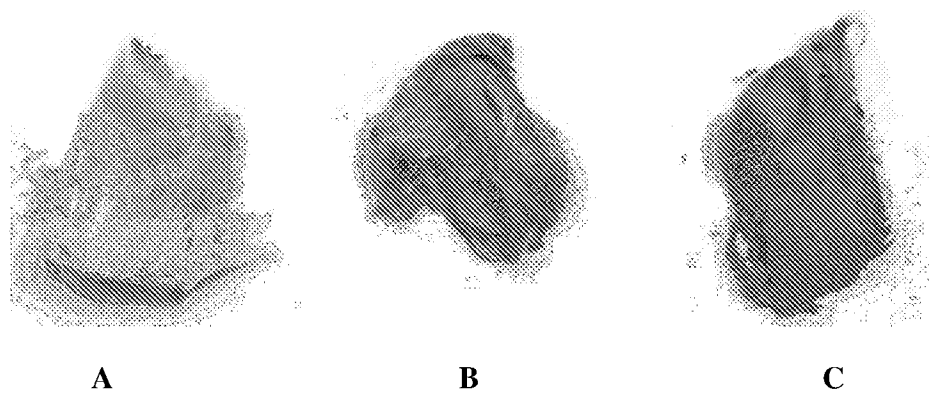


FIGURE 1

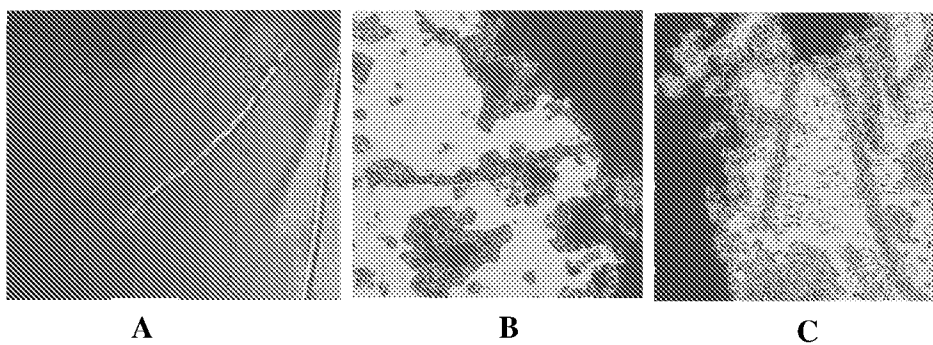


FIGURE 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2017/053799

A. CLASSIFICATION OF SUBJECT MATTER
D01F8/14, C04B14/38, C04B16/06, C04B20/10 Version=2017.01

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)

D01F, C04B

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)

Patseer, IPO Internal Database

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2009084101 A (SEIREN CO LTD, KB SEIREN LTD) 23 April 2009 abstract, para[0003],[0006]	1-11
Y	WO2014207760 A2 (RELIANCE INDUSTRIES LIMITED) 31 December 2014 abstract, page 4, line	1-11
Y	WO 2012016237 (UNITED RESOURCE RECOVERY CORPORATION & NORTH CAROLINA STATE UNIVERSITY) 2 February 2012 abstract; para [0007], [0008], claim 1	1-11
Y	US5700559 A (ADVANCED SURFACE TECHNOLOGY) 23 December 1997 col 6, line 19-22; col 7, line 9-27	1-11
A	US5698331 A (TORAY INDUSTRIES, INC) 16 December 1997 col 4, line 14-18, col 1, line 38-42	1-11

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

* Special categories of cited documents:	"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
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"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	"&" document member of the same patent family

Date of the actual completion of the international search

13-10-2017

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IB2017/053799

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