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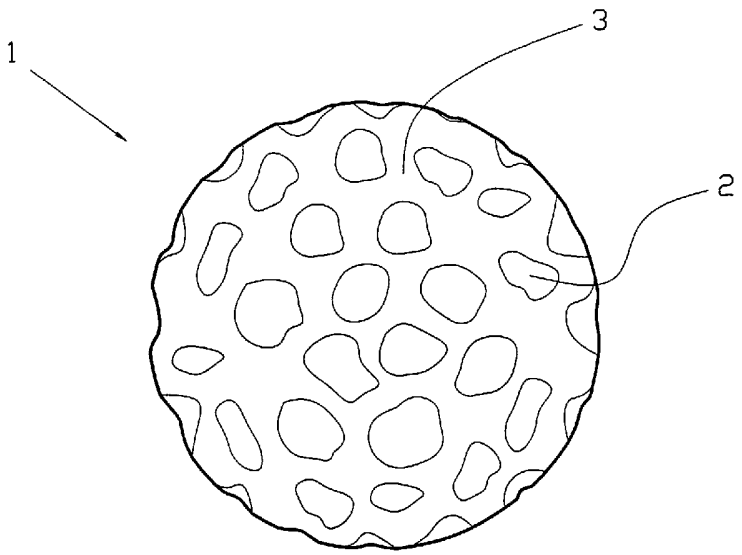
(54) Title: A CONCRETE MIXTURE FOR USE IN OIL-AND GAS WELLS



(57) Abstract: A concrete mixture for use between a casing and a rock wall in a borehole arranged for exploration or production of oil or gas, or arranged for maintenance of such exploration or productoin wells, in which the concrete mixture, due the pressure of said gas or oil or surrounding structures, or due to the hole depth below the sea surface, must withstand high pressures, and simulatenously the specific gravity of the concrete mixture is adjusted by means of the concrete mixture containing a specific gravity adjusting aggregate having a specific gravity less than the specific gravity of cement for the liquid concrete to exert an adapted pressure on the structure surrounding the wellbore, wherein the specific gravity adjusting aggregate used in the concrete mixture consists of compact glass balls.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

A CONCRETE MIXTURE FOR USE IN OIL- AND GAS WELLS

This invention regards a concrete mixture for use in oil- and gas fields, more particularly a mixture comprising a significant proportion of glass balls with rough surfaces. The object of the invention is to provide a concrete of high compressive strength having low specific gravity.

In some circumstances when using concrete, it is necessary to reduce the specific gravity of the concrete mixture to reduce the stress on surrounding structures during the pouring phase. An obvious example of this is the cementing of an oil well. In here, concrete is used to fill the space between the borehole casing and the bedrock through which the hole extends. Some rock structures are unstable and may collapse if subjected to a hydrostatic pressure of liquid concrete that is filled around the casing. This may result in large, undesirable fractures in the formations surrounding the borehole.

To reduce the specific gravity of the concrete mixture, flue ash, among other things, is commonly used as an additive aggregate, in the form of balls of a diameter down to 0.25 mm. The flue ash provides a desired option of adjusting the specific gravity of the concrete mixture, but the properties of the flue ash render it rather unsuitable when desiring to fulfil other purposes than a reduced specific gravity. The flue ash is a by-product of combustion or refining of silica, among other things. It often contains substances hazardous to health. Of greatest significance to the property of the concrete mixture, however, is the inability of the flue ash to withstand high pressures. Already at pressures of ca. 60 bars (800 psi), the flue ash collapses. This results in settling in the concrete prior to hardening, hence an increase in the specific gravity of the concrete.

The object of the invention is to remedy the disadvantages of prior art.

The object is achieved through features disclosed in the description below and in subsequent claims.

In a concrete mixture intended to be poured between a casing of an oil or gas well and the surrounding rock wall or between tubulars of different diameter, additive aggregates known *per se* are used, including cement, water, sand and possibly agents for adjusting density, viscosity and hardening.

To reduce the specific gravity of the concrete mixture, glass particles are mixed into the water, for example particles of the brand Liaver Super-K from Liapor GmbH & Co. KG,

Hallendorf, Pautzfeld, Germany, essentially in the form of glass balls with a diameter of 0.25-0.8 mm. Liaver Super-K is available at different specific gravities, typically from ca. 0.45 to 2.5 g/cm^3. The most used type has a specific gravity from 0.45 to 1.0 g/cm^3. The invention is not limited to use of spherical particles, inasmuch as other particle shapes also may be used to achieve the desired effect.

A concrete mixture ready for use advantageously contains ca. 30% glass balls, but the invention is not limited to this volume percentage.

Preferably, the most used types of glass particles have a specific gravity that allows them to stay afloat or, if a stirring motion is maintained in the water, to suspend them in the water. At the floating or suspended state of the glass particles in the water, a uniform distribution of the glass balls is maintained when the water-/glass ball mixture is added to the remainder of the additive aggregates during the concrete mixing process.

According to the invention, the specific gravity of the concrete mixture is adjusted by using a type of glass particle having a specific gravity that, at ca. 30% volume percentage admixture of glass particles, provides the desired concrete specific gravity required for the pouring task at hand. Given this, the concrete mixture may be used under conditions at which the pressure on surrounding structures must be minimized.

The glass particles define a compact cross section. The surface is rough.

Concrete with glass balls admixed have great compressive strength. Testing of concrete mixtures show crushing of 0.3% of the glass balls at a pressure of nearly 1100 bars (15000 psi) and a temperature of 175 °C. Given this, a concrete mixture according to the invention exhibits insubstantial settling during hardening and great compressive strength when hardened.

In the preferred spherical form, the surface of the glass particles exhibits a great ability for adhering to cement. When pumping a concrete mixture containing glass balls, it has been found that the wear on pump- and pipe components is reduced due to the collective abrasiveness of the aggregate mixture being lowered. The cement-covered glass balls provide a reduced abrasive action as compared with the other main constituents of a concrete mixture. At the same time, the ability of the concrete mixture to flow through pipes and similar is improved, wherebythe power requirement when pumping is reduced.

In tests the concrete mixture according to the invention exhibits little shrinkage and a strong adhesion to steel. This provides good contact between for example the casing in an oil/gas well and the surrounding concrete.

Glass has a relatively high thermal capacity. During the setting and hardening processes on the concrete, this high thermal capacity provides a moderating effect on the temperature increase naturally occurring in this phase. Said effect is of great significance particularly in wells wherein gas condensate exists in a frozen state. An temperature increase of the gas hydrate may bring the gas into a vapour

state, resulting in a great volumetric expansion. The expansion may cause damage to technical installations within and around the well. Use of glass balls in the concrete mixture thus will reduce the risk of such damage during pouring operations in wellbores.

In the following, a non-limiting example of a preferred embodiment is described.

A concrete mixture according to the invention consisting of:

36.25 litres of seawater having a specific gravity of 1.025 g/cm^3;
4.5 litres of CaCl having a specific gravity of 1.314 g/cm^3; 30 litres of glass balls Liaver Super-K 1 having a specific gravity of 1.000 g/cm3; and
100 litres of G-cement having a specific gravity of 3.220 g/cm^3

exhibited a specific gravity of 1.71 g/cm^3 in a soft state. After hardening at 69 bars (ca. 950 psi) pressure, the specific gravity was 1.71 g/cm^3.

Laboratory tests were carried out, in which a concrete mixture I known *per se* and appropriate for the purpose was compared with a concrete mixture II according to the invention. A summary of several repeated tests shows the following measurement results:

Property after hardening at 45 °C and 150 bars for 24hrs	Concrete mixture I	Concrete mixture II	II/I (%)
Specific gravity (g/cm^3)	1.737	1.742	100.3
Compression test on test cube 2x2x2": Breaking load (kN)	32.8	43.1	131.4
Piston penetration before breakage (mm)	1.1	1.5	136.4
Flexibility test on rod 15x2x2 cm: Young's modulus (Gpa)	8.32	8.78	105.5
Adhesion test, pouring in steel cylinder Ø2"x10cm: Slip at load (kN)	31	55	177.4

The measurement results show that the concrete mixture according to the invention has provided the expected effect concerning compressive strength and adhesion.

Claims

1. A concrete mixture for use between a casing and a rock wall in a borehole arranged for exploration or production of oil or gas, or arranged for maintenance of such exploration or production wells, in which the concrete mixture, due to the pressure of said gas or oil or surrounding structures, or due to the hole depth below the sea surface, must withstand high pressures, and simultaneously the specific gravity of the concrete mixture is adjusted by means of the concrete mixture containing a specific gravity adjusting aggregate having a specific gravity less than the specific gravity of cement for the liquid concrete to exert an adapted pressure on the structure surrounding the wellbore, c h a r a c t e r i z e d i n that the specific gravity adjusting aggregate used in the concrete mixture consists of compact glass balls.

2. The concrete mixture according to claim 1, c h a r a c t e r i z e d i n that the proportion of glass balls constitutes up to 40% of the total volume of the concrete mixture.

3. The concrete mixture according to one or more of the preceding claims, c h a r a c t e r i z e d i n that the specific gravity of the glass balls is between 0.45 and 2.5 g/cm^3.

4. The concrete mixture according to one or more of the preceding claims, c h a r a c t e r i z e d i n

that the diameter of the glass balls is between 0.25 and 0.80 mm.

5. The concrete mixture according to one or more of the preceding claims, c h a r a c t e r i z e d i n that the glass balls have rough surfaces.

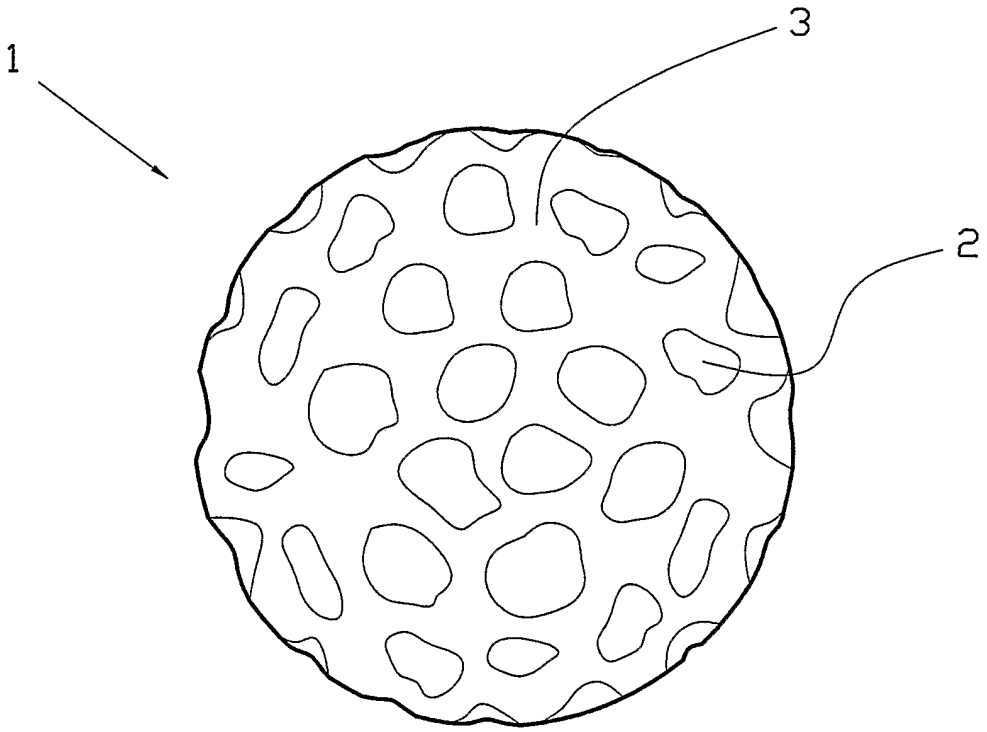

Fig. 1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 2003/000374

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: C04B 14/22, C04B 28/02, C04B 40/00, E21B 33/14, E21B 33/13
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)

IPC7: C04B, E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4385935 A (SKJELDAL), 31 May 1983 (31.05.1983), column 1, line 10 - line 13; column 1, line 54 - line 66; column 2, line 29 - line 34	1-3,5
A	WO 02064528 A1 (SCHLUMBERGER TECHNOLOGY B.V.), 22 August 2002 (22.08.2002), page 1, line 3 - line 5; page 4, line 8 - line 11; page 6, line 15 - line 17	1-5
A	US 4234344 A (TINSLEY ET AL), 18 November 1980 (18.11.1980), claim 1	1-5

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 January 2004	03 -02- 2004
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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