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Señores

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO

DIVISION DE NUEVAS CREACIONES

E. S. D.

REF: INTEVEP, S.A.

Expediente No.01 099.043 - Solicitud de Patente

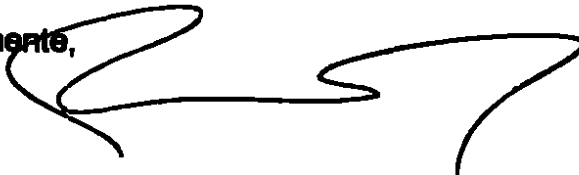
SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO
Radicación: 01099043 00000001 Folios: 5
Fecha (Año): 2002-01-17 16:35:14
Tramite: 002 PATENTES D 1 REGISTRAD/ 323 COMPLET
Dependencia: 2020 DIVISION DE NUEVAS CREACIONES

Titulada: EMULSIÓN DE ACEITE EN AGUA COMO FLUIDO DE
FRACTURAMIENTO Y METODO DE PREPARACIÓN Y APLICACIÓN

RAMIRO CASTRO DUQUE, vecino de Bogotá, portador de la tarjeta profesional No. 1003, obrando como apoderado de la sociedad, INTEVEP, S.A., según lo acredita el documento de poder protocolizado en esa División bajo el No. 14558, me permito anexar al presente escrito los siguientes documentos:

1. Copia certificada por la Oficina de Patentes de Estados Unidos de la primera solicitud presentada para la misma invención, de la cual REIVINDICAMOS PRIORIDAD, junto con su correspondiente traducción del inglés al castellano.

Del señor Jefe atentamente,



RAMIRO CASTRO DUQUE

C.C. No. 170.322 de Bogotá

Código 340

Cra 7 No. 16-56 Piso 9

Bogotá, Enero 16, 2002

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November 27, 2001

THIS IS TO CERTIFY THAT ANNEXED HERETO IS A TRUE COPY FROM THE RECORDS OF THE UNITED STATES PATENT AND TRADEMARK OFFICE OF THOSE PAPERS OF THE BELOW IDENTIFIED PATENT APPLICATION THAT MET THE REQUIREMENTS TO BE GRANTED A FILING DATE UNDER 35 USC 111.

APPLICATION NUMBER: 09/717,330

FILING DATE: November 20, 2000



By Authority of the
COMMISSIONER OF PATENTS AND TRADEMARKS

W. Montgomery
W. MONTGOMERY
Certifying Officer

11-22-00

Case Docket No. 00-336

THE COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

Sir:

Transmitted herewith for filing is the patent application of:

INVENTOR: SARKIS KAKADJIAN ET AL.

FOR: CROSSLINKED EMULSION FRACTURING FLUID

Enclosed are:

- (~~XXX~~) Two sheets of drawing(s).
 () An Assignment of the invention to
 () A certified copy of _____ Application
 No. _____, Filed _____.
 () This Patent Application is entitled to small entity status.
 (~~XXX~~) INFORMATION DISCLOSURE STATEMENT, LISTING OF PRIOR ART ON
 FORM PTO 1449 AND COPIES.

The filing fee has been calculated as shown below:

	SMALL ENTITY		OTHER THAN A SMALL ENTITY	
	No. Filed	No. Extra	Rate	Fee
For Basic Fee				\$ 355
Total Claims	19	20 =	x 9 \$	x 18 \$
Indep Claims	3	- 3 =	x 40 \$	x 80 \$
Multiple Dependent Claim () Presented			+135 \$	+270 \$
			TOTAL \$	TOTAL \$ 710

- () Please charge my Deposit Account No. 02-0184 in the amount of _____. A duplicate copy of this sheet is enclosed.
- (~~XX~~) A check in the amount of \$710.00 to cover the filing fee.
- (~~XX~~) The Commissioner is hereby authorized to charge payment of the following fees associated with this communication or credit any overpayment to Deposit Account No. 02-0184. A duplicate copy of this sheet is enclosed.
- (x) Any additional filing fees required under 37 CFR 1.16.
 (x) Any patent application processing fees under 37 CFR 1.17.
- (~~XX~~) The Commissioner of hereby authorized to charge payment of the following fees during the pendency of this application or credit any overpayment to Deposit Account No. 02-0184. A duplicate copy of this sheet is enclosed.
- (x) Any patent application processing fees under 37 CFR 1.17.
 (x) Any filing fees under 37 CFR 1.16 for presentation of extra claims.

Date: November 20, 2000

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 Date of Signature

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BACKGROUND OF THE INVENTION

The invention relates to the field of fracturing fluids and, more particularly, to a fracturing fluid useful in fracturing a subterranean formation for enhancing production from same.

The use of fracturing fluids for enhancing production from subterranean formations is well known. In such endeavors, a fluid is pumped into a well with the intent of fracturing a particular formation so as to increase permeability of the formation so that fluids can flow more rapidly from the formation into a production well.

Important concerns when evaluating and formulating a fracturing fluid are pumpability, viscosity, cost and recoverability, among others. Numerous different types of fluids have been used as fracturing fluids. Conventionally used fluids include gasoline viscosified with napalm, gelled oils, linear gelled water, cross-linked gelled water and foamed gels.

In connection with pumpability and viscosity, it is desirable that the fluid be easily pumpable at low pumping pressures while sufficiently viscous that the fluid, when

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pumped into a well, will break-up a subterranean structure and increase the permeability of the structure as desired.

It is also desirable, once the subterranean formation is fractured, that the fluid be easily recovered from the well.

Conventional fluids utilize expensive additives in large amounts so as to meet these requirements, and the need remains for an acceptable fracturing fluid which is inexpensive in preparation and use, and which yields the desired results.

It is therefore the primary object of the present invention to provide a fracturing fluid which performs well as a fracturing fluid and has reduced cost for preparation.

It is a further object of the present invention to provide a method for preparing such a drilling fluid.

It is a still further object of the present invention to provide a method for fracturing a formation utilizing such a fracturing fluid.

Other objects and advantages of the present invention will appear hereinbelow.

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SUMMARY OF THE INVENTION

In accordance with the present invention, the foregoing objects and advantages have been readily attained.

In accordance with the invention, an oil in water fracturing fluid emulsion is provided, which emulsion comprises a dispersed oil phase; and a continuous water phase comprising a solution of cross-linkable polymer in water.

In further accordance with the present invention, an oil in water fracturing fluid emulsion is prepared according to a method which comprises the steps of providing a water phase comprising a solution of a cross-linkable polymer in water; providing an oil phase; forming an oil in water emulsion from said water phase and said oil phase; adjusting pH of said emulsion to a pH of between about 9.0 and about 13.0; and cross-linking said polymer solution so as to provide a cross-linked emulsion.

In accordance with another aspect of the present invention, a method is provided for fracturing a subterranean formation through a well, which method comprises the steps of providing an oil in water fracturing

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fluid emulsion comprising a dispersed oil phase; a continuous water phase comprising a solution of cross-linkable polymer in water; and a propping agent carried by said emulsion; pumping said emulsion into a well communicated with a subterranean formation so as to form cracks in said formation; and removing said emulsion whereby said propping agent is positioned in said cracks.

BRIEF DESCRIPTION OF THE DRAWINGS

A detailed description of preferred embodiments of the invention follows, with reference to the attached drawings, wherein:

Figure 1 graphically illustrates viscosity over time for emulsions in accordance with the present invention when subjected to different amounts of breaker; and

Figure 2 graphically illustrates viscosity at different temperatures for a cross-linked emulsion in accordance with the present invention as compared to a polymer free gel.

DETAILED DESCRIPTION

The invention relates to an oil in water fracturing fluid emulsion which is useful for fracturing subterranean formations so as to improve permeability of same and, thereby, to improve production of hydrocarbons. In accordance with the present invention, the fracturing fluid is prepared utilizing inexpensive and readily available ingredients, and further utilizing reduced amounts of ingredients which increase the cost of conventional fracturing fluids.

In accordance with the present invention, the fracturing fluid is provided as an emulsion of a dispersed oil phase in a continuous water phase. As will be further discussed below, the water phase is provided as a polymer in water solution, and the emulsion is treated with a cross-linking agent which serves to cross-link the polymer and increase viscosity of the overall emulsion. This advantageously allows for using the emulsion as a fracturing fluid as well as a carrier of propping agents or propants which are left behind in the formation to keep fractures or cracks formed in the formation open, thereby

enhancing production of hydrocarbons and other desired fluids.

The oil phase of the emulsion of the present invention may advantageously be any hydrocarbon which is preferably inexpensive and readily available such as, for example, gasoil, mineral oil and mixtures thereof. Of course, other suitable oil or hydrocarbon phases could be utilized so long as they are compatible with the well and formation, as well as the polymer solution and its cross-linking agent. Gasoil and mineral oil are particularly desirable because they are readily available at reasonable cost and are compatible with the well.

The water phase is preferably formed by mixing a solution of the desirable cross-linkable polymer in water. The water can be obtained from any acceptable source, and may include brine, fresh water, and the like.

The emulsion may advantageously be prepared having a ratio by volume of oil to water of between about 80:20 and about 20:80. The proper ratio should be selected depending upon the expected fracturing force required for fracturing the well, as well as various pumping parameters particular to a subject well. The emulsion is preferably prepared

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having an average droplet size of less than about 20 micrometers, more preferably between about 2 micrometers and about 5 micrometers.

In accordance with the present invention, the emulsion preferably includes a cross-linking agent which cross-links the polymer so as to increase viscosity of the overall emulsion, thereby rendering the emulsion ideal for use as a fracturing fluid and as a carrier of a propping agent. In this regard, various polymers are suitable. Preferred polymers include polysaccharides, cellulose derivatives, xanthan gums, and the like, and hydroxy propyl guar is one example of a suitable polymer. The polymers are preferably present in the polymer solution in an amount between about 10 and about 70 lbs of polymer per 1000 gallons of water.

The cross-linking agent in accordance with the present invention may suitably be any agent which will produce or serve as a source of desired ions which act to cross-link the various chains or branches of polymer present in the water phase of the emulsion. Preferred cross-linking agents include aluminum, titanium, zirconium, antimony, chromium, borate and mixtures thereof, all of which can

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serve as the source of free ions as desired. Borate and any source of free borate ions in solution are preferred.

The water phase of the emulsion of the present invention may also advantageously be mixed with a salt such as potassium chloride and the like so as to avoid excessive clay swelling which would adversely impact upon the attributes of the emulsion.

Emulsions according to the invention also preferably include a suitable surfactant so as to facilitate forming of the emulsion as well as to improve stability of same. Suitable surfactants are discussed below.

The emulsion is preferably mixed with and serves as an excellent carrier for a propping agent, as mentioned above. The propping agent should be selected as any granular substance having a desirable particle or grain size which will serve to lodge in cracks and fractures induced into the formation, and thereby hold such cracks or fractures open so as to enhance hydrocarbon production from same. Such propants are well known to the person of ordinary skill in the art.

Before cross-linking, the emulsion may suitably have a viscosity of between about 90 and about 150 cP at 511 s^{-1}

and 80°F. The cross-linking of the emulsion provides an increase in emulsion viscosity, preferably to a viscosity of between about 150 and about 750 cP at 170 s⁻¹ and 180°F. This allows the emulsion to be used as an excellent carrier for the propping agent so as to advantageously deliver the propping agent to the formation as it is fractured. This advantageously allows for the formation to be fractured and propping agent delivered all utilizing a single emulsion fracturing fluid and process step.

Through use of an oil in water emulsion and cross-linking of polymer in the water phase of the emulsion, a fluid is provided which has the desired viscosity and pumpability, and which also serves as an excellent propping agent carrier. The combination of oil in water emulsion with cross-linked polymer advantageously provides for reduced amounts of polymer and cross-linking agent which results in reduced cost.

In accordance with the present invention, an oil in water fracturing fluid emulsion can be prepared as follows.

The water phase is prepared by mixing the selected polymer in water until a solution is formed.

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The oil phase, such as gasoil, mineral oil and the like, is obtained and an emulsion is formed of the oil phase in the water phase, preferably utilizing a surfactant. Suitable surfactants include a combination of sulfates, alkaline metal sulfonates and non-ionic surfactants selected from the group consisting of alkyl phenols, aliphatic-ethoxylated alcohols, and mixtures thereof. A surfactant package is preferably provided having a ratio of anionic surfactant to non-ionic surfactant, by volume, of between about 70:30 and about 80:20.

Once the emulsion is formed, it has been found in accordance with the invention that the pH may frequently need to be adjusted so as to allow for the desired cross-linking. In order to obtain the desired cross-linking, a pH of between about 9.0 and about 13.0, preferably between about 9.5 and about 12.0, is critical. The pH can be adjusted by mixing with any suitable and well-known pH controller such as monoethanolamine, sodium hydroxide, potassium hydroxide and the like. Once the suitable pH is obtained, the emulsion is then cross-linked by mixing with a suitable cross-linking agent such as an agent selected

from the group consisting of aluminum, titanium, zirconium, antimony, chromium, borate and mixtures thereof. In accordance with the present invention, borate compounds are most preferred, as are compounds which generate borate ions in solution in the water phase, as such borate ions appear to enhance the cross-linking process so as to obtain the desired viscosity of the emulsion in accordance with the present invention. If the emulsion is to be transported by flowing through conduits before use, it may be desirable to add the cross-linking agent after such transport. Thus, the cross-linking agent can be added at the time the emulsion is formed, just before or simultaneously with addition of the propping agent, or any point therebetween.

Once the emulsion is complete, any desired propping agent or propant can be mixed into the emulsion as desired, and the emulsion serves as an excellent carrier for carrying the propping agent down through a well and to a subterranean formation which is to be the subject of a fracturing process. Typically, the propping agent is not added to the emulsion until just before use.

Once the formation is fractured, it is desirable to remove the fracturing fluid, especially any polymers and

the like which remain after the process. In order to facilitate removal of the fracturing fluid, it is desired to break the cross-link of the polymer so as to reduce viscosity and allow for pumping of the broken fracturing fluid back to the surface. Breaking can be accomplished utilizing breakers such as oxidizer breakers, enzymes and combinations thereof. Such breaking agents or breakers are well known to a person of ordinary skill in the art.

Once the cross-linking is broken, the reduced viscosity emulsion advantageously encapsulates remaining or residual polymer so as to facilitate removal of the entire fracturing fluid including polymers, while nevertheless leaving propping agents behind, in cracks or fractures in the formation, so as to enhance hydrocarbon production from the formation as desired.

The fracturing fluid in accordance with the present invention is advantageous in that viscosities up to 750 cP are provided at temperatures between about 110°F and about 220°F, which provides for excellent propping agent transport. Further, the system uses very low polymer concentration, providing excellent results utilizing 14-18 lbs. of polymer per 1000 gallons of water and providing

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satisfactory results up to temperatures of about 180°F and potentially up to about 220°F. This is a reduced concentration and improvement in temperature tolerance as compared to conventional fracturing fluids.

In addition, the oil phase is low cost, and all additives are commercially available.

Example

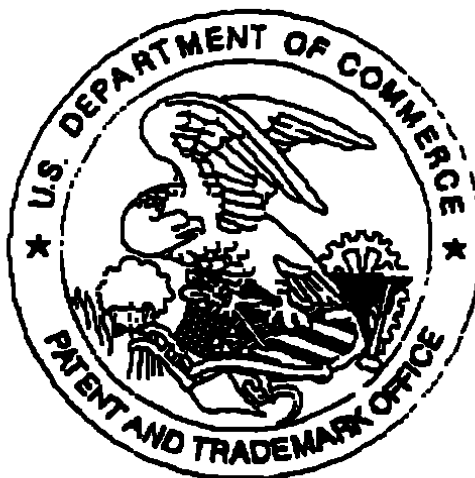
This example demonstrates preparation of a fracturing fluid in accordance with the present invention, as well as analysis of same.

0.5 barrels of a gasoil-mineral oil mixture were obtained for use as the oil phase.

The water phase was provided as 0.5 barrels of fresh water mixed with polymer hydroxy propyl guar (HPG) polymer at a rate of 50 lbs. polymer per 1000 gallons of water, and 6 lbs. of potassium chloride per barrel were added to the water. During emulsion formation, a commercial surfactant was used at a rate of 20 lbs. of surfactant per barrel of total emulsion. This surfactant is an anionic:nonionic surfactant having a ratio of 75:25, and is selected so as to be compatible with drilling fluid and

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SCANNED # 14

Application deficiencies were found during scanning:

☒ Page(s) 15 of the specification were not present:
for scanning. (Document title)

☐ Page(s) _____ of _____ were not present:
for scanning. (Document title)

☐ Scanned copy is best available.

Table 1

170°F

Time (min)	Breaker (lbs./1000 gal)							
	0		0.5		0.75		1.0	
	n'	K'	n'	K'	n'	K'	n'	K'
5	0.4160	0.2700	0.3892	0.2170	0.5846	0.1527	0.3396	0.1656
30	0.7198	0.0346	0.5590	0.0497	0.4924	0.0500	0.5129	0.0149
74	0.7112	0.0349	0.4597	0.0613	0.439	0.0525	0.4875	0.0157
110	0.5895	0.0608	0.4502	0.0514	0.5018	0.0310	0.4300	0.0170
146	0.4171	0.1160	0.3863	0.0562	0.4431	0.0348	0.4328	0.0185
186	0.2723	0.1611	0.3482	0.0600	0.3680	0.0451	0.4063	0.0226

The emulsion prepared in this example was also tested utilizing different amounts of breaker so as to illustrate viscosity change over time. Figure 1 shows the emulsion of the present invention when treated with different amounts of breaker, and the resulting viscosity at 170°F. As shown, 0.5 lbs/1000 gallons of breaker and greater provided for excellent reduction in viscosity after an initial high-viscosity period which is ideal for utilizing the emulsion of the present invention as a fracturing fluid. The high viscosity in the initial period allows the fluid to be utilized for forming fractures, while the break in cross-linking and reduction in viscosity allows for the emulsion, with encapsulated polymer, to be readily removed from the well, leaving propping agent behind.

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Figure 2 further shows the emulsion as prepared in this example as compared to a conventional polymer-free gel in viscosity at different temperatures, which further demonstrates the benefit of the cross-linking of the present invention in providing for use as a fracturing fluid, as well as a propping agent transport. As shown, at temperatures between 110°F and 170°F, the cross-linked emulsion has a greater viscosity in all cases, with the degree of magnitude of improvement in viscosity of the cross-linked emulsion being greater as temperature increases.

It should readily be appreciated that in accordance with the present invention, an emulsion and method for forming same have been provided which allow for an effective and inexpensively prepared fracturing fluid. Further, methods are provided for use of this fracturing fluid in fracturing formations so as to enhance hydrocarbon and other desired fluid production.

This invention may be embodied in other forms or carried out in other ways without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered as in all respects

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illustrative and not restrictive, the scope of the
invention being indicated by the appended claims, and all
changes which come within the meaning and range of
equivalency are intended to be embraced therein.

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52WHAT IS CLAIMED

1. An oil in water fracturing fluid emulsion, comprising:
a dispersed oil phase; and
a continuous water phase comprising a solution of cross-linkable polymer in water.
2. The emulsion of claim 1, wherein said emulsion has a viscosity of between about 90 and about 150 cP at 511 s^{-1} and 80°F .
3. The emulsion of claim 1, wherein said polymer is cross-linked and said emulsion has viscosity of between about 150 cP and about 750 cP at 170 s^{-1} and 180°F .
4. The emulsion of claim 1, wherein said oil phase is selected from the group consisting of gasoil, mineral oil and mixtures thereof.
5. The emulsion of claim 1, wherein said water phase contains said polymer in an amount between about 10 and about 70 lbs. of said polymer per 1000 gallons of water.

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6. The emulsion of claim 5, wherein said polymer is selected from the group consisting of polysaccharide, cellulose derivatives, xanthan gum and combinations thereof.

7. The emulsion of claim 6, wherein said polymer is hydroxy propyl guar.

8. The emulsion of claim 1, further comprising a propping agent carried by said emulsion.

9. A method for making a fracturing fluid emulsion, comprising the steps of:

providing a water phase comprising a solution of a cross-linkable polymer in water;

providing an oil phase;

forming an oil in water emulsion from said water phase and said oil phase;

adjusting pH of said emulsion to a pH of between about 9.0 and about 13.0; and

cross-linking said polymer solution so as to provide a cross-linked emulsion.

10. The method of claim 9, wherein said cross-linked emulsion has a viscosity of between about 150 and about 750 cP at 170 s^{-1} and $180\text{ }^{\circ}\text{F}$.

11. The method of claim 9, wherein said oil phase is selected from the group consisting of gasoil, mineral oil and mixtures thereof.

12. The method of claim 9, wherein said water phase contains said polymer in an amount between about 10 and about 70 lbs. of said polymer per 1000 gallons of water.

13. The method of claim 12, wherein said polymer is selected from the group consisting of polysaccharide, cellulose derivatives, xanthan gum and combinations thereof.

14. The method of claim 13, wherein said polymer is hydroxy propyl guar.

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15. The method of claim 9, wherein said cross-linking step comprises mixing said emulsion with a cross-linking agent.

16. The method of claim 15, wherein said cross-linking agent is selected from the group consisting of aluminum, titanium, zirconium, antimony, chromium, borate and mixtures thereof.

17. A method for fracturing a subterranean formation, comprising the steps of providing an oil in water fracturing fluid emulsion comprising a dispersed oil phase; a continuous water phase comprising a solution of cross-linkable polymer in water; and a propping agent carried by said emulsion;

pumping said emulsion into a well communicated with a subterranean formation so as to form cracks in said formation; and

removing said emulsion whereby said propping agent is positioned in said cracks.

18. The method of claim 17, wherein said emulsion is cross-linked and wherein said removing step comprises breaking cross-linking of said polymer so as to provide a reduced viscosity emulsion, and removing said reduced viscosity emulsion from said well.

19. The method of claim 18, wherein said reduced viscosity emulsion encapsulates said polymer whereby said removing step removes said polymer.

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Abstract

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Practitioner's Docket No. 00-336

PATENT

COMBINED DECLARATION AND POWER OF ATTORNEY
(ORIGINAL, DESIGN, NATIONAL STAGE OF PCT, SUPPLEMENTAL, DIVISIONAL,
CONTINUATION, OR C-I-P)

As a below named inventor, I hereby declare that:

TYPE OF DECLARATION

This declaration is of the following type:

(check one applicable item below)

- ☒ original.
☐ design.

NOTE: With the exception of a supplemental oath or declaration submitted in a reissue, a supplemental oath or declaration is not treated as an amendment under 37 CFR 1.312 (Amendments after allowance). M.P.E.P. § 714.16, 7th Edition.

- ☐ supplemental.

NOTE: If the declaration is for an International Application being filed as a divisional, continuation or continuation-in-part application, do not check next item; check appropriate one of last three items.

- ☐ national stage of PCT.

NOTE: If one of the following 3 items apply, then complete and also attach **ADDED PAGES FOR DIVISIONAL, CONTINUATION OR C-I-P**.

NOTE: See 37 C.F.R. § 1.534a (continued prosecution application) for use of a prior nonprovisional application declaration in the continuation or divisional application being filed on behalf of the same or fewer of the inventors named in the prior application.

- ☐ divisional.
☐ continuation.

NOTE: Where an application discloses and claims subject matter not disclosed in the prior application, or a continuation or divisional application names an inventor not named in the prior application, a continuation-in-part application must be filed under 37 C.F.R. § 1.534a (application filing requirements — nonprovisional application).

- ☐ continuation-in-part (C-I-P).

INVENTORSHIP IDENTIFICATION

WARNING: If the inventors are each not the inventors of all the claims, an explanation of the facts, including the ownership of all the claims at the time the last claimed invention was made, should be submitted.

My residence, post office address and citizenship are as stated below, next to my name. I believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter that is claimed, and for which a patent is sought on the invention entitled:

TITLE OF INVENTION

CROSSLINKED EMULSION FRACTURING FLUID

00021-00000-12000

SPECIFICATION IDENTIFICATION

the specification of which:

(complete (a), (b), or (c))

(a) ☒ is attached hereto.

NOTE: The following combinations of information supplied in an oath or declaration filed on the application filing date with a specification are acceptable as minimums for identifying a specification and compliance with any one of the items below will be accepted as complying with the identification requirement of 37 CFR 1.63:

"(1) name of inventor(s), and reference to an attached specification which is both attached to the oath or declaration at the time of execution and submitted with the oath or declaration on filing;

"(2) name of inventor(s), and attorney docket number which was on the specification as filed;

or

"(3) name of inventor(s), and title which was on the specification as filed."

Notice of July 13, 1985 (1177 O.G. 60).

(b) ☐ was filed on _____ as ☐ Serial No. 0 / _____
or ☐ _____
and was amended on _____ (if applicable).

NOTE: Amendments filed after the original papers are deposited with the PTO that contain new matter are not accorded a filing date by being referred to in the declaration. Accordingly, the amendments involved are those filed with the application papers or, in the case of a supplemental declaration, are those amendments claiming matter not encompassed in the original statement of invention or claims. See 37 C.F.R. § 1.67.

NOTE: The following combinations of information supplied in an oath or declaration filed after the filing date are acceptable as minimums for identifying a specification and compliance with any one of the items below will be accepted as complying with the identification requirement of 37 CFR 1.63:

"(4) application number (consisting of the series code and the serial number, e.g., 08/123,456);

"(5) serial number and filing date;

"(6) attorney docket number which was on the specification as filed;

"(7) title which was on the specification as filed and reference to an attached specification which is both attached to the oath or declaration at the time of execution and submitted with the oath or declaration; or

"(8) title which was on the specification as filed and accompanied by a cover letter accurately identifying the application for which it was intended by either the application number (consisting of the series code and the serial number, e.g., 08/123,456), or serial number and filing date. Absent any statement to the contrary, it will be presumed that the application filed in the PTO is the application which the inventor(s) executed by signing the oath or declaration."

M.P.E.P. § 801.01(h), 7th Ed.

(c) ☐ was described and claimed in PCT International Application No. _____, filed on _____ and as amended under PCT Article 19 on _____ (if any).

(Declaration and Power of Attorney [1-1]—page 2 of 7)

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SUPPLEMENTAL DECLARATION (37 C.F.R. § 1.57(b))

(complete the following where a supplemental declaration is being submitted)

- ☐ I hereby declare that the subject matter of the
 - ☐ attached amendment
 - ☐ amendment filed on _____

was part of my/our invention and was invented before the filing date of the original application, above-identified, for such invention.

ACKNOWLEDGEMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information, which is material to patentability as defined in 37, Code of Federal Regulations, § 1.56,

(also check the following items, if desired)

- ☒ and which is material to the examination of this application, namely, information where there is a substantial likelihood that a reasonable Examiner would consider it important in deciding whether to allow the application to issue as a patent, and
- ☒ in compliance with this duty, there is attached an information disclosure statement, in accordance with 37 C.F.R. § 1.88.

PRIORITY CLAIM (35 U.S.C. §§ 119(a)-(d))

NOTE: "The claim to priority need be in no special form and may be made by the attorney or agent if the foreign application is referred to in the oath or declaration as required by § 1.63. The claim for priority and the certified copy of the foreign application specified in 35 U.S.C. 119(b) must be filed in the case of an interference (§ 1.632), when necessary to overcome the date of a reference relied upon by the examiner, when specifically required by the examiner, and in all other situations, before the patent is granted. If the claim for priority or the certified copy of the foreign application is filed after the date the issue fee is paid, it must be accompanied by a petition requesting entry and by the fee set forth in § 1.178. If the certified copy is not in the English language, a translation need not be filed except in the case of interference; or when necessary to overcome the date of a reference relied upon by the examiner; or when specifically required by the examiner; in which event an English language translation must be filed together with a statement that the translation of the certified copy is accurate." 37 C.F.R. § 1.66(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §§ 119(a)-(d) of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

(complete (c) or (b))

- (c) ☒ no such applications have been filed.
- (b) ☐ such applications have been filed as follows.

NOTE: Where item (c) is entered above and the International Application which designated the U.S. itself claimed priority check item (b), enter the details below and make the priority claim.

(Declaration and Power of Attorney [1-1]—page 3 of 7)

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COUNTRY (OR INDICATE IF PCT)	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 37 USC 119
			☐ YES NO ☐
			☐ YES NO ☐
			☐ YES NO ☐
			☐ YES NO ☐
			☐ YES NO ☐

CLAIM FOR BENEFIT OF PRIOR U.S. PROVISIONAL APPLICATION(S)
(34 U.S.C. § 119(e))

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below:

PROVISIONAL APPLICATION NUMBER**FLUNG DATE**

_____ / _____

_____ / _____

_____ / _____

**CLAIM FOR BENEFIT OF EARLIER US/PCT APPLICATION(S)
UNDER 35 U.S.C. § 120**

- ☐ The claim for the benefit of any such applications are set forth in the attached ADDED PAGES TO COMBINED DECLARATION AND POWER OF ATTORNEY FOR DIVISIONAL, CONTINUATION OR CONTINUATION-IN-PART (C-I-P) APPLICATION.

(Declaration and Power of Attorney [1-1]—page 4 of 7)

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**ALL FOREIGN APPLICATION(S), IF ANY, FILED MORE THAN 12 MONTHS
(6 MONTHS FOR DESIGN) PRIOR TO THIS U.S. APPLICATION**

NOTE: If the application filed more than 12 months from the filing date of this application is a PCT filing forming the basis for this application entering the United States as (1) the national stage, or (2) a continuation, divisional, or continuation-in-part, then also complete **ADDED PAGES TO COMBINED DECLARATION AND POWER OF ATTORNEY FOR DIVISIONAL, CONTINUATION OR C-I-P APPLICATION** for benefit of the prior U.S. or PCT application(s) under 35 U.S.C. § 130.

POWER OF ATTORNEY

I hereby appoint the following practitioner(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

(list name and registration number)

Robert H. Bachman, (19,374); Gregory P. LaPointe, (28,395);
Barry L. Kelmacher (29,999); and George A. Coury, (34,309)

(check the following item, if applicable)

- ☐ I hereby appoint the practitioner(s) associated with the Customer Number provided below to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.
- ☐ Attached, as part of this declaration and power of attorney, is the authorization of the above-named practitioner(s) to accept and follow instructions from my representative(s).

NOTE: "Special care should be taken in continuation or divisional applications to ensure that any change of correspondence address in a prior application is reflected in the continuation or divisional application. For example, where a copy of the oath or declaration from the prior application is submitted for a continuation or divisional application filed under 37 CFR 1.53(b) and the copy of the oath or declaration from the prior application designates an old correspondence address, the Office may not recognize, in the continuation or divisional application, the change of correspondence address made during the prosecution of the prior application. Applicant is required to identify the change of correspondence address in the continuation or divisional application to ensure that communications from the Office are mailed to the current correspondence address. 37 CFR 1.53(b)(4)." § 601.02, M.P.E.P., 7th Edition.

SEND CORRESPONDENCE TO

DIRECT TELEPHONE CALLS TO:
(Name and telephone number)

☒ **Address**
BACHMAN & LAPOINTE, P.C.
900 Chapel Street, Suite 1201
New Haven, CT 06510-2802

Gregory P. LaPointe
(203)777-6628, Ext. 111

☐ **Customer Number** _____

(complete the following if applicable)

Since this filing is a ☐ continuation ☐ divisional there is attached hereto a Change of Correspondence Address so that there will be no question as to where the PTO should direct all correspondence.

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DECLARATION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

SIGNATURE(S)

NOTE: Carefully indicate the family (or last) name, as it should appear on the filing receipt and all other documents.

NOTE: Each inventor must be identified by full name, including the family name, and at least one given name without abbreviation together with any other given name or initial, and by his/her residence, post office address and country of citizenship. 37 CFR § 1.634(c).

NOTE: Inventors may execute separate declarations/oaths provided each declaration/oath sets forth all the inventors. Section 1.634(c) requires that a declaration/oath, inter alia, identify each inventor and prohibits the execution of separate declarations/oaths which each sets forth only the name of the executing inventor. 63 Fed. Reg. 53,191, 53,142, October 10, 1997.

Full name of sole or first inventor

Sarkis Kakadjian
(GIVEN NAME) (MIDDLE INITIAL OR NAME) (FAMILY (OR LAST) NAME)

Inventor's signature _____

Date _____ Country of Citizenship _____

Residence _____

Post Office Address _____

Full name of second joint inventor, if any

OSCAR RAUSEN
(GIVEN NAME) (MIDDLE INITIAL OR NAME) (FAMILY (OR LAST) NAME)

Inventor's signature _____

Date _____ Country of Citizenship _____

Residence _____

Post Office Address _____

Full name of third joint inventor, if any

Rosalinda Marcquez
(GIVEN NAME) (MIDDLE INITIAL OR NAME) (FAMILY (OR LAST) NAME)

Inventor's signature _____

Date _____ Country of Citizenship _____

Residence _____

Post Office Address _____

(Declaration and Power of Attorney [1-1]—page 8 of 7)

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(check proper box(es) for any of the following added page(s)
that form a part of this declaration)

- ☒ Signature for fourth and subsequent joint inventors. Number of pages added one
.....
- ☐ Signature by administrator(s), executor(s) or legal representative for deceased or incapacitated inventor. Number of pages added _____
.....
- ☐ Signature for inventor who refuses to sign or cannot be reached by person authorized under 37 CFR 1.47. Number of pages added _____
.....
- ☐ Added page for signature by one joint inventor on behalf of deceased inventor(s) where legal representative cannot be appointed in time. (37 CFR 1.47)
.....
- ☐ Added pages to combined declaration and power of attorney for divisional, continuation, or continuation-in-part (C-I-P) application.
☐ Number of pages added _____
.....
- ☐ Authorization of practitioner(s) to accept and follow instructions from representative.
.....

(if no further pages form a part of this Declaration,
then end this Declaration with this page and check the following item)

- ☐ This declaration ends with this page.

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ADDED PAGE TO COMBINED DECLARATION AND POWER OF ATTORNEY FOR SIGNATURE BY FOURTH AND SUBSEQUENT INVENTORS

Full name of fourth joint inventor, if any

Jose Blanco
(GIVEN NAME) (MIDDLE INITIAL OR NAME) (FAMILY (OR LAST NAME))

Inventor's signature

Date Country of Citizenship

Residence

Post Office Address

Full name of fifth joint inventor, if any

(GIVEN NAME) (MIDDLE INITIAL OR NAME) (FAMILY (OR LAST NAME))

Inventor's signature

Date Country of Citizenship

Residence

Post Office Address

Full name of sixth joint inventor, if any

(GIVEN NAME) (MIDDLE INITIAL OR NAME) (FAMILY (OR LAST NAME))

Inventor's signature

Date Country of Citizenship

Residence

Post Office Address

Added Page to Combined Declaration and Power of Attorney for Signature by Fourth and Subsequent Inventors (1-2)

09717330-112000

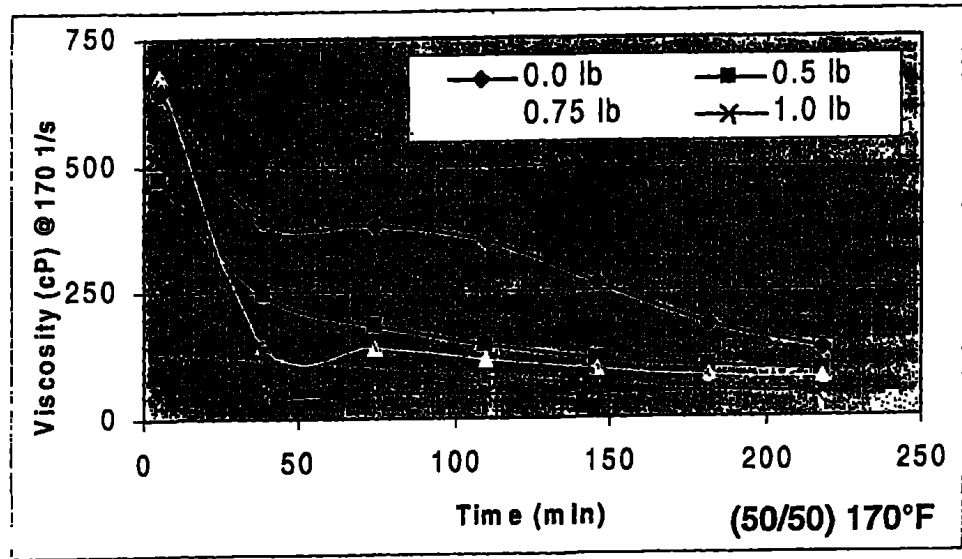


FIGURE 1

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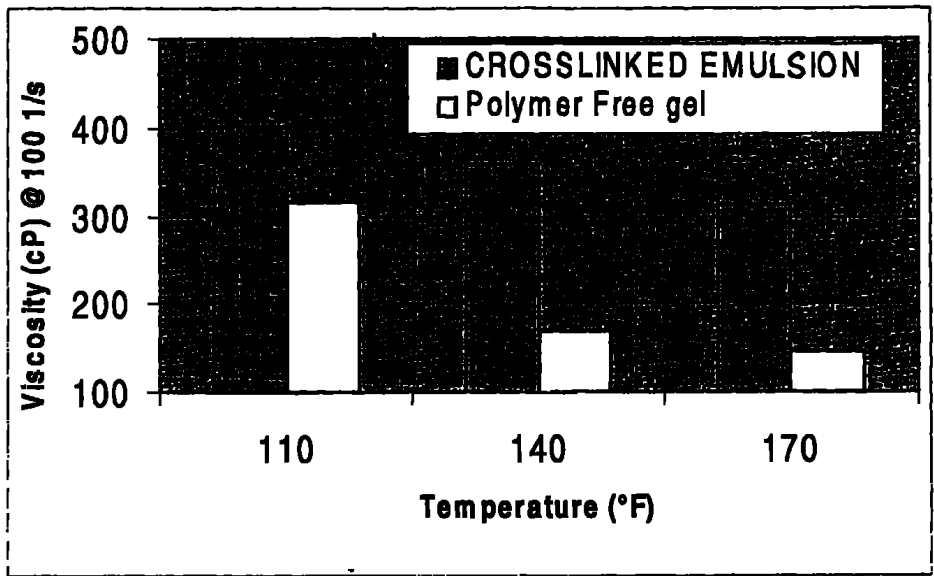


FIGURE 2

Handwritten signatures or initials.

TRADUCCIÓN DEL INGLÉS AL CASTELLANO de la Solicitud de
Patente de los Estados Unidos No.09/717,330 relacionada con:

**EMULSIÓN DE ACEITE EN AGUA COMO FLUIDO DE
FRACCIONAMIENTO Y MÉTODO DE PREPARACIÓN Y
APLICACIÓN**

ANEXOS. La Solicitud de Patente de los Estados Unidos Serie No.09/
717,330 arriba mencionada, Declaración y Poder, Solicitud de Patente,
Certificación del Comisionado de Patentes y Marcas de los Estados
Unidos de América.

LOS ESTADOS UNIDOS DE AMÉRICA

**DEPARTAMENTO DE COMERCIO DE LOS ESTADOS UNIDOS DE
AMÉRICA**

Oficina de Patentes y Marcas de los Estados Unidos

Noviembre 27, 2001

**ESTE PARA CERTIFICAR QUE ANEXO AL PRESENTE SE
ENCUENTRA UNA FIEL COPIA TOMADA DE LOS REGISTROS
DE LA OFICINA DE PATENTES Y MARCAS DE LOS ESTADOS
UNIDOS DE AQUELLOS DOCUMENTOS DE LA SOLICITUD DE
PATENTE IDENTIFICADA ABAJO LA CUAL CUMPLE LOS
REQUISITOS PARA CONCEDERLE UNA FECHA DE
PRESENTACIÓN BAJO LA NORMA 35USC 111.**

**NUMERO DE SOLICITUD: 09/717,330
FECHA DE PRESENTACION: Noviembre 30, 2000**

**Por autorización del
COMISIONADO DE PATENTES Y MARCAS
W. Montgomery (Firmado)
W. MONTGOMERY
Funcionario de Certificaciones**

SELLO ADHERIDO

ANTECEDENTES DE LA INVENCION

**La invención se relaciona con el campo de los fluidos de
fraccionamiento y, más particularmente, con un fluido de**

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fraccionamiento útil para fracturar una formación subterránea con el fin de mejorar su producción.

El uso de los fluidos de fraccionamiento para mejorar la producción de las formaciones subterráneas es bien conocido. En estos esfuerzos se bombea un fluido dentro de un pozo con el propósito de fracturar una formación específica, con el fin de aumentar la permeabilidad de la formación para que los fluidos puedan fluir más rápidamente desde el yacimiento hasta un pozo de producción.

Cuando se evalúa y se formula un fluido de fraccionamiento, las consideraciones más importantes son, entre otras, la capacidad de bombeo, la viscosidad, el costo y la capacidad de recuperación. Muchos tipos diferentes de fluidos han sido utilizados como fluidos de fraccionamiento. Utilizados en forma convencional, los fluidos incluyen gasolina con viscosidad incrementada con napalm, gasolina reticulada, gel lineal base agua, gel base agua reticulada y geles espumados.

Con respecto a la capacidad de bombeo y la viscosidad, es deseable que el fluido pueda ser fácilmente bombeado a bajas presiones de bombeo y suficientemente viscoso para que el fluido, cuando es bombeado en un pozo, rompa una estructura subterránea y así poder llegar a aumentar la permeabilidad de la estructura, como se desea.

Es también deseable una vez que la formación subterránea se fractura, que el fluido pueda ser fácilmente recuperado del pozo.

Los fluidos convencionales utilizan aditivos costosos en grandes cantidades con el fin de llenar los requisitos, y por lo tanto queda la necesidad de encontrar un fluido de fraccionamiento aceptable el cual sea barato en su preparación y uso, y el cual también produzca los resultados deseados.

Consecuentemente, el principal objetivo de la presente invención es proveer un fluido de fraccionamiento el cual realiza un buen trabajo como fluido de fraccionamiento, y un costo reducido de preparación.

Otro objetivo de la presente invención es proveer un método para la preparación de este fluido de fraccionamiento.

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Otro objetivo más de la presente invención es proporcionar un método para fracturar una formación utilizando este fluido de fraccionamiento.

Otros objetivos y ventajas de la presente invención se describirán más adelante.

RESUMEN DE LA INVENCION

De acuerdo con la presente invención, los objetivos y ventajas anteriores son fácilmente obtenidos.

De acuerdo con la presente invención, se proporciona una emulsión de aceite en agua como fluido de fraccionamiento. Esta emulsión comprende una fase dispersa de aceite; y una fase continua de agua que comprende una solución de polímero reticulable en agua.

Adicionalmente, de acuerdo con la presente invención, se prepara una emulsión de aceite en agua como fluido de fraccionamiento, de acuerdo con un método que comprende los pasos siguientes: proporcionar una fase de agua que comprende una solución de un polímero reticulable en agua; proporcionar una fase de aceite; formar una emulsión de aceite en agua de dicha fase de agua y dicha fase de aceite; ajustar el pH de dicha emulsión a un pH de entre 9,0 y 13,0; y reticular dicha solución de polímero con el fin de obtener una emulsión reticulada.

De acuerdo con otro aspecto de la presente invención, se proporciona un método para fracturar una formación subterránea a través de un pozo. Este método comprende los pasos de proveer una emulsión de aceite en agua como fluido de fraccionamiento que comprende una fase dispersa de aceite; una fase continua de agua que comprende una solución de polímero reticulable en agua; y un material de soporte llevado por dicha emulsión; bombear dicha emulsión dentro de un pozo comunicado con una formación subterránea con el fin de formar grietas en dicha formación; y remover dicha emulsión por donde dicho material de soporte está ubicado dentro de dichas fisuras.

BREVE DESCRIPCION DE LOS DIBUJOS

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deseables porque son fácilmente disponibles, a un costo razonable y son compatibles con el pozo.

La fase de agua se forma preferiblemente mezclando una solución deseable del polímero reticulable en agua. El agua puede obtenerse de cualquier fuente aceptable, y puede incluir agua de mar, agua dulce y similares.

La emulsión puede prepararse de manera conveniente con una relación en volumen de aceite en agua de entre 80:20 y 20:80. La relación adecuada debería ser seleccionada dependiendo de la consistencia de fraccionamiento esperada que se requiere para fracturar el pozo, así como también de varios parámetros de bombeo particulares de un pozo dado. La emulsión es preferiblemente preparada con diámetro promedio de gotas menor de 20 micrómetros, más preferiblemente entre 2 micrómetros y 5 micrómetros.

De acuerdo con la presente invención, la emulsión preferiblemente incluye un agente de reticulación el cual entrecruza el polímero con el fin de aumentar la viscosidad de toda la emulsión, obteniendo así la emulsión ideal para ser usada como un fluido de fraccionamiento y como un transportador de un agente de soporte. En este aspecto, varios polímeros son adecuados. Los polímeros preferidos incluyen polisacáridos, derivados de celulosa, gomas de xantan, y similares, y el hidroxipropil guar es un ejemplo de un polímero adecuado. Los polímeros preferiblemente están presentes en la solución polimérica en una cantidad entre 10 y 70 libras de polímero por 1 000 galones de agua.

De acuerdo con la presente invención, el agente de reticulación puede ser de manera conveniente cualquier material que produce o sirve como una fuente de iones deseados los cuales actúan para reticular las varias cadenas de polímeros presentes en la fase de agua de la emulsión. Los agentes de reticulación preferidos incluyen compuestos de aluminio, titanio, zirconio, antimonio, cromo, borato, y sus mezclas; todos ellos pueden servir como fuente de iones libres, como se desea. Sin embargo, se prefiere usar el borato y cualquier fuente de iones libres de borato en solución.

La fase de agua de la emulsión de la presente invención puede también mezclarse de manera conveniente con una sal, por ejemplo el cloruro de potasio y similares con el fin de evitar el aumento excesivo del

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volumen de las arcillas de la formación que podría impactar adversamente sobre las características de la emulsión.

De acuerdo con la presente invención, las emulsiones también preferiblemente incluyen un tensioactivo adecuado con el fin de facilitar la formación de la emulsión y mejorar la estabilidad de la misma. Los tensioactivos adecuados se describen más adelante.

La emulsión se mezcla preferiblemente con el material de apoyo y sirve como un excelente portador del mismo, como se mencionó anteriormente. El agente de soporte puede ser seleccionado de cualquier sustancia granular que tenga una partícula descable o tamaño de grano, el cual servirá para alojarse en las grietas y fracturas inducidas en la formación y por consiguiente pueden mantener abiertas estas grietas o fracturas con el fin de mejorar la producción de hidrocarburo de esta manera. Estos agentes son bien conocidos para la persona experta en el arte.

Antes de la reticulación, la emulsión puede tener de manera adecuada una viscosidad de entre 90 y 150 cP a 511 s^{-1} y 80 °F. La reticulación de la emulsión aumenta su viscosidad, preferiblemente a una viscosidad de entre 150 y 750 cP a 170 s^{-1} y 180 °F. Esto permite que la emulsión pueda usarse como un excelente transportador para el material de soporte con el fin de suministrar el agente de soporte a la formación, de manera conveniente, cuando se fracture. Esto permite ventajosamente que la formación sea fracturada y todo el material de soporte sea suministrado, utilizando un solo paso en el proceso de fraccionamiento de la emulsión.

A través del uso de una emulsión de aceite en agua y la reticulación del polímero en la fase de agua de la emulsión, se proporciona un fluido el cual tiene la viscosidad y la capacidad de bombeo deseadas, y el cual también sirve como un excelente portador del agente de soporte. La combinación de la emulsión de aceite en agua con el polímero reticulado, proporciona ventajosamente cantidades reducidas de polímeros y agentes de reticulación, lo que resulta en la reducción de los costos.

De acuerdo con la presente invención, una emulsión de fluido de fraccionamiento de aceite en agua puede prepararse como sigue.

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La fase de agua se prepara mezclando el polímero seleccionado en agua hasta que se forme una solución.

La fase de aceite, tal como el gasoil, el aceite mineral y otros, se obtiene y se forma una emulsión a partir de la fase de aceite en la fase de agua, preferiblemente utilizando un tensioactivo. Los tensioactivos adecuados incluyen una combinación de sulfatos, sulfonatos de metal alcalino y tensioactivos no iónicos seleccionados del grupo constituido por fenoles alquílicos, alcoholes alifáticos etoxilados, y sus mezclas. Se proporciona preferiblemente un paquete de tensioactivos con una relación de tensioactivo aniónico a tensioactivo no iónico, en volumen, entre 70:30 y 80:20.

Una vez formada la emulsión, se encontró, de acuerdo con la presente invención, que frecuentemente el pH puede requerir ser ajustado con el fin de permitir la reticulación deseado. Para obtener la reticulación deseado, un pH de entre 9,0 y 13,0, preferiblemente entre 9,5 y 12,0, es crítico. El pH puede ser ajustado mezclándolo con cualquier controlador de pH adecuado y conocido, tales como la monoetanolamina, el hidróxido de sodio, el hidróxido de potasio y similares. Cuando se obtiene el pH adecuado, la emulsión es reticulada después al mezclarla con un material adecuado de reticulación, tales como un material seleccionado del grupo constituido por compuestos de aluminio, titanio, zirconio, antimonio, cromo, borato y sus mezclas. De acuerdo con la presente invención, los compuestos de borato son mucho más preferidos, por ser compuestos que generan iones de borato en solución en la fase de agua, y estos iones de borato aparecen para mejorar el proceso de reticulación con el fin de obtener la viscosidad deseada de acuerdo con la presente invención. Si la emulsión debe transportarse fluyendo a través de las tuberías antes del uso, puede ser deseable agregar el agente de soporte después de este transporte. Por lo tanto, el agente de reticulación puede ser añadido al tiempo que se forma la emulsión, justo antes o simultáneamente con la adición del agente de soporte, o en cualquier punto intermedio.

Una vez se finaliza la emulsión, cualquier material de apoyo soporte puede ser mezclado en la emulsión, como se desea, y la emulsión sirve como un excelente medio de transporte para llevar el agente de soporte hacia abajo a través de; pozo y a una formación subterránea la cual será sometida a un proceso de fraccionamiento. Típicamente, el material de soporte no se agrega a la emulsión sino hasta justo antes de su uso.

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Después que la formación se fraccione, es deseable remover el fluido de fraccionamiento, especialmente cualesquier polímeros y similares que se quedan después del proceso. Con el fin de facilitar la remoción del fluido de fraccionamiento, se desea romper la reticulación del polímero con el fin de reducir la viscosidad y permitir el bombeo del fluido de fraccionamiento de regreso a la superficie. El rompimiento puede lograrse utilizando rompedores tales como rompedores oxidantes, enzimas y combinaciones de ellos. Estos agentes de rompimiento rompedores son bien conocidos para una persona experta en el arte.

Una vez que se rompe la reticulación, la emulsión con viscosidad reducida encapsula el polímero restante o residual con el fin de facilitar la remoción de todo el fluido de fraccionamiento incluyendo los polímeros, mientras los materiales de soporte permanecen en las grietas y fracturas de la formación, para poder mejorar la producción del hidrocarburo proveniente de la formación, como se desea.

De acuerdo con la presente invención, el fluido de fraccionamiento es ventajoso ya que permite que las viscosidades hasta 750 cP a 170 s^{-1} pueden obtenerse a temperaturas entre 110°F y 220°F , lo que proporciona un transporte excelente de material de soporte. Además, el sistema utiliza una concentración muy baja de polímero, y da excelentes resultados utilizando 14 a 18 libras de polímero por 1 000 galones de emulsión y también permite obtener resultados satisfactorios hasta temperaturas de entre 180°F y potencialmente hasta 220°F . Esta es una concentración reducida de polímeros y representa una mejora en la tolerancia de temperatura comparado con los fluidos de fraccionamiento convencionales.

Adicionalmente, la fase de aceite es de bajo costo, y todos los aditivos están disponibles comercialmente.

Ejemplo

Este ejemplo demuestra la preparación de un fluido de fraccionamiento de acuerdo con la presente invención, como también un análisis de ella.

0,5 barriles de una mezcla de gasoil-aceite mineral se obtuvieron para ser usados como fase de aceite.

La fase de agua se obtuvo con 0,5 barriles de agua dulce mezclada con el polímero hidroxipropil guar (HPG) en una relación de 50 libras de polímero por 1 000 galones de agua, y 6 libras de cloruro de potasio por barril se añadieron al agua. Durante la formación de la emulsión, un tensioactivo comercial fue utilizado en un porcentaje de 20 libras de tensioactivo por barril de emulsión total. Este tensioactivo es un tensioactivo aniónico: no iónico con una relación de 75:25, y se selecciona en forma tal de poder ser compatible con el fluido de perforación y (la hoja 15 del documento fue reemplazada inadvertidamente por otra que no concuerda con el original traducido)

TABLA 1

170 °F

Rompedor (libras./1000 galones)								
Tiempo (minutos)	0		0,5		0,75		1,0	
	n'	K'	n'	K'	n'	K'	n'	K'
5	0,4160	0,2700	0,3992	0,2170	0,5846	0,1527	0,3396	0,1656
38	0,7198	0,0346	0,5590	0,0497	0,4924	0,0500	0,5129	0,0149
74	0,7112	0,0349	0,4597	0,0613	0,439	0,0525	0,4875	0,0157
110	0,5895	0,0605	0,4502	0,0514	0,5018	0,0310	0,4300	0,0178
146	0,4171	0,1160	0,3863	0,0562	0,4431	0,0348	0,4328	0,0185
186	0,2723	0,1611	0,3482	0,0600	0,3680	0,0451	0,4063	0,0226

La emulsión preparada en este ejemplo fue también probada utilizando diferentes cantidades del rompedor con el fin de ilustrar el cambio en la viscosidad con el tiempo. La Figura 1 muestra la emulsión de la presente invención cuando es tratada con diferentes cantidades del rompedor, y la viscosidad resultante a 170°F. Como se puede observar, 0,5 libras/1 000 galones del rompedor y mayores, proporcionaron una reducción excelente de viscosidad después de un período inicial de alta viscosidad, lo cual es ideal para la utilización de la emulsión de la presente invención como un fluido de fraccionamiento. La alta viscosidad en el período inicial permite utilizar el fluido para formar las fracturas, mientras que el rompimiento de la reticulación y la reducción en la viscosidad permiten que la emulsión, con el polímero encapsulado, pueda ser fácilmente removida del pozo, dejando atrás el agente de soporte.

La Figura 2 muestra además la emulsión como es preparada en este ejemplo comparada a un gel convencional libre de polímero con respecto

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a la viscosidad a diferentes temperaturas, lo que demuestra el beneficio de la reticulación de la presente invención para obtener un fluido utilizable para el fraccionamiento y también para el transporte del material de soporte. Como se puede observar, la emulsión reticulada tiene una mayor viscosidad en todos los casos a temperaturas entre 110 °F y 170 °F, con un grado de mejoramiento muy elevado de la viscosidad de la emulsión reticulada y el cual es mayor a medida que aumenta la temperatura.

Se puede apreciar fácilmente que de acuerdo con la presente invención, se proporciona una emulsión y un método para formarla, los cuales permiten tener un fluido de fraccionamiento preparado de manera efectiva y asequible. Adicionalmente, gracias a estos métodos, se puede usar este fluido de fraccionamiento para fracturar las formaciones con el fin de mejorar la producción de hidrocarburo y otