

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
18 December 2008 (18.12.2008)

PCT

(10) International Publication Number
WO 2008/151791 A2

(51) International Patent Classification:
C09K 8/28 (2006.01) *C09K 8/52* (2006.01)
C09K 8/34 (2006.01)

(74) Agents: DE GREGORI, Antonella et al.; Barzano' & Zarnardo Milano S.p.A., Via Borgonuovo 10, I-20121 Milan (IT).

(21) International Application Number:
PCT/EP2008/004678

(22) International Filing Date: 9 June 2008 (09.06.2008)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
MI2007A001196 14 June 2007 (14.06.2007) IT

(81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(71) Applicant (*for all designated States except US*): ENI S.p.A. [IT/IT]; Piazzale E. Mattei, 1, I-00144 Rome (IT).

(72) Inventors; and

(75) Inventors/Applicants (*for US only*): DEL GAUDIO, Lucilla [IT/IT]; Via Trieste 16/C, I-20097 San Donato Milanese (Milan) (IT). ALBONICO, Paola [IT/IT]; Via Castel Morrone 9, I-20129 Milan (IT). COBIANCO, Sandra [IT/IT]; Via Strasburgo 5/E, I-20097 San Donato Milanese (IT). EMILIANI, Chiara Neva [IT/IT]; Via Don Bosco 16, I-20132 Milan (IT). RIPA, Giuseppe [IT/IT]; Via XX Settembre, 139, I-27011 Belgioioso (Pavia) (IT).

(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— without international search report and to be republished upon receipt of that report

(54) Title: WATER-BASED FLUID FOR PREVENTING THE FORMATION OF W/O EMULSIONS OR FOR RESOLVING W/O EMULSIONS ALREADY FORMED IN POROUS MATRICES

(57) Abstract: The invention relates to a water-based fluid for applications in the oil field, comprising non-ionic surfactants, stable at temperatures ranging from 10 to 90°C, having an HLB ranging from 8 to 20 and soluble in water, with a saline content ranging from 0 to 60% by weight, and possibly salts. The fluid can be conveniently used as completion fluid for preventing the formation of inverse W/O emulsions or as a remedial fluid for resolving emulsions already formed in oil wells in which oil-based mud has been used.



WO 2008/151791 A2

5

WATER-BASED FLUID FOR PREVENTING THE FORMATION OF W/O EMULSIONS OR FOR RESOLVING W/O EMULSIONS ALREADY FORMED IN POROUS MATRICES

10 The present invention relates to a water-based fluid which can be used as completion fluid for preventing the formation of inverse W/O emulsions in oil wells or as a remedial fluid for resolving W/O emulsions already formed.

15 More specifically, the invention relates to a fluid comprising non-ionic surfactants characterized by a suitable HLB and possible salts, which can be used for preventing the formation of inverse W/O emulsions or for resolving them when they have already been formed, in oil wells in which oil-based drilling fluids have been used.

20 The productivity of an oil well is strongly influenced by all the operations which are carried out in the well from the first drilling phases until completion.

25 The drilling of gas mineralized wells, characterized by productive formations with a high clay content, mainly reactive, generally requires the use of drilling fluids capa-

ble of stabilizing the walls of the hole to prevent the well from collapsing due to the swelling action of the reactive clays. Oil-based fluids can be used for this purpose, generally inverse W/O emulsions, or fluids based on
5 water containing specific additives capable of interacting with clays and limiting swelling problems.

In some cases, however, especially in multilayer formations, the water fluids do not guarantee satisfactory results and consequently the only alternative is the use of
10 an oil-based fluid.

The interaction however of the oil drilling fluid present as residue or filtered from the porous matrix, with that used in the subsequent completion phase, normally a saline water solution (brine), can cause a temporary or
15 permanent reduction in the well productivity.

It has in fact been observed that when the filtrate of the oil-based mud which penetrates the porous matrix during perforation, comes into contact with the completion brine, it can form emulsions of the W/O type, very viscous and
20 stable even at a high temperature.

The filtrate of the oil-based mud, as the term itself indicates, consists of oil (lamium, gas oil) and surfactants present in the mud formulation, characterized by a low HLB. Polyamides of modified fatty acids, amines of
25 alkoxyated fatty acids are those which are most frequently

found in commercial formulations of oil-based mud. These surfactants are used for formulating oil-based mud as they allow extremely stable inverse W/O emulsions to be obtained.

5 Once the completion phase has been completed, the well is opened and the production is started. In some cases, however, mainly in gas wells, the delivery is slow, or there is not even any production of hydrocarbons.

10 Among the possible damage mechanisms which can cause the lack of delivery, the most probable is the formation of emulsions. If a W/O emulsion is formed, it can have a high viscosity and cannot be removed by subsequent flushings with brine as the continuous phase consists of oil: this type of emulsions acts as a real plug which obstructs the
15 delivery.

20 The damage induced by emulsions is a problem which can occur in producer wells where a lack of hydrocarbon delivery can be observed and in water-injector wells, when the water injected for sustaining the field pressure, is injected into an oil level.

 There are currently no effective technologies for resolving/preventing this problem. The only alternative option is to use water-based mud for drilling, compatible with the completion fluid (brine).

25 This option however is not always possible in wells with

a high reactive clay content, where the use of water-based mud could cause serious problems of instability of the hole.

It has now been found that when oil-based drilling fluids are used, which have been formulated with a particular type of surfactants, the use of a water-based fluid to which surfactants characterized by a suitable HLB and solubility in aqueous solutions with a high saline content have been added, both prevents the formation of a W/O inverse emulsion and resolves the above emulsion if this has already been formed. In the first case, we speak of using completion fluids, in the second, of using remedial fluids.

An objective of the present invention relates to a water-based fluid, for use in the oil field, comprising non-ionic surfactants, stable at temperatures ranging from 10 to 90°C, having an HLB ranging from 8 to 20 and soluble in water, with a saline content ranging from 0 to 60% by weight and possibly salts.

The use of said fluid for preventing the formation of W/O inverse emulsions or for resolving emulsions already formed in oil wells in which oil-based mud is used, represents a further objective of the present invention.

The salts present in the fluid of the present invention, are generally selected from CaCl_2 at a concentration ranging from 1-35% by weight, KCl at a concentration ranging

from 1-10% by weight, CaBr_2 at a concentration ranging from 40-60% by weight.

The non-ionic surfactants added to the fluid of the invention preferably have an HLB ranging from 10 to 15.

5 When the fluid is used for preventing the formation of W/O emulsions, it is called completion fluid or brine, and, in this case, the surfactants are present at a concentration ranging from 0.1 to 1% by weight, whereas when it is used for resolving emulsions already formed, it is called
10 remedial fluid or brine, and the surfactants are present at a concentration ranging from 0.2 to 5% by weight.

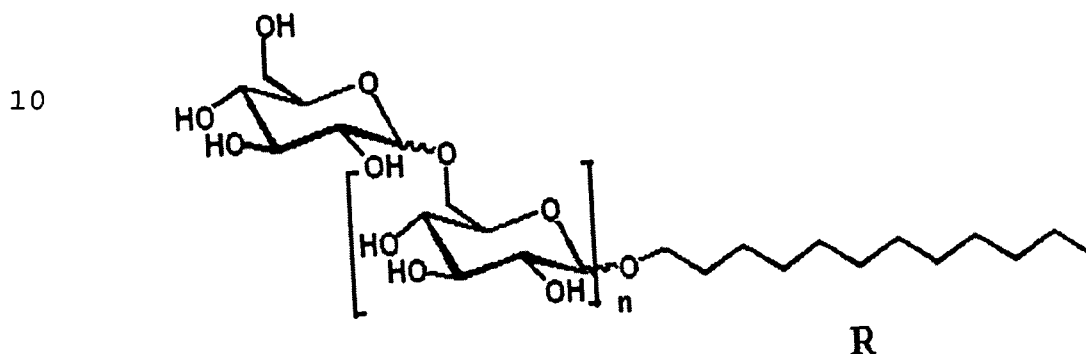
The fluids of the invention can be suitably used for preventing or breaking W/O inverse emulsions in hydrocarbon production wells and in water-injector wells, which are the
15 reason for the lack of hydrocarbon delivery.

The group of alkyl polyglucoside surfactants has proved to be particularly suitable for the purposes of the present invention, as it is stable within the temperature range of 10-90°C and is soluble in water, with a salt content ranging from 0 to 60% by weight.
20

Completion or remedial fluids can be prepared, for example, including commercial alkyl polyglucoside surfactants, with no toxicity, which are already used in various fields (detergence, cosmetic, food industry), such as Seppic products marked SL8, SL10 and Cognis product called GP215.
25

The use of some of these is already known in the oil field, for cleaning applications of the casing.

Particularly satisfactory results have been obtained with Glucopon 215, an alkyl polyglucoside of Cognis, having
5 a structure as shown in figure 1, wherein R represents an alkyl chain with a C8-C10 length and n has the value of 1.5 and represents the oligomerization degree



15 The completion fluid of the invention is particularly effective when it interacts with oil-based drilling fluids which are present in the formation as residue or filtrate from the porous matrix.

The remedial fluid of the invention, on the contrary,
20 is particularly effective when it interacts directly with an already formed W/O emulsion, present in the formation as interaction product between fluids used in previous treatment (for example between a residue or filtrate of an oil-based drilling mud and a traditional completion brine).

25 The oil-based drilling fluids mainly consist of an

oil, generally a low toxicity paraffin oil, used as dispersing phase, such as lamium, for example, and a surfactant or a pair of surfactants, one of which acts as primary emulsifier (present in the mud at a concentration of 3-5% v/v) and the other one as secondary emulsifier (1-3% in the mud).

The following are examples of surfactants or pairs of surfactants which are present in the main commercial types of oil-based mud:

Mud Nr.	Primary emulsifier 0.33% v/v	
1	Polyamine fatty acids	
2	Alkoxylated amines of fatty acids	Sulphonic acid
3	Polyamine fatty acids	
4	Non-ionic surfactant	
5	Alkoxylated amines of fatty acids	Ester phosphate

These surfactants are available on the market under the following trade-names:

Mud Nr.	Primary emulsifier 0.33% v/v	Secondary emulsifier 0.13% v/v
1	Novatec P	Novatec S
2	Invermul NT	EZ MUL NT
3	Avoil PE LT	Avoil SE LT
4	Carbotec	Carbomul
5	Faze MUL	Faze WET

The filtrate generally consists of all the components

present in the oil-based mud which are able to filter through the porous matrix.

The model filtrates used in the present invention were prepared by dissolving in lamium, a pair of surfactants selected from those present in the six types of oil-based muds previously considered.

The concentration of the surfactants in lamium however is an order of magnitude lower than the minimum value used in the original mud formulation (0.33% primary emulsifier, 0.13% secondary emulsifier). In this way, a low residue of the two surfactants was simulated on site, assuming a comparable filtration in the matrix.

The examples provided below are for illustrative and non-limiting purposes of the present invention.

15 FORMATION OF EMULSIONS

Example 1

In this example, the formation of emulsions with variations in the W(brine)/O(synthetic filtrate) ratio, was verified.

20 A synthetic oil filtrate (FS) was used, comprising lamium, a low toxicity paraffin oil used for the formulation of the oil-based drilling fluids (OBM) and two surfactants Novatec P (primary) and Novatec S (secondary), in which the primary emulsifier is present at a concentration of 0.33% v/v and the secondary emulsifier at a concentration of

25

0.13% v/v.

A given volume of FS is mixed - in a 500 ml beaker, at a temperature of 25°C, under stirring (500 rpm) by means of a Silverson stirrer, for ten minutes - with an aqueous solution of CaCl_2 (salt concentration of 380 g/l) at three different mixing ratios: 75/25, 50/50 and 25/75, for a total volume of 200 ml. The formation of a W/O emulsion stable for months was observed for the three mixing ratios. The emulsions were characterized by means of rheological and electric conductivity measurements. Table 1 shows the results obtained.

Example 2

In this example, the formation of emulsions also with other completion brines, was evaluated.

The formation of emulsions was verified using the same procedure described in example 1, but considering the W/O mixing ratio equal to 75/25 only, as it is considered the most representative of real well conditions, the formation of emulsions with other completion brines was also verified: CaCl_2 3%, CaCl_2 10%, KCl 3% and CaBr_2 54%. The formation of stable and viscous W/O emulsions were observed with all the brines used, as confirmed by the electric conductivity data of the various emulsions, compared with the electric conductivity value measured for the same brine, reported in Table 2.

From the rheological characterization it can also be seen that the viscosity at low shear rates of the emulsions formulated with KCl 3% is higher by about an order of magnitude with respect to those containing CaCl_2 at 34%, as
5 illustrated by comparison of the flow curves of Figure 1.

Example 3

In this example, the formation of emulsions with representative synthetic filtrates of different commercial oil-based muds and KCl 3% as completion brine, was evaluated.
10 ated.

Synthetic filtrates of all the five commercial oil-based muds shown in the table below reported, were prepared and emulsified in a ratio of 25/75 with KCl at 3%.

Mud Nr.	Primary emulsifier 0.33% v/v	Secondary emulsifier 0.13% v/v
1	Novatec P	Novatec S
2	Invermul NT	EZ MUL NT
3	Avoil PE LT	Avoil SE LT
4	Carbotec	Carbomul
5	Faze MUL	Faze WET

20 In all cases, an emulsion was prepared which was stable over time, for months, and viscous.

Example 4

In this example, the formation of emulsions with synthetic filtrates representative of different commercial
25 oil-based muds and CaCl_2 as completion brines, is evaluated.

ated.

Synthetic filtrates of all the five commercial oil-based muds reported in the previous example, were prepared and emulsified in a ratio of 25/75 with CaCl_2 $d=1.25$ s.g.

5 In all cases, a stable and viscous emulsion was produced.

PREVENTION OF THE FORMATION OF EMULSIONS: EVALUATION OF THE
EFFECTIVENESS OF THE COMPLETION FLUID

Example 5

In this example, the effectiveness of the prevention
10 treatment object of this patent, is evaluated.

Using the same procedure described in example 1, the possibility of preventing the formation of emulsions by adding a surfactant to the brine, was verified. The surfactants used belong to the class of the non-ionic, alkyl polyglucosides, soluble in the brines used for the test. The
15 concentrations adopted range from 0.2 to 1% as reported in Table 3. As can be observed from the electric conductivity values, all the surfactants tested allow to prevent a W/O emulsion as they are characterized by a conductivity comparable with that of the brine used, with the exception of
20 the SL 4 system which did not give positive results at the concentration used.

Example 6

In this example, the prevention of emulsion formation
25 with synthetic filtrates representative of different com-

mercial oil-based muds and CaCl_2 $d=1.25$ added with 0.5% of Glucocon 215, is evaluated.

50 ml of synthetic filtrate (25% by volume) representative of the selected 5 commercial oil-based muds, are emulsified with 150 ml of CaCl_2 $d=1.25$ (75% by volume) added with 0.5% of Glucocon 215, for 10 minutes at 5,000 revs with a Silverson equipped with a grid with rectangular holes, in a 250 ml high-shaped beaker. The ratio between water phase and oil phase was maintained constant to evaluate all the synthetic filtrates, assuming the excess of brine as being representative of a field situation.

With this procedure, the possibility of preventing the formation of viscous and stable emulsion through the addition of a surfactant to the brine (Glucocon 215 at 0.5%), was verified.

At the end of the emulsifying procedure, all the five systems evaluated, for periods of time less than 30 minutes, showed a perfect separation of the oil phase from the water phase. The two separated phases were limpid.

20 **Example 7**

Verification of the prevention of the formation of stable emulsion with synthetic filtrates representative of different commercial oil-based muds and KCl 3% added with 0.5% of Glucocon 215.

25 The same experimentation reported in example 6 was car-

ried out, but changing the brine.

In this case, at the end of the emulsifying procedure, almost all the five systems evaluated reached, over a period of less than 30 minutes, a perfect separation of the oil phase from the water phase. The two separate phases were limpid. For the emulsions coming from the synthetic filtrate with Carbotec + Carbomul and Faze mul + Faze wet as surfactants in the starting filtrate, the formation of always unstable emulsions but which require much longer resolution times, was observed.

RESOLUTION OF ALREADY FORMED EMULSIONS: EVALUATION OF THE EFFECTIVENESS OF THE REMEDIAL FLUID

Example 8

In this example, the resolution of emulsions (made with synthetic filtrate and CaCl_2 d= 1.25 s.g.) with brines added with different concentrations of Glucopon 215, is evaluated.

The emulsion with the brine phase (CaCl_2 d= 1.25 s.g.) and the synthetic filtrate corresponding to mud nr. 1 in the Table, is prepared by means of a Silverson stirrer. The operative conditions of the emulsification are 5 minutes of stirring at 5,000 rpm. The ratio between the two phases is 25:75.

A series of samples are prepared, wherein equal volumes of brines (as such or added with increasing concentrations

of glucopon) are put in contact with the emulsion.

The study was carried out by adjusting a static separation kinetic test of the phases with Turbiscan. This instrument is capable of monitoring over time the transmission profile and back scattering of the sample, starting
5 from the base of the cell up to its top, revealing the presence of different phases and evolutions of the same. With this system it is possible to set aside the subjectivity of visual observations and compare the behaviour of
10 samples prepared in different ways. 10 ml of resolver (= brine + surfactant) to be tested and 10 ml of emulsions are placed above (as the emulsion is water in oil, it necessarily remains above). An initial measurement of the sample, and other subsequent measurements over time, allow the possible phase de-mixing to be followed, until a complete disappearance of the starting emulsion.
15

On the basis of this test, increasing concentrations up to 5% of the surfactants DFE 726 and Glucopon 215 CS in CaCl_2 $d=1.25$ as resolvers for an emulsion (75w/25 o) prepared with CaCl_2 $d=1.25$, were initially evaluated and compared. Glucopon 215 was proved to be more effective in the resolution of the emulsion, even if, at the beginning, the phase separation is more rapid with DFE. The latter, in fact, also at the highest concentration tested (5%) never
20 leads to a total resolution of the emulsion. Three samples
25

in comparison are photographed in figure 2, after 21 hours from resolver/emulsion contact: the blank sample (absence of surfactants in the resolver) and samples with 5% of DFE and Glucopon 215 CS UP, respectively. It can be seen that with Glucopon a perfect resolution of the emulsion is obtained in two perfectly limpid phases (already in only 4 hours) whereas with DFE a turbid halo remains inside the water phase, which remains as such over time (even months). In the blank sample, the volume of the emulsion phase remains unchanged but a separation of excess of oil is observed.

Example 9

Verification of the resolution of emulsions made with synthetic filtrate and different brines added with different concentrations of Glucopon 215.

Resolution times of emulsions formed according to the protocol defined in the previous example with different brines such as KCl 3%, CaCl_2 3% and CaBr_2 d= 1.8, were determined. Solutions from 0.5 to 5% of Glucopon in brine were prepared as resolvers; the same type of brine was used for the preparation of the emulsion and the resolver.

The data obtained are synthetically reported in Table 4. In the presence of brine at a high saline concentration, faster resolutions of the emulsion are obtained. All the concentrations of Glucopon tested lead, in different times,

to a complete resolution of the emulsion, whereas, in the absence of the surfactant, the emulsion remains stable.

Example 10

In this example, the resolution of emulsions made with synthetic filtrate and brine KCl 3% with different brines added with different concentrations of Glucocon 215, is evaluated.

In order to increase the resolution rate of the emulsion, it was verified whether brines different from KCl 3% were capable of carrying Glucocon with a higher efficiency.

In Table 5 the resolution times of the emulsion from KCl 3% with resolvers consisting of 5 and 8% of Glucocon in different brines, were reported.

The use of CaCl_2 3% can be an advantageous alternative to KCl 3%, whereas brines having high densities do not appear to have the same efficiency.

Example 11

Temperature effect on the resolution of emulsions (made with synthetic filtrate and KCl 3%) with brine CaCl_2 added with Glucocon 215.

The temperature effect on the resolution times of the emulsion made with synthetic filtrate and KCl, by contact with solutions at 8% of Glucocon 215 in KCl and CaCl_2 at 3%, was evaluated.

These tests were carried out in continuous on Turbiscan

thermo-regulated at 40°C, with automatic measurements every 20 minutes, in order to allow a better discrimination of the kinetics and resolution characteristics of the emulsion.

5 The temperature effect allowed the resolution times to be accelerated by 60% with respect to those obtained at room temperature (1 - 2 days).

 In Table 6 the resolutions of the emulsion obtained with brines CaCl_2 and KCl 3%, at room temperature and at
10 40°C, were reported.

 The use of CaCl_2 at 10% instead of 3% can be considered advantageous as, even if it does not lead to significant variations in the resolution times, it allows more limpid solutions of GlucoPON to be obtained, above all in cases in
15 which it is used at high concentrations (8%).

VERIFICATION OF THE FORMATION OF EMULSIONS AND PREVENTION
OF THEIR FORMATION IN A POROUS MEDIUM

Example 12

 Test for evaluating the damage of the porous medium induced by the interaction of the oil filtrate with the completion brine.
20

 The evaluation of the degree of damage caused by a fluid on a productive formation during the drilling and completion phases is performed by means of an experimental
25 apparatus which allows the flushing of fluids in a porous

medium (rock cores). The system consists of a water pressurized Hassler cell in which a rock core is inserted having a diameter of 2.54 cm and a varying length (in our tests it was 7 cm) contained in a rubber sleeve. The apparatus allows an accurate characterization of the initial and final permeability of the core and the evaluation of the residual damage of the core.

The test was performed according to the following procedure:

1. vacuum saturation of the core with the fluid SF = synthetic filtrate, which simulates the filtrate of a drilling oil-based mud. The SF contains lamium (refinery cut based on aliphatic hydrocarbons) and 1/10 of the concentration of surfactants (primary emulsifier and secondary emulsifier) used for the formulation of oil-based muds.
2. after determining the initial permeability to oil the brine CaCl_2 34% is injected into the core, maintaining the pressure constant (70 bar) with the use of a cylinder equipped with a floating piston. At the same time, the quantity of fluids which have filtered through the core is monitored by means of an electronic balance connected to a data processing system.
3. Finally, if the core is not completely plugged, SF is injected again and the final permeability to oil is

measured.

4. the global damage of the core is determined as the ratio between the final and the initial permeability.

Example 13 - comparative

5 After determining the initial permeability to oil (8 mD), following what is described at point 2 of example 12, the injection of CaCl_2 was started, with a pressure of 75 bar. The emission of 5 ml of oil was observed, and the filtration was subsequently blocked. The pressure was increased to 90 bar but, after the emission of a further 5-6
10 ml, the complete block was obtained. The attempt to inject SF with a pressure of 85-90 bar in the opposite direction with respect to that of the brine, did not allow the flow to be re-established in the core, which resulted completely
15 damaged.

Example 14

 A test with CaCl_2 added with 1% of the surfactant GP 215 was performed following the procedure described at point 2 of example 12. Any block of the core was observed,
20 and its permeability was fully recovered after flushing with oil. The residual damage was consequently null.

FIELD APPLICATIONS

 Some of the most representative case histories for field applications performed with GlucoPON added to the
25 completion brine to prevent the formation of emulsions, are

provided hereunder.

Example 15

In Armida 4 bis the well was drilled in OBM and shot in brine + Glucocon; in Basil 8 Glucocon was added to the completion brine to effect an HRWP for sand control; in Armida 4 Glucocon was added to the brine to control the well during wireline operations.

In all cases, the benefit of the system on the well production was noticed, which was obtained according to the estimations where a new level was completed, or was maintained according to the trend in the well in which was performed an operation where the closing of the well is required.

Italy

- 15 • Armida 4BIS
- Well Armida 4 BIS
- Date 31/08/05
- (in production for 2 months)
- Qgas 96.800 Sm³/g
- 20 FTHP 234 kg/cm²
- SBHP 483 kg/cm²
- Drilling fluid OBM
- Completion fluid Brine + 3% Glucocon
- Basil 8
- 25 Well Basil 8

Date 10/12/05

Qgas 225.600 Sm³/g (*)

FTHP 144 kg/cm²

SBHP 235 kg/cm²

5 Drilling fluid OBM

Completion fluid Brine + 3% Glucocon for HRPW

(*) from an early production

* Armida 4

10 Glucocon was added to the brine used for controlling the well during wireline operations. During these operations, in fact, brine could have come into contact with the formation, shot in OBM, therefore creating emulsions. The operations were successfully effected as the production of the well was restarted, with no decrease in production.

15 Table 1

ID test	O:W mixing ratio	Electric conductivity (μS/cm)	Viscosity @ 1000 s ⁻¹ (cP)	Viscosity @ 1 s ⁻¹ (cP)
1	75:25	0.09	100	2,000
2	50:50	0.07	---	---
3	25:75	0.07	---	---
20 4	Brine 100%	180 mS/cm	1.5	1.5

25

Table 2

Electric conductivity values of brines and emulsions prepared therewith

Type of brine	Electric conductivity of brine (mS/cm)	Emulsion conductivity (μ S/cm)
CaCl ₂ 3%	43	30
CaCl ₂ 10%	106.6	36
CaCl ₂ 38%	> 200	41
KCl 3%	53	10
CaBr ₂ 54%	> 200	45

Table 3

Electric conductivity values of surfactant/water/SF systems

Surfactant	Concentration (%)	Electric conductivity (mS/cm)
SL 4	1	0.135 (W/O emulsion)
SL 8	1	166
SL 10	1	166
	0.4	94
GP 215	1	166
	0.4	166
	0.2	152
Brine (CaCl ₂ 34%) as such for comparison		180

Table 4

Emulsion resolution times for various resolvers tested

Type of brine	Glucopon 215 CS UP concentration					
	5%	3%	2%	1%	0.5%	0%
CaBr ₂ d= 1.8	1h 45' ± 10'	1h 45' ± 10'	1h 45' ± 10'	1h 45' ± 10'	3-6 h	Stable emul-sion
CaCl ₂ d=1.25	3h 50' ± 10'	4-21 h			21 h	
Ca Cl ₂ 3%	3 days	3-8 days				
KCl 3%	6 days	6-22 days				

Table 5

Resolution times of the emulsion from KCl 3% with different brines and two Glucopon concentrations

Brine	Resolution time with Glucopon 215 CS UP 5%	Resolution time with Glucopon 215 CS UP 8%
KCl 3%	6 days	2-3 days
CaCl ₂ 3%	2 days	1-2 days
CaCl ₂ d= 1.25	2-5 days (with initial expansion of the emulsion)	
CaBr ₂ d= 1.8	2-5 days (with initial expansion of the emulsion)	

Table 6

Resolution times of the emulsion from KCl 3% obtained at temperatures of 25 and 40°C with GlucoPON 8% carried by two different brines (KCl and CaCl₂ 3%)

Brine	Resolution time with GlucoPON 215 CS UP 8%	
	T = 25 °C	T = 40 °C
KCl 3%	2-3 days	> 26 hrs
CaCl ₂ 3%	1-2 days	14 hr

CLAIMS

1. A water-based fluid for applications in the oil field, comprising non-ionic surfactants, stable at temperatures ranging from 10 to 90°C, having an HLB ranging from 8 to 20
5 and soluble in water, with a saline content ranging from 0 to 60% by weight, and possibly salts.
2. The fluid according to claim 1, wherein the salts are selected from CaCl_2 at a concentration ranging from 1-35% by weight, KCl at a concentration ranging from 1-10% by
10 weight, CaBr_2 at a concentration ranging from 40-60% by weight.
3. The fluid according to claim 1, wherein the non-ionic surfactants have an HLB ranging from 10 to 15.
4. The fluid according to claim 1, wherein the non-ionic
15 surfactants belong to the group of alkyl polyglucoside surfactants.
5. The fluid according to claim 4, wherein the alkyl polyglucoside surfactants are selected from those commercial marked SL8, L10 of Seppic and that one called GlucoPON 215
20 of Cognis.
6. Use of the fluid according to claim 1 as completion fluid for preventing the formation of W/O inverse emulsions or as remedial fluid for resolving already formed emulsions in oil wells in which oil-based muds have been used.
- 25 7. Use according to claim 6 wherein, when the fluid is

used for preventing the formation of emulsions, it contains non-ionic surfactants at a concentration ranging from 0.1 and 1% by weight, when it is used for resolving emulsions, it contains non-ionic surfactants at a concentration ranging from 0.2 to 5 % by weight.

8. Use according to claim 6, both in wells producing hydrocarbons and in water-injector wells.

9. Use according to claim 6, wherein the oil-based muds comprise a paraffin oil used as dispersing phase and a surfactant or a pair of surfactants, one of which acts as primary emulsifier v/v and the other as secondary emulsifier.

10. Use according to claim 9, wherein the paraffin oil is lamium.

11. Use according to claim 9, wherein the primary emulsifier is present in the mud at a concentration of 3-5% by weight and the secondary emulsifier at a concentration of 1-3% by weight.

12. A process for preventing W/O inverse emulsions which are formed in hydrocarbons production wells drilled with oil-based fluids, wherein the water-based fluid of claim 1 is injected into the well and left to interact with the drilling oil-based fluids present in the formation as residue or as filtrate from the porous matrix.

13. A process for resolving W/O inverse emulsions which are formed in hydrocarbon production wells, drilled with

oil-based fluids, wherein the water-based fluid of claim 1 is injected into the well and left to interact directly with the W/O emulsion already formed.

5

10

15

20

25

1/1

Fig. 1

Comparison of flow curves of two emulsions formulated with KCl 3% and CaCl_2 34%, respectively.

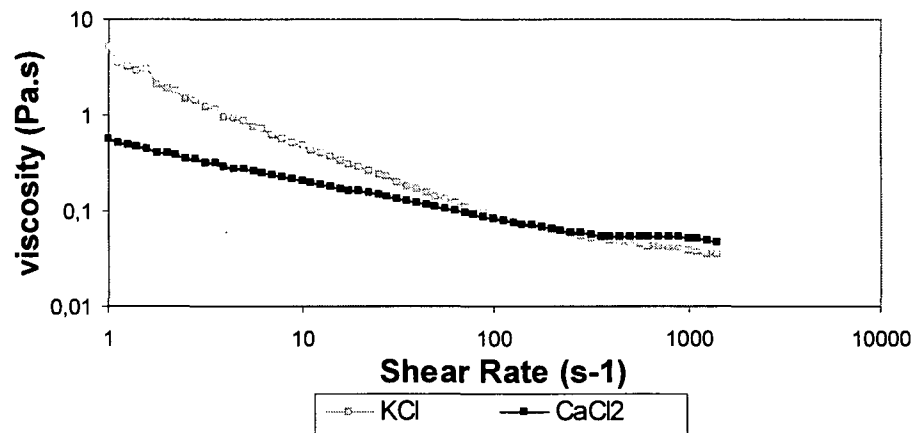


Fig. 2

Samples 4 hours after the starting of the test. From left to right: blank, DFE 5%, Glucocon 5%.

