The invention relates to a delayed-setting concrete based on blast furnace slag. The invention further relates to a method of initiating the setting of said concrete.
DELAYED-SETTING CONCRETE

[0001] The present invention relates to the building and construction sector. More precisely, the invention relates to a concrete whose setting is initiated after it has been poured, and to a method for initiating the setting of said concrete.

[0002] The concrete currently in use in special works has a rheology which is not adapted to the criteria for the preparation of deep foundations.

[0003] The major problem is the change in the rheology. In fact, the initial set time is very often shorter than the concrete setting time; this results in the production of structures in which the following are observed:

- [0004] poor coating of the reinforcements,
- [0005] inclusions of drilling sludge,
- [0006] poor adhesion between the concrete and the reinforcements.

[0007] Attempts to modify these concretes with adjuvants do not easily make it possible, if at all, to attain the desired rheology, thereby limiting the volume of concrete pours and hence the efficiency.

[0008] The invention proposes to overcome these disadvantages by means of a concrete whose setting is initiated after it has been poured. Said concrete will hereafter be called “delayed-setting concrete”.

[0009] Thus, according to a first feature, the invention relates to a delayed-setting concrete based on blast furnace slag.

[0010] Said concrete advantageously consists of a mixture essentially comprising a blast furnace slag, aggregates such as sand and/or coarse or fine gravels, and water.

[0011] The blast furnace slag generally represents from about 10% to about 35% by weight of the concrete composition. Although the nature of the blast furnace slag is not particularly critical, it is preferably of the basic type and the weight ratio CaO/SiO₂ is preferably about 1.10 and about 1.35. As an example of slag which can be used within the framework of the present invention, there may be mentioned a material comprising the following main components (in percentages by weight): 33 to 40% of SiO₂, 8 to 16% of Al₂O₃, 39 to 44% of CaO, 4 to 9% of MgO and 0.5 to 1.5% of a source of S²⁻ ions.

[0012] The customary aggregates used to make concrete, namely sand and/or coarse or fine gravels, generally represent from about 60% to about 80% by weight of the concrete composition, the remainder of the mixture consisting of water.

[0013] The concrete according to the invention can also comprise any inert material commonly used in this field, for example fly ash and/or calcareous or siliceous fillers. In this case the amount of inert materials used is between about 5% and about 30% by weight, based on the weight of the blast furnace slag.

[0014] According to the invention, the blast furnace slag advantageously has a grain size below about 200 µm, preferably below about 100 µm. It is desirable that this grain size should not be below about 30 µm.

[0015] The concrete according to the invention does not set as such. It therefore enables indefinite volumes to be concreted without the risk of defects induced by premature initial setting.

[0016] According to the invention, the setting of the concrete is initiated after it has been poured into the trenches.

[0017] Thus, according to another feature, the invention relates to a method of initiating the setting of the concrete described above, which consists in activating the blast furnace slag.

[0018] In one embodiment of the invention, shown in FIGS. 1A to 1C, the slag is activated with the aid of an alkaline activating agent using the principle of ion diffusion.

[0019] FIG. 1A shows a reinforcing cage equipped with perforated tubes 10 placed about one meter apart. These tubes are covered with a non-woven fabric to prevent the laitance from clogging them. After concreting, these tubes are filled with a solution of an alkaline activating agent such as sodium hydroxide, potassium hydroxide or sodium or potassium carbonate (FIG. 1B). After a few days, the alkaline ions migrate out of the perforated tubes and diffuse into the concrete, activating the blast furnace slag and initiating the setting of the concrete (FIG. 1C).

[0020] In this embodiment, it is desirable to use the alkaline agent in an amount such that the final pH of the concrete is brought to a value of between about 12 and about 13.5, preferably to a value of about 12.7.

[0021] FIGS. 2A to 2C show another embodiment of the invention, which makes it possible to initiate the setting of the concrete more rapidly.

[0022] As in the previous embodiment, a reinforcing cage equipped with perforated tubes 10 is used (FIG. 2A). After concreting, an activating agent is injected under pressure (FIG. 2B); it diffuses by percolation into the concrete mass, activates the blast furnace slag and thus initiates the setting of the concrete (FIG. 2C).

[0023] Activating agents which can be used are lime-based compounds such as lime itself or hydrated lime (also known as slaked lime). It is also possible to use a sulfate-based compound such as gypsum. A mixed compound (lime-based compound/sulfate-based compound) is also suitable; in this case the weight ratio lime-based compound/sulfate-based compound is generally between about 0.5 and about 1.5.

[0024] In this case it is desirable to use the activating agent in an amount of between about 2% and about 15% by weight, based on the weight of the blast furnace slag.

[0025] In a variant of the embodiments described above, it is possible to enclose the activating agent in an envelope, especially a soluble envelope, which degrades over time and thereby allows said activating agent to diffuse gradually.

[0026] Polyvinyl alcohol films may be mentioned as an example of envelopes which can be used in the method of the invention.

[0027] The invention is illustrated by the Example below, which is given purely by way of indication.
EXAMPLE

[0028] A concrete of the following composition is prepared:

<table>
<thead>
<tr>
<th>Component</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blast furnace slag</td>
<td>400 kg</td>
</tr>
<tr>
<td>Sand 0/5</td>
<td>850 kg</td>
</tr>
<tr>
<td>Fine gravel 5/25</td>
<td>900 kg</td>
</tr>
<tr>
<td>Water</td>
<td>about 200 l</td>
</tr>
</tbody>
</table>

[0029] This concrete does not set; setting can be initiated by one of the methods described above. This concrete does not therefore require the use of adjuvants.

What is claimed is:

1. A delayed-setting concrete based on blast furnace slag.
2. A concrete according to claim 1 which consists of a mixture essentially comprising a blast furnace slag, aggregates and water.
3. A concrete according to claim 1 or 2 in which the blast furnace slag represents from about 10% to about 35% by weight of the concrete composition.
4. A concrete according to one of claims 1 to 3 in which the blast furnace slag has a grain size below about 200 µm, preferably below about 100 µm.
5. A method of initiating the setting of the concrete as defined in one of claims 1 to 4, which consists in activating the blast furnace slag.

6. The method according to claim 5 in which activation is effected by means of an alkaline agent such as sodium hydroxide, potassium hydroxide or sodium or potassium carbonate.

7. The method according to claim 6 in which the amount of alkaline agent used is such that the final pH of the concrete is between about 12 and about 13.5.

8. The method according to claim 5 in which activation is effected by means of a lime-based compound, a sulfate-based compound or a mixture of a lime-based compound and a sulfate-based compound.

9. The method according to claim 8 in which activation is effected by means of a mixture of a lime-based compound and a sulfate-based compound in a weight ratio of between about 0.5 and about 1.5.

10. The method according to claim 8 or 9 in which the amount of activating agent used is between about 2% and about 15% by weight, based on the weight of the blast furnace slag.

11. The method according to one of claims 5 to 10 in which the activating agent is enclosed in an envelope which degrades over time.

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