METHOD AND COMPOSITION FOR SECURING A MEMBER IN A HOLE

Abstract: This invention relates to a method, a composition, and a device (10) suitable for securing an elongate member (12) in a hole (14) provided in a rock face (16). The device comprises an elongate pervious sleeve (10.1) closed at both ends and filled with a settable composition (10.2). The settable composition includes the following components: calcium carbonate; water activated binder; retarder; tixotropic agent; accelerator; settling retarder; and inert filler. The components of the settable composition are selected on ratios so as to select and control the extent of expansion upon setting. In use, the device (10) is submerged in water and inserted in the hole (14). One end of the elongate member (12) is then inserted into the settable composition (10.2). The material (10.2) expands when setting to trap said end of the elongate member (12) in the hole (14).
METHOD AND COMPOSITION FOR SECURING A MEMBER IN A HOLE

INTRODUCTION AND BACKGROUND TO THE INVENTION

This invention relates to a method, a composition, and a device for securing a member in a hole.

Various methods and devices for securing an elongate member in a hole are known. For example, one method for securing an anchor bolt in a hole provided in a rock face includes the steps of introducing a resin and hardener mixture into the hole and inserting one end of the anchor bolt into the resin. The resin is allowed to set to secure the anchor in the hole.

The known methods and devices suffer from one disadvantage or the other and the method described above, in particular, suffer from the disadvantage that the resin is difficult to store, handle and apply. For example, if the resin and hardener are not mixed in the correct ratio, it will not set properly and the anchor bolt will fail. Another disadvantage of the resin is that it has relatively low flexuralibility.

OBJECT OF THE INVENTION

It is therefore an object of the present invention to provide a method, a composition and a device for securing a member in a hole with which the aforesaid disadvantages can be overcome or at least minimised.
SUMMARY OF THE INVENTION

According to a first aspect of the invention there is provided a settable composition of the type which expands on setting and which is suitable for securing a member in a hole, the composition comprising:

- between 2 and 70% particulate calcium oxide on a mass per mass basis; and
- between 1 and 60% particulate water activated binder.

Further according to the invention the composition includes a retarder for retarding the onset of the setting process. The retarder may constitute between 0.01 and 5% of the composition on a mass per mass basis.

The composition may include a tixotropic agent for keeping the composition in a fluid state while being agitated. The tixotropic agent may constitute between 0.01 and 5% of the composition on a mass per mass basis.

The composition may include an accelerator for accelerating the setting process. The accelerator may constitute between 0.01 and 5% of the composition on a mass per mass basis.
Alternatively or in addition, the composition may include a setting retarder for retarding the setting process. The setting retarder may constitute between 0.01 and 5% of the composition on a mass per mass basis.

The composition may further include an inert particulate filler. The filler may constitute between 40 and 80% of the composition on a mass per mass basis.

The water activated binder may comprise any composition selected from the group consisting of Portland cement; aluminous cement; gypsum; hydrated lime; or pozzolanic material.

It was found that the extent of expansion of the composition on setting is adjustable by varying the ratio in which the above ingredients are selected.

According to a second aspect of the invention there is provided a method of securing a member in a hole including the steps of:
- disposing a settable composition according to the first aspect of the invention in the hole;
- disposing at least part of the member in the hole in abutting relationship with the settable composition; and
- allowing the settable composition to set and expand to trap said end of the elongate member in the hole.
The method may include the further step of wetting the settable composition prior to disposing the settable composition in the hole.

Alternatively the method may include the step of wetting the settable composition after disposing the material in the hole.

The method may include the optional step of disposing the settable composition on said at least part of the member prior to disposing said part in the hole.

It will be appreciated that it is immaterial whether the member or the settable composition is disposed in the hole first.

Alternatively the settable composition may be pumped into the hole. The settable composition may in such case be in the form of a semi-solid, which prior to setting, liquefies when agitated. The arrangement may be such that the settable composition is pumped into the hole while being in the form of a slurry, which sets to a semi-solid body instantaneously after the pumping step, with the member being inserted into the semi-solid body, before setting thereof to a solid body.

According to a third aspect of the invention there is provided a device for securing a member in a hole, the device comprising a body of settable
composition according to the first aspect of the invention; and a pervious container for the material, the arrangement being such that a portion of the member is disposed in the hole together with the settable composition and the material allowed to set and expand to trap said portion of the member in the hole.

The container and the body may be elongate.

Alternatively the body may be tubular and may surround said portion of the member.

The settable composition may be prepared by a method including the steps of treating particulate limestone, having a high calcium carbonate content, as follows:

- reducing the diameter of the limestone particles to between 5 and 50 mm;
- heating the particles to a temperature of between 900 and 1900 °C;
- reducing the size of the particles; and
- screening the particles to obtain a particle diameter of below 0.3 mm.

The obtained material may be mixed with other compositions or particulate material selected from the group consisting of: retarders for retarding the onset of the setting process; setting retarders for retarding the setting process;
accelerators for accelerating the setting process; tixotropic agents for keeping the composition in a fluid state while being agitated; inert fillers; and water activated binders.

5 The invention will now be described by way of a non-limiting example.

A settleable composition in accordance with a first embodiment of the invention is prepared by a method including the step of:

- treating particulate limestone, having a high calcium carbonate content,

10 as follows:

- reducing the diameter of the limestone particles to between 5 and 50 mm;

- heating the particles to a temperature of between 900 and 1900°C;

- reducing the size of the particles;

15 - screening the particles to obtain a particle diameter of below 0.3 mm; and

- mixing the obtained composition with other compositions or particulate material selected from the group consisting of: retarders for retarding the onset of the setting process; setting retarders for retarding the setting process; accelerators for accelerating the setting process; tixotropic agents for keeping the composition in a fluid state while being agitated; inert fillers; and water activated binders selected from the group
consisting of Portland cement; aluminous cement; gypsum; hydrated lime; or pozzolanic material.

The final obtained settable composition has the following typical composition on a mass per mass basis, depending on the amount of expansion that is desired when setting:

- Calcium carbonate 2 to 70%;
- Water activated binder 1 to 60%;
- Retarder 0.01 to 5%;
- Tixotropic agent 0.01 to 5%;
- Accelerator 0.01 to 5%; and
- Setting retarder 0.01 to 5%;
- Inert filler 40 to 80%.

15 **BRIEF DESCRIPTION OF THE DRAWINGS**

The invention will now be described even further by way of non-limiting examples with reference to the accompanying drawings wherein:

figure 1 is a side view of a device according to a second embodiment of the invention for securing an elongate member in a hole, showing a preparatory step in a method according to the invention;

figure 2 is the same view as that of figure 1, showing a second step in the method according to the invention;
figure 3 is the same view as that of figure 2, showing a third step in the method according to the invention;
figure 4 is a cross-sectional side view of a device according to a third embodiment of the invention for securing an elongate member in a hole; and
figure 5 is a cross-sectional side view of a device according to a fourth embodiment of the invention for securing an elongate member in a hole.

10 DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

Referring to figures 1 to 3, a device according to a second embodiment of the invention, suitable for securing an elongate member 12 in a hole 14 provided in a rock face 16, is generally designated by reference numeral 10.

The device 10 comprises an elongate pervious sleeve 10.1 closed at both ends and filled with a settable composition 10.2 described above in accordance with the first embodiment of the invention.

The components of the settable composition are selected on ratios so as to select and control the extent of expansion upon setting. Should a relatively higher ratio of expansion be required, relatively more calcium oxide is introduced and vice versa. A settable composition 10.2 having a high expansion upon reaction with water is obtained.
Referring to figure 1, in use, the device 10 is submerged in water and inserted in the hole 14. One end of the elongate member 12 is inserted into the settable composition 10.2, as indicated by arrow A. Referring to figure 3, the material 10.2 expands when setting to trap said end of the elongate member 12 in the hole 14.

The applicant foresees that the device 10 is suitable for securing a large number of different elongate members such as anchor bolts or the like in holes.

Referring to figure 4, a device according to a third embodiment of the invention, suitable for securing an elongate member 12 in a hole (not shown), is generally designated by reference numeral 10A.

The device 10A is similar to the device 10, but comprises an elongate tubular body 18 of settable composition 10.2A, defining a bore 22 for receiving one end 12.1 of the elongate member 12. The body 18 is covered with a permeable sheet 10.1A for containing the settable composition 10.2A.

In use, said end 12.1 is located in the bore 22 and the body 18 submerged in water. Thereafter the body 18 is immediately inserted in the hole (not shown) wherein the elongate member 12 is to be located. The settable composition
10.2A sets and expands to trap the end 12.1 of the elongate member 12 in the hole.

