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(54) **Method and apparatus for the introduction of fibrous material into a substance**

Verfahren und Vorrichtung zur Einführung von Faserstoff in eine Substanz

Procédé et dispositif pour l'intoduction de matière fibreuse dans une substance

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EP 0 940 168 B1

Description

[0001] This invention relates to methods and apparatus for the introduction of fibrous material into a substance or mixture. In particular but not exclusively, the invention relates to such methods in which cellulose fibres, other organic fibres or mineral fibres are provided in pelletised form for subsequent addition to mixture of ingredients.

[0002] Cellulose or mineral fibre are commonly used to modify the rheological properties of liquid systems, including those based on cement and water, and those based on bitumen. The fibres have a gelling or thickening effect on these systems which may include, for example, a cement-based tile adhesive or a bituminous road surfacing compound. Cellulose and mineral fibre usage has increased partly due to the demise of asbestos fibre.

[0003] Cellulose fibre may be derived for example from recycled paper, timber, woodpulp, or various other agri-materials such as straw, flax. Other organic fibres include, for example, polyester, polythene and polypropylene. Mineral fibre is commonly made from glass, basaltic rock or steel slag.

[0004] Fibre is normally supplied in compressed bales which may be from 1 Kg to 400 Kg in weight. There are three main methods for adding fibre to the mixes. In one such method, bales may be added direct to a mixer. Thus, in the case of hot bitumen mixes, the whole bale (including polyethylene packaging) may be added, the plastic quickly dissolving into the hot liquid bitumen. Alternatively, and particularly in the use of dry powder mixes, the fibre is emptied from the packaging direct into the mixer, or perhaps via a hopper and screw arrangement, possibly after a weighing operation to obtain the exact quantity required for a batch. These methods are labour intensive and often require an operative to work very close to mixing machinery, with environmental problems of dust, fumes and noise.

[0005] In a further method, bales of fibre may be emptied into a pneumatic blowing machine and dosed gravimetrically or volumetrically into the mixer along a pipe which may be 25-150 mm in diameter for example. This method lends itself to the use of bigger bales with consequent reductions in labour intensity, and also provides a solution to the environmental problems. However, it still falls short of true bulk handling.

[0006] In another method, the fibre may be pelletised, or granulated possibly by the fibre manufacturer, in a pelletising or granulating process in which small compressed pellets or granules are formed by extrusion, pressing or other available method. Normally, an additive is used which lubricates this process and acts as a binder. This additive may be bitumen, wax, oil or other suitable materials. However it is also possible to pelletise or granulate some fibres without any additives. The pellets or granules lend themselves to true bulk handling. They can be delivered in bulk loads of up to 20 tonnes and blown into a silo in a similar method to that used for animal feed pellets for example. From the silo, pellets or granules can be screwed, conveyed, dosed or weighed as required in a fully automatic manner without labour costs. However, the use of pellets or granules is very often not preferred because it is difficult to achieve an effective dispersion of the fibre due to the work required in the mixer to break up the hard-compressed pellets or granules into their constituent fibres.

[0007] Where pellets or granules are used, as a component of powder or liquid mixes, the mixer is relied upon to achieve a fortuitous breakdown of the pellets or granules into dispersed fibre by shear, attrition and abrasion effected by the other components of the mix which may include stone aggregate for example, the mixer paddles themselves and possibly by the elevated temperature of the mixture causing the binder material if present to soften, or to diminish the binding effect. Dispersion of fibre in this way is not what the mixer was designed to achieve and, therefore, it performs the task usually inefficiently. The result can be longer mixing times with consequent reduction in plant capacity and increased wear and tear and power consumption. Even then, dispersion may be incomplete resulting in non-homogeneous mixes and inconsistent thickening effect.

[0008] DE-4336403A discloses an arrangement for supplying reinforcement fibres to a concrete mixture. The arrangement includes means for untangling tangled reinforcement fibres.

[0009] US-A-4092737 discloses an arrangement for disintegrating clumps of reinforcing steel fibres prior to introduction into a concrete mix.

[0010] We have therefore designed an improved method for the addition and substantially uniform dispersion of fibres in a mixture which overcomes or mitigates at least some of the disadvantages of the above methods. In particular it provides a method in which the fibrous material is initially rendered into compact pelletised or granulated form for efficient storage, handling and transport and then returned to an open fluffy state at the mixing station. This considerably improves storage, transport and handling of the fibre as it is in a compact form which can be transported and handled in bulk and which also can be metered automatically into a mixture using a screw conveyor and the like.

[0011] The process also includes the novel step of refibreising the pellets or granules prior to addition to the mixture. Thus the method as a whole includes the innovative feature of temporarily reducing a fibrous material to a compact pelletised or granular state for storage, transport, handling and metering and thereafter returning it to an open-textured state prior to mixing.

[0012] In one aspect, this invention provides a method of producing a substantially uniform dispersion of fibrous material in a mixture, which comprises:

providing or obtaining a supply of pellets or granules of compacted fibrous material;

refibreising said pellets or granules to cause at least some of said pellets or granules to expand to a relatively open-textured fibrous material; and
introducing said refibreised open-textured fibrous material into said mixture and mixing it therewith.

[0013] Said supply of pellets or granules may be obtained by pelletising or granulating at a pelletising or granulating station a fibrous base material by at least one of compaction and possibly binding of the fibres of the fibrous base material with said pelletised or granular base material thereafter being transported to a remote refibreising station for said refibreising.

[0014] Said fibrous material preferably comprises cellulose or other organic or mineral fibres or a mixture thereof. Cellulose fibre may be derived from e.g. recycled paper, timber, woodpulp or various other agri-materials such as flax or straw. Organic fibres may be of polyethylene, polyester, or polypropylene. Mineral fibres may be derived from glass, basaltic rock or steel slag.

[0015] Preferably, said refibreising is performed by means of one or more of grinding hammer-milling, disc-refining, pulverising and air impaction or other means of attrition. The preferred objective is to separate the fibres by mechanical means without causing unnecessary damage to the fibres themselves. The opening and refibreising of the material may continue after addition to the mixture, by the mixing action applied thereto.

[0016] Said mixture may comprise a wide range of different materials, but this method has been designed with particular reference to the addition of fibrous material into a liquid-based system to improve its rheological properties, for example those based on cement and water (e.g. a cement-based tile adhesive) and those based on bitumen (e.g. road-surfacing compounds).

[0017] In another aspect, there is provided apparatus for the introduction of a generally open-textured fibrous material into a mixture, said apparatus comprising:-

storage means adapted to store in use a supply of pelletised or granulated compacted fibrous material;
a fibreising means adapted to expand said pelletised or granular compacted fibrous material to a generally open-textured form;
means for delivering in use said pelletised or granular compacted fibrous material from said storage means to said fibreising means;
means for conveying said expanded open-textured fibrous material from said fibreising means, and introducing it into said mixture.

[0018] The invention may be performed in various ways, and an embodiment thereof will now be described by way of example only, reference being made to the accompanying drawing, which is a schematic view of a refibreising and mixing station for use in an embodiment of the invention.

[0019] The described embodiment implements a storage handling and metering system for fibrous materials. In this system fibrous material is initially rendered into compact pelletised or granulated form using generally conventional techniques, so that the material may be handled and transported relatively easily. Thereafter the pellets or granules are passed to a fibreising means which breaks down the pellets or granules so as to regenerate the open, 'fluffy' fibrous matrix from which the pellets or granules were made. This fibrous matrix can then be passed to a mixer where it is readily dispersed in either the liquid or powder mixture without the need for excessive mixing.

[0020] The fibreiser consists of a system for inputting the pellets or granules, a method of 'opening' them to reconstitute the raw fibre, and an output system to discharge the fibre. The method used to open the fibre can employ one of many available techniques including grinding, hammer-milling, disc refining, pulverising and air impaction. Different types of pellet or granules may be best handled by different of these various techniques and each application would need to be considered on its merits. The throughput of the fibreiser can be controlled by air conveying, gravity, centrifugal forces or by a combination of methods.

[0021] The fibreiser is placed at a convenient point in the line between the storage hopper or silo for the pellets or granules, and the mixer to which they are to be added. Feed to the fibreiser can be by gravity, screw or belt conveyor or by pneumatic blowing for example, and the discharge into the mixer can equally employ one or more of these methods.

[0022] Referring now to the Figure, this shows a schematic arrangement for a typical process for making a mixture including dispersed fibre in accordance with this invention. The process shown is that which might be used for the production of road asphalt although the invention could equally be applied to other mixtures which include a liquid component or to dry powder mixes.

[0023] Fibre pellets or granules 1 previously produced by extrusion, pressing etc. with or without a binder as required are delivered by a bulk vehicle 2 and blown pneumatically via a pipe 3 into a storage silo 4. A screw conveyor 5 conveys the pellets as required. The pellets then fall by gravity through a fibreiser 6 into a mixer 9.

[0024] The fibreiser may employ one or more of the actions described above, thereby partially or fully opening the fibre pellets or granules to at least partially return them to an open matrix form whereby substantially uniform distribution of the constituent fibres throughout the mixture is assured. At the same time, different grade aggregates which are stored in the hoppers 7 are weighed into the weigh hopper 8 which also discharges into the mixer 9. Hot liquid bitumen is added and, on completion of mixing, the batch is dropped into a discharge chute 10, and travels along a conveyor 11 into a storage hopper 12, where it is held until it is required to be loaded into a lorry 13 for transport to the road construction site.

Claims

1. A method of producing a substantially uniform dispersion of fibrous material in a substance, which comprises:

   providing or obtaining a supply of pellets or granules (1) of compacted fibrous material;
   refibreising said pellets or granules (1) to cause at least some of said pellets or granules (1) to expand to a relatively open-textured fibrous material; and
   introducing said refibreised fibrous open-textured material into said substance and mixing it therewith.

2. A method according to Claim 1 wherein said supply of pellets or granules of compacted fibrous material is obtained by pelletising or granulating at a pelletising or granulating station a fibrous base material by at least compaction of the fibres of the fibrous base material with said pellets or granules thereafter being transported to a remote refibreising station (6).
   refibreising said pelletised or granular base material to recover a relatively open-textured fibrous material; and
   introducing and mixing said refibreised fibrous material into said substance.

3. A method according to Claim 2, wherein said pelletising or granulating step includes binding of the fibres of the fibrous material.

4. A method according to any preceding Claim, wherein said fibrous material comprises cellulose, other organic fibre, or mineral fibres or a mixture thereof.

5. A method according to Claim 4, wherein said cellulose fibres are derived from one or more of recycled paper, timber, wood pulp, flax or straw.

6. A method according to Claim 4, wherein said mineral fibres are derived from one or more of glass, basaltic rock or steel slag.

7. A method according to any preceding Claim, wherein said refibreising is performed by means of one or more of grinding, hammer-milling, disc-refining, pulverising and air impaction.

8. A method according to any preceding Claim, wherein said substance is liquid-based.

9. A method according to any preceding Claim, wherein said substance comprises a mixture of cement and water.

10. A method according to Claim 8, wherein said substance comprises bitumen-based material.

11. Apparatus for the introduction of a generally open-textured fibrous material into a substance, said apparatus comprising:-

    storage means (2, 4) adapted to store in use a supply of pelletised or granulated compacted fibrous material (1);
    a fibreising means (6) adapted to expand said pelletised or granular compacted fibrous material to a generally open-textured form;
    means (5) for delivering in use said pelletised or granular compacted fibrous material from said storage means (4) to said fibreising means (6);
    means (9) for conveying said expanded open-textured fibrous material from said fibreising means, and introducing it into said substance.

Patentansprüche

1. Verfahren zum Herstellen einer im wesentlichen einheitlichen Dispersion von faserstoffartigem Werkstoff in einer Substanz, folgendes umfassend:

   Zurverfügungstellen oder Erhalten einer Quelle von Pellets oder Granulatpartikeln (1) von kompaktem, faserstoffartigem Werkstoff;
   Faserisieren der Pellets oder Granulatpartikel (1), um wenigstens einige der Pellets oder Granulatpartikel (1) zu einem faserstoffartigen Werkstoff mit relativ offener Oberflächenbeschaffenheit zu strekken; und
   Einführen des faserisierten, faserstoffartigen Werkstoffs mit offener Oberflächenbeschaffenheit in die Substanz und Mischen mit dieser.

2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, daß** die Quelle von Pellets oder Granulatpartikeln von kompaktem, faserstoffartigem Werkstoff durch Pelletisieren oder Granulieren eines faserstoffartigen Basiswerkstoffes in einer Pelletiserstation oder Granulierstation dadurch erhalten wird, daß die Fasern des faserstoffartigen Basiswerkstoffes mit den Pellets oder Granulatpartikeln wenigstens verdichtet und danach zu einer entfernten Faserisierstation (6) transportiert werden,
   Faserisieren des pelletisierten oder granulierten Basiswerkstoffes zum Wiederherstellen eines faserstoffartigen Werkstoffes mit relativ offener Oberflächenbeschaffenheit; und
   Einführen und Mischen des faserisierten faserstoffartigen Werkstoffes in die Substanz.

3. Verfahren nach Anspruch 2, **dadurch gekenn-**

zeichnet, daß der Schritt des Pelletisierens oder Granulierens ein Binden der Fasern des faserstoffartigen Werkstoffes umfaßt.

4. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, daß** der faserstoffartige Werkstoff Zellulose, andere organische Fasern oder Mineralfasern oder eine Mischung dieser umfaßt.

5. Verfahren nach Anspruch 4, **dadurch gekennzeichnet, daß** die Zellulosefasem aus Recyclingpapier, Nutzholz, Zellstoff, Flachs und/oder Stroh gewonnen werden.

6. Verfahren nach Anspruch 4, **dadurch gekennzeichnet, daß** die Mineralfasern aus Glas, Basaltstein und/oder Stahlschlacke gewonnen werden.

7. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, daß** das Faserisieren mittels Mahlen, Hammermahlen, Tellerraffinieren, Pulverisieren und/oder Luftbeaufschlagung ausgeführt wird.

8. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, daß** die Substanz flüssigkeitsbasiert ist.

9. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, daß** die Substanz eine Mischung aus Zement und Wasser enthält.

10. Verfahren nach Anspruch 8, **dadurch gekennzeichnet, daß** die Substanz einen bitumenbasierten Werkstoff enthält.

11. Vorrichtung zum Einführen eines faserstoffartigen Werkstoffs mit im wesentlichen offener Oberflächenbeschaffenheit in eine Substanz, wobei die Vorrichtung folgendes umfaßt:

Speichermittel (2, 4) zum Speichern einer Quelle von pelletisiertem oder granuliertem, kompaktem, faserstoffartigem Werkstoff (1);
Faserisierungsmittel (6) zum Strecken des pelletisierten oder granulierten, kompakten, faserstoffartigen Werkstoffes in eine Form mit offener Oberflächenbeschaffenheit;
Mittel (5) zum Zuliefern des pelletisierten oder granulierten, kompakten, faserstoffartigen Werkstoffes von dem Speichermittel (4) zu dem Faserisierungsmittel (6);
Mittel (9) zum Fördern des gestreckten, die offene Oberflächenbeschaffenheit aufweisenden faserstoffartigen Werkstoffes von dem Faserisierungsmittel und zu dessen Einführen in die Substanz.

Revendications

1. Procédé de fabrication d'une dispersion sensiblement homogène de matière fibreuse dans une substance, qui comprend les opérations consistant à :

- se munir de ou obtenir une alimentation de pastilles ou granulés (1) de matière fibreuse compactée ;
- dépastiller lesdites pastilles ou granulés (1) pour amener au moins une partie desdites pastilles ou granulés (1) à s'agrandir jusqu'à une matière fibreuse à texture relativement ouverte ; et
- introduire ladite matière à texture ouverte fibreuse dépastillée dans ladite substance et la mélanger avec elle.

2. Procédé selon la revendication 1, dans lequel ladite alimentation de pastilles ou de granulés de matière fibreuse compactée est obtenue par :

- pastillage ou granulation à une station de pastillage ou de granulation d'une matière de base de fibre par au moins un compactage des fibres de la matière de base fibreuse, lesdites pastilles ou granulés étant par la suite transportés jusqu'à une station de dépastillage éloignée (6) ;
- dépastiller ladite matière de base pastillée ou granulaire pour récupérer une matière fibreuse à texture relativement ouverte ; et
- introduire et mélanger ladite matière fibreuse dépastillée dans ladite substance.

3. Procédé selon la revendication 2, dans lequel ladite étape de pastillage ou de granulation comprend la liaison des fibres de la matière fibreuse.

4. Procédé selon l'une quelconque des revendications précédentes, dans lequel ladite matière fibreuse comprend la cellulose, d'autres fibres organiques, ou des fibres minérales ou un mélange de celles-ci.

5. Procédé selon la revendication 4, dans lequel lesdites fibres de cellulose sont issues d'au moins l'un parmi le papier recyclé, le bois d'oeuvre, la cellulose technique, le lin ou la paille.

6. Procédé selon la revendication 4, dans lequel lesdites fibres minérales sont.issues d'au moins l'un parmi le verre, la roche basaltique ou le laitier de haut fourneau.

7. Procédé selon l'une quelconque des revendications précédentes, dans lequel ledit dépastillage est effectué au moyen d'au moins une opération choisie

parmi le broyage, le broyage en broyeur à marteaux, le raffinage sur broyeur à disques, la pulvérisation et l'impaction d'air.

8. Procédé selon l'une quelconque des revendications précédentes, dans lequel ladite substance est à base liquide.

9. Procédé selon l'une quelconque des revendications précédentes, dans lequel ladite substance comprend un mélange de ciment et d'eau.

10. Procédé selon la revendication 8, dans lequel ladite substance comprend une matière à base de bitume.

11. Appareil pour l'introduction d'une matière fibreuse à texture généralement ouverte dans une substance, ledit appareil comprenant :

- un moyen de stockage (2, 4) adapté pour stocker, lors de l'utilisation, une alimentation de matière fibreuse compactée pastillée ou granulée (1) ;
- un moyen de dépastillage (6) adapté pour agrandir ladite matière fibreuse compactée pastillée ou granulaire jusqu'à une forme à texture généralement ouverte ;
- un moyen (5) pour adresser, lors de l'utilisation, ladite matière fibreuse compactée pastillée ou granulaire, dudit moyen de stockage (4) audit moyen de dépastillage (6) ;
- un moyen (9) pour transporter ladite matière fibreuse à texture ouverte élargie provenant dudit moyen de dépastillage et introduire celle-ci dans ladite substance.

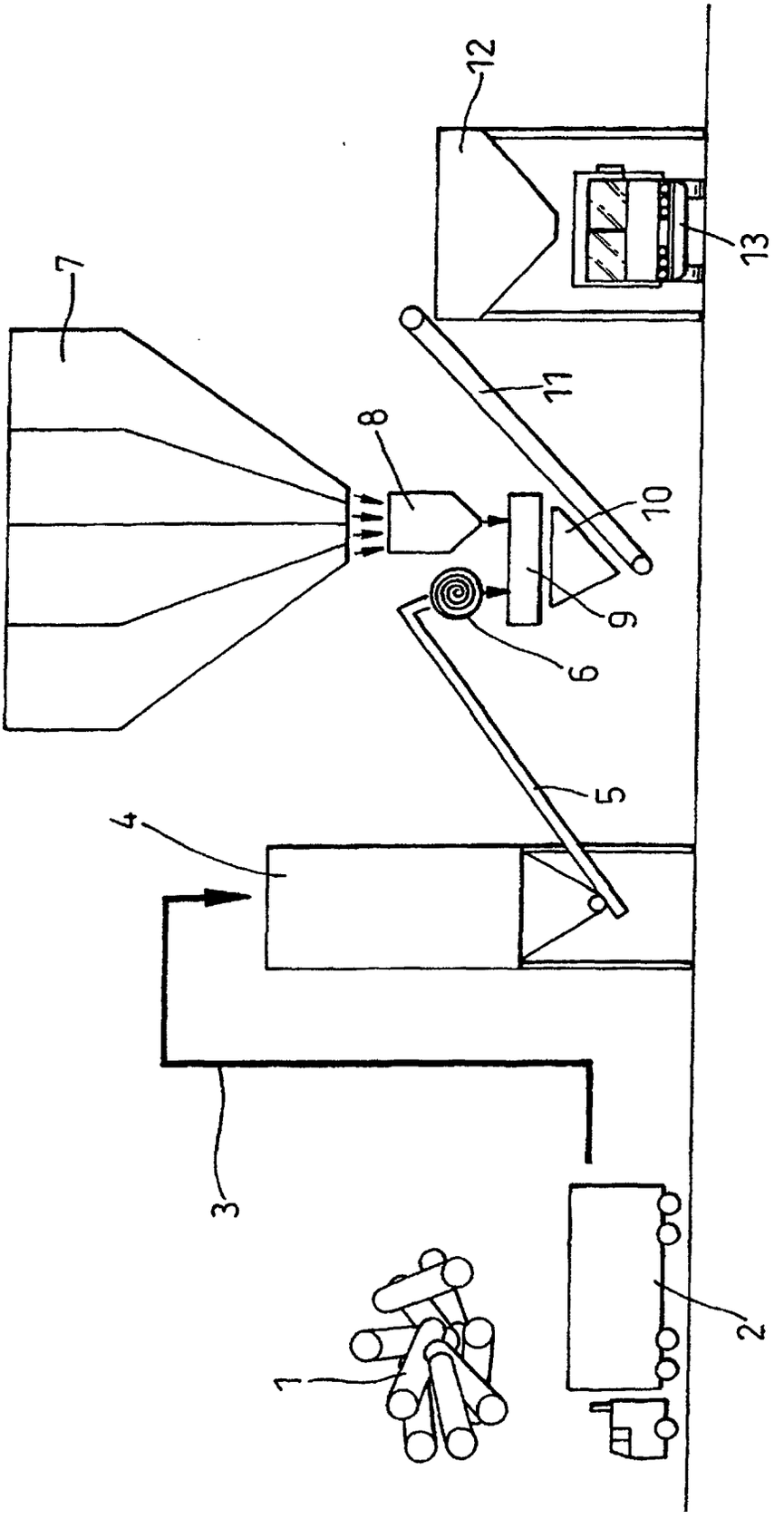

Fig. 1