

Description**TECHNICAL FIELD**

5 This invention relates to an improvement in the field of concrete additives useful in modifying the properties of concrete. This invention also relates to a concrete-ready bag containing concrete admixture which is added directly to a concrete mixer, or similar apparatus, during a concrete mixing operation. Specifically, the present invention relates to a method for modifying the properties of a concrete by
 10 introducing a pre-weighted amount of powdered or solid concrete admixture within a container into a wet mixer and thereafter agitating the resulting mix until the container disintegrates and the admixture is dispersed.

BACKGROUND OF THE INVENTION

15 As known in the art, an admixture is a material other than hydraulic cement, water, and aggregates that is used as an ingredient of concrete or mortar and is added to the batch immediately before or during its mixing. Admixtures are used to modify the properties of the concrete in such a way as to make it more suitable for a particular purpose or for economy. Thus, the major reasons for using admixtures are (1) to achieve certain structural improvements in the resulting cured concrete; (2) to improve the quality of
 20 concrete through the successive stages of mixing, transporting, placing, and curing during adverse weather or traffic conditions; (3) to overcome certain emergencies during concreting operations; and (4) to reduce the cost of concrete construction. In some instances, the desired result can only be achieved by the use of an admixture. In addition, using an admixture allows the employment of less expensive construction methods or designs and thereby offsets the costs of the admixture.

25 For example, at the end of a delivery, concrete mixers may contain from 91 to 272 Kg (200 to 600 pounds) of residual cement, sand or rock when left in the mixer overnight, the residual concrete will settle and harden in the bottom of the mixer. While the residual materials can be washed out of the mixer with a large amount of water, disposal of the liquid may cause an environmental problem particularly in large metropolitan areas. To avoid this problem, it is desirable to delay or retard the setting of residual concrete
 30 in a mixer so that it remains fluid and the residual material can still be used the next day. It is also desirable to be able to delay or retard the setting of concrete in a mobile mixer while the mixer is being transported to another location. For specific applications, it may also be desirable to retard or delay the setting of concrete for a specific length of time curing breakdown or delay in traffic in populated areas. The addition of retarding admixture to the concrete is used to solve each of these problems. By varying the amounts of a
 35 retarding admixture used in a batch, the setting of the concrete can be delayed for a selected time period. The availability of a pre-weighed or pre-measured quantity of retarding admixture can increase the accuracy with which the setting time can be delayed.

Admixtures are commercially available as water-soluble solids or powders, requiring job mixing at the point of usage, or a ready-to-use liquids added at bulk blending stations. The successful use of admixtures
 40 depends upon the accuracy with which they are prepared and batched. Batching means the weighing or volumetric measuring of the ingredients for a batch of either concrete or mortar and introducing them into the mixer. The amount of admixture added during batching must be carefully controlled. Inaccuracies in the amount of admixture added can significantly affect the properties and performance of the concrete being batched and even defeat the original purpose of including the admixture. The need for accuracy in
 45 measuring the amount of solid admixture to be added to a batch is particularly acute where only a relatively small amount of admixture is acquired for the job.

Solid powdered admixtures are packaged and sold in bags, boxes and drums, and the admixture is added to the concrete mixture by opening the package and shovelling or dumping the admixture directly
 50 into a concrete mixer, or similar apparatus, during the concrete mixing operation. This labour-intensive task is often messy and can also result in a non-uniform dispersion of admixture. Accordingly, it is desirable to have a method of dispersing admixture which is less labour-intensive, less messy and more effective at uniformly distributing the admixture throughout the mixture.

JP-A-59/192523 discloses placing capsules of surfactant into mortar or concrete which has been previously kneaded, and the step of further kneading the mixture to destroy the capsule. The capsule itself
 55 is made of water-soluble film, or an easily destructible material including glass, paper or plastics.

US-A-4725465 discloses the use of a water-soluble paper envelope to enclose a neutralizing composition for containing chemical spills. This is in order to allow rapid administration of the chemical-neutralizing composition and the paper in question is one which dissolves freely upon contact with water in less than 30

seconds, and preferably within 5 seconds.

JP-A-42/072724 discloses a cement setting accelerator in capsule form where the capsule wall is water-soluble or melted by the heat of hydration of the cement. The capsules are dispersed by subsequent vibration.

It is an object of the present invention to provide a method for providing a pre-measured amount of cement admixture to a concrete wet mixer which is less labour-intensive than conventional methods.

It is also an object of the present invention to provide a method for uniformly distributing admixture throughout fresh concrete.

The present invention is characterized by the features of claim 1.

DETAILED DESCRIPTION OF THE INVENTION

As used herein, the term "effective amount" of admixtures means an adequate quantity of material per cubic meter of hardened concrete to impart the desired improvement in the wet/dry concrete. Often, more than one bag of admixture material is added to a commercial concrete mixer. As a result, the total amount of admixture from the bags must "cumulatively" result in an effective amount. Typically, one bag containing from about 45.4 gm (0.10 lb.) to about 45.4 Kg (100.0 lb.) of admixture is added to each cubic meter of concrete (dry weight).

As used herein, the term "uniform distribution" or "relatively uniform distribution" means that the admixture is distributed in such a manner as that the desired property, i.e. air entrainment, retardation, acceleration, etc., can be observed (preferably measured) in samples taken from the beginning, middle and end of the concrete mixture.

As used herein the term "batch type concrete mixer" means any batch mixer suitable for thoroughly mixing cement and aggregates so as to obtain a homogeneous mass and coat all particles with cement paste. Preferred concrete mixers are: (1) rotating mixers, consisting of a revolving drum or a square box revolving about its diagonal axis and usually provided with deflectors and blades to improve the mixing; or (2) paddle mixers, consisting of a stationary box with movable paddles which perform the mixing. Rotating mixers are most preferred for use in the present invention.

Many manufacturers have developed water soluble papers. For example, Gilbreth Company, Philadelphia PA., markets "Dissolve", which is a water-soluble paper prepared by coating synthetic paper with polyvinyl alcohol. The resolvable papers comprise carboxy methyl cellulose and the sodium or potassium salt of carboxy methyl cellulose. (See U.S. Patent 3,859,125 issued January 7, 1975 to Miller, et al.) These specialized papers would surely dissolve in the aqueous environment of a concrete mixing operation. However, these papers are very expensive and, it is believed that these papers would dissolve too rapidly and could produce a large clump of admixture within the mix which might resist distribution. Furthermore, the alcohol coatings of the soluble paper may have a detrimental effect on the resulting concrete as they tend to detract air in the wet mix.

In the construction field, many methods of strengthening concrete have been developed through the years. One modern method involves distributing fibers throughout a fresh concrete mixture. Upon hardening, this concrete is referred to as fiber-reinforced concrete. Fibers can be made of steel, glass, or synthetic materials, e.g., polypropylene, nylon, polyethylene, polyester, rayon, high-strength aramid, (i.e. Kevlar®), or mixtures thereof. Preferred fibers of the present invention are synthetic fibers. Preferred synthetic fibers, according to the present invention, are manufactured from 100% virgin polypropylene in collated, fibrillated form. Preferred fibers are about 1/2 to about 3/4 inch in length. Fibers, in general, are further discussed in ASTM designation C116, "Standard Specification for Fiber-Reinforced Concrete and Shotcrete", incorporated herein by reference.

Mixtures of two or more admixtures are also contemplated by the present invention.

It has been discovered that a packaging material prepared from paper of a non-soluble, traditional variety abrades more slowly and, surprisingly, distributes the admixture very uniformly throughout the fresh concrete mixture. These non-soluble papers tend to disintegrate upon the wet abrasion found in the concrete mixer, they do not dissolve, because the cellulosic materials found within the paper are insoluble in water. The abrasion of the sand, gravel and other concrete components causes the paper to disintegrate, i.e. fragment into pieces which are unnoticeable to the human eye and have no detrimental effect on the properties of the finished concrete. Preferred papers contemplated in the present invention include repulpable and beater paper, shopping bag kraft paper, and multiwall kraft paper. The most preferred papers are repulpable, beater papers. Flexible paper container material are further described in Kirk-Othmer, Encyclopedia of Chemical Technology, 3rd ed. (1981), vol. 16, page 801, incorporated herein by reference.

One paper which is particularly effective in the present invention is a 22.7 Kg (50 lb.) white beater paper. This paper is fabricated from 100% pine pulp, has a basis weight of about 22.7 Kg (50 lb.), a machine direction tear of about 109, a machine direction tensile of about 16, sizing of about 0, a brightness (TAPPI) of about 80.0, and a moisture content of about 5.6%. These paper specification determinations are further described in Kirk-Othmer, *Encyclopedia of Chemical Technology*, 3rd ed., (1981), Vol. 1b, pp. 771-780, incorporated herein by reference. This paper can be fabricated into a bag or pouch. Union Camp Corporation, Wayne, NJ., fabricates a 22.7 Kg (50 lb.) white multi-wall beater paper bag which is most preferred in the present invention.

Bags or pouches can be fabricated in any shape, provided that they fit into the fill opening of a standard concrete mixture. A preferred embodiment of the present invention includes 0.68 Kg (1.5 lb.) of admixture contained in a 38.1 x 35.6 cm (15" x 14") flat pillow pouch fabricated from the 22.7 Kg (50 lb.) white multiwall beater paper bag described above.

The bag or pouch is typically placed inside the concrete mixer drum via the drum opening. This may be done before introducing the other concrete components, during the introduction of the concrete components, after the introduction of the concrete components, or any combination of the three. Mixing times should be at least about 5 minutes.

We have discovered that it is also helpful to seal bags of the present invention with a water soluble adhesive. These adhesives can be any water soluble or water miscible adhesive which imparts sufficient bond strength to prevent premature opening of the bag in transit. It is also important that the adhesive does not impart any deleterious qualities to the resulting concrete. A typical water soluble adhesive suitable for use in the present invention is a one-part acrylic copolymer emulsion adhesive.

It has also been discovered that distribution of most admixtures can be improved by including a dispersant in the package along with the admixture. These dispersants can be water-reducing and high-range water-reducing dispersants selected from the group consisting of lignosulfonates (e.g., sodium lignosulfonate), naphthlene sulfonate, malemine sulfonate, "superplasticizers" (like those described in U.S. Patent Nos. 4,518,725 to Arfaei on March 21, 1989; 4,657,593 to Aignesberger et al. on April 4, 1987; and 4,814,014 to Guicquero on May 21, 1985, incorporated herein by reference), and mixtures thereof. Preferred dispersants are lignosulfonate and naphthlene sulfonate. Liquid dispersants are added to the admixture by spraying or any other acceptable coating means. Dry dispersants, in powder form, may be added directly to the bag containing the admixture. The ratio of dispersant to admixture is typically from about 1 : 1 to about 1 : 15 w/w. The preferred ratio of dispersant of admixture is from about 1 : 6 to about 1 : 9 w/w. The level of dispersant can vary based on the dispersant itself.

Although certain specific embodiments of the invention have been shown and described for use in the present invention, it will be apparent in accordance with the broader aspect of the invention that various modifications and other embodiments are possible. For example, preferred papers with slightly different characteristics may also work, or concrete mix, cement, sand and mixtures thereof may also be added to the admixture. It is to be understood, therefore, that the invention is not limited to the specific arrangements shown.

The following examples depict typical embodiments of the present invention:

EXAMPLE I

Method of producing a Fibre-Containing Product

A quantity of 0.68 Kg (1.5 lb.) of collated, fibrillated polypropylene fibres which are 12.7 mm (1/2") in length are weighed. The fibres are distributed by W. R. GRACE & CO.-CONN., Cambridge, MA under the name GRACE FIBERS™. These fibres have the following typical properties:

Specific Gravity	0.91
Absorption	None
Modulus of Elasticity	322.6 Kg/cm ² (500 Kg/in ²)
Melt Point	160 °C
Ignition Point	590 °C
Alkali, Acid + Salt Resistance	High

The fibres are manually packaged in a 35.6 x 38.1 cm (14" x 15") flat pillow-type bag holding 22.7 Kg (50 lb.), formed of white multi-wall beater paper, and manufactured by Union-Camp Corp., Wayne, NJ. The

bag comprises one open end which has a lip.

The bag is fed into an automatic sealing/folding machine. The machine then applies the adhesive to the bag lip, folds the bag to close the bag, and applies enough pressure to seal the bag. The bag is then put into a cardboard box for shipping.

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EXAMPLE II

Method of Using the Improved Concrete Additive Products of the Present Invention

10 The concrete additive product of any previous Example is removed from the cardboard box. The bag is placed in a revolving drum-type rotating concrete mixer containing 1 m³ of fresh ready-mix concrete mixture through the drum opening. The fresh concrete and bag are mixed for 5 minutes. The admixture distribution is uniform.

EXAMPLE III

Alternative Method of Using the Improved Concrete Additive Products of the Present Invention

20 The concrete additive product of Example II is removed from the cardboard box. The bag is placed in a revolving drum-type rotating concrete mixer via an automated magazine feed dispenser which introduces the bag to the other concrete components at a rate of one bag per 1 m³ of concrete. Water is added to the dry mix and the fresh concrete slurry is mixed by rotating the drum for 5 minutes. The admixture distribution is uniform.

25 Claims

1. A method for modifying the properties of a concrete comprising the steps of :
 - (a) introducing into fresh concrete an unopened non-water-soluble repulpable beater paper bag containing fibres operative to reinforce said concrete upon hardening of said concrete, said fibres being comprised of steel, glass, synthetic material, or a combination thereof; and
 - (b) mixing the fresh concrete of step (a) in a batch type mixer for sufficient time to cause said non-water-soluble repulpable beater paper bag to disintegrate by fragmentation into pieces and distribute the admixture relatively uniformly throughout the fresh concrete.
- 35 2. A method according to claim 1, wherein said repulpable beater paper bag comprises multiwall Kraft paper.
3. A method according to claim 1 or 2, wherein said paper is a repulpable beater paper has a basis weight of about 22.7 Kg (50 lbs.), a machine direction tear of about 109, and a machine direction tensile

40 of about 16.
4. A method according to claim 3, wherein said repulpable beater paper is fabricated from 100% pine pulp.
- 45 5. A method according to any one of the preceding claims, wherein the bag is sealed with a water soluble adhesive.
6. A method according to claim 5, wherein the water soluble adhesive is a one-part acrylic copolymer emulsion adhesive.
- 50 7. A method according to any one of claims 1 to 6, wherein one said bag is used per cubic meter of concrete.
8. A method according to any one of claims 1 to 7, wherein said fibres are comprised of polypropylene in collated, fibrillated form.
- 55 9. A method according to any one of claims 1 to 8, wherein said fibres are 13.6 to 19.1 mm (1/2 to 3/4 inch) in length.



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Patentansprüche

1. Verfahren zum Modifizieren der Eigenschaften von Beton, bei dem
 - a) ein ungeöffneter Papierbeutel aus wasserunlöslichem, aufschließbarem Holländer-Papier, welcher Fasern enthält, die geeignet sind, den Beton bei Aushärten des Betons zu verstärken, und aus Stahl, Glas, synthetischem Material oder einer Kombination derselben zusammengesetzt sind, in den frischen Beton eingebracht wird und
 - b) der frische Beton aus Schritt a) in einem Chargenmischer für eine ausreichende Zeit gemischt wird, damit sich der Papierbeutel aus wasserunlöslichen, aufschließbaren Holländer-Papier unter Fragmentieren in Stücke zersetzen und sich das Gemisch relativ gleichmäßig im frischen Beton verteilen kann.
2. Verfahren nach Anspruch 1, bei dem der aufschließbare Holländer-Papierbeutel mehrwandiges Kraft-Papier umfaßt.
3. Verfahren nach Anspruch 1 oder 2, bei dem das Papier ein aufschließbares Holländer-Papier mit einem Flächengewicht von etwa 22,7 kg (50 lbs.), einer Reißfestigkeit in Maschinenrichtung von etwa 109 und einer Zugfestigkeit in Maschinenrichtung von etwa 16 ist.
4. Verfahren nach Anspruch 3, bei dem das aufschließbare Holländer-Papier aus 100% Kiefer-Zellstoff hergestellt ist.
5. Verfahren nach einem der vorhergehenden Ansprüche, bei dem der Beutel mit einem wasserlöslichen Klebstoff verschlossen ist.
6. Verfahren nach Anspruch 5, bei dem der wasserlösliche Klebstoff eine Einkomponenten-Acrylcopolymer-Emulsion ist.
7. Verfahren nach einem der Ansprüche 1 bis 6, bei dem ein solcher Beutel pro Kubikmeter Beton verwendet wird.
8. Verfahren nach einem der Ansprüche 1 bis 7, bei dem die Fasern aus Polypropylen in kollationierter, fibrillierter Form bestehen.
9. Verfahren nach einem der Ansprüche 1 bis 8, bei dem die Fasern 13,6 bis 19,1 mm (1/2 bis 3/4 inch) lang sind.

Revendications

1. Méthode pour modifier les propriétés d'un béton comprenant les étapes de :
 - (a) introduction dans un béton frais d'un sac en papier de battage repulpable non soluble dans l'eau non ouvert, contenant des fibres opérationnelles pour renforcer ledit béton jusqu'à durcissement dudit béton, lesdites fibres comprenant de l'acier, du verre, un matériau synthétique ou une combinaison de ceux-ci ; et
 - (b) mélange du béton frais de l'étape (a) dans un mélangeur de type en discontinu pour un temps suffisant pour faire que ledit sac en papier battage repulpable non soluble dans l'eau se désintègre par fragmentation en morceaux et distribue l'additif de mélange relativement uniformément à travers le béton frais.
2. Méthode selon la revendication 1, dans laquelle ledit sac en papier de battage repulpable comprend du papier kraft multiparoi.
3. Méthode selon la revendication 1 ou 2, dans laquelle ledit papier est un papier de battage repulpable qui a un poids de base d'environ 22,7 kg (50 livres), un déchirement dans la direction de la machine d'environ 109 et une tension dans la direction de la machine d'environ 16.
4. Méthode selon la revendication 3, dans laquelle ledit papier de battage repulpable est fabriqué à partir de pulpe de pin à 100%.



5. Méthode selon l'une quelconque des revendications précédentes, dans laquelle le sac est scellé avec un adhésif soluble dans l'eau.
6. Méthode selon la revendication 5, dans laquelle l'adhésif soluble dans l'eau est un adhésif en émulsion de copolymère acrylique en une partie.
7. Méthode selon l'une quelconque des revendications 1 à 6, dans laquelle un dit sac est utilisé par mètre cube de béton.
8. Méthode selon l'une quelconque des revendications 1 à 7, dans laquelle lesdites fibres comprennent du polypropylène sous forme fibrillée, collée.
9. Méthode selon l'une quelconque des revendications 1 à 8, dans laquelle lesdites fibres ont une longueur de 13,6 à 19,1 mm (1/2 à 3/4 de pouce).