Referring to figure 5, device according to a fourth embodiment of the invention, suitable for securing an elongate member 12 in a hole 14, is generally designated by reference numeral 10B.

The device 10B comprises settable composition of the type described above, that has been adapted for injection into the hole by a slurry pump. The settable composition is adapted so that it is in a semi-solid form prior to setting, except when the material is agitated, whereupon it liquefies. For this purpose, a tixotropic agent is included in the composition.

In use, the settable composition 10.2B is pumped into the hole 14 in slurry form. After pumping, the material 10.2B immediately sets to a semi-solid body and the elongate member is inserted into the semi-solid body, as indicated by arrow B, prior to the material setting to a solid body.

It will be appreciated that variations in detail are possible with a settable composition, a method and a device according to the invention for securing a member in a hole without departing from the scope of the appended claims.
CLAIMS

1. A settable composition of the type which expands on setting and which is suitable for securing a member in a hole, the composition comprising:
   - between 2 and 70% particulate calcium oxide on a mass per mass basis; and
   - between 1 and 60% particulate water activated binder.

2. A settable composition according to claim 1 which includes a retarder for retarding the onset of the setting process.

3. A settable composition according to claim 2 wherein the retarder constitutes between 0.01 and 5% of the composition on a mass per mass basis.

4. A settable composition according to any one of the preceding claims which includes a tixotropic agent for keeping the composition in a fluid state while being agitated.

5. A settable composition according to claim 4 wherein the tixotropic agent constitutes between 0.01 and 5% of the composition on a mass per mass basis.
6. A settable composition according to any one of the preceding claims which includes an accelerator for accelerating the setting process.

7. A settable composition according to claim 6 wherein the accelerator constitutes between 0.01 and 5% of the composition on a mass per mass basis.

8. A settable composition according to any one of the preceding claims which includes a setting retarder for retarding the setting process.

9. A settable composition according to claim 8 wherein the setting retarder constitutes between 0.01 and 5% of the composition on a mass per mass basis.

10. A settable composition according to any one of the preceding claims which includes an inert particulate filler.

11. A settable composition according to claim 10 wherein the filler constitutes between 40 and 80% of the composition on a mass per mass basis.

12. A settable composition according to any one of the preceding claims wherein the water activated binder comprises any composition selected
from the group consisting of Portland cement; aluminous cement; gypsum; hydrated lime; and pozzolanic material.

13. A settable composition according to any one of the preceding claims wherein it was found that the extent of expansion of the composition on setting is adjustable by varying the ratio in which the ingredients of the composition are selected.

14. A method of securing a member in a hole including the steps of:

- disposing a settable composition according to the first aspect of the invention in the hole;
- disposing at least part of the member in the hole in abutting relationship with the settable composition; and
- allowing the settable composition to set and expand to trap said end of the elongate member in the hole.

15. A method according to claim 14 which includes the further step of wetting the settable composition prior to disposing the settable composition in the hole.

16. A method according to claim 14 which includes the further step of wetting the settable composition after disposing the material in the hole.
17. A method according to any one of claims 14 to 16 which includes the optional step of disposing the settable composition on said at least part of the member prior to disposing said part in the hole.

18. A method according to any one of claims 14 to 17 wherein it is immaterial whether the member or the settable composition is disposed in the hole first.

19. A method according to any one of claims 14 to 18 wherein the settable composition is pumped into the hole.

20. A method according to claim 19 wherein the settable composition is in the form of a semi-solid, which prior to setting, liquefies when agitated.

21. A method according to claim 20 wherein the arrangement is such that the settable composition is pumped into the hole while being in the form of a slurry, which sets to a semi-solid body instantaneously after the pumping step, with the member being inserted into the semi-solid body, before setting thereof to a solid body.

22. A device for securing a member in a hole, the device comprising a body of settable composition according to the claims 1 to 13; and a pervious container for the material, the arrangement being such that a portion of
the member is disposed in the hole together with the settable composition and the material allowed to set and expand to trap said portion of the member in the hole.

23. A device according to claim 22 wherein the container and the body are elongate.

24. A device according to claim 22 wherein the body is tubular and surrounds said portion of the member.

25. A settable composition substantially as herein described and exemplified.

26. A method of securing a member in a hole substantially as herein described and as illustrated in the accompanying drawings.

27. A device substantially as herein described and as illustrated in the accompanying drawings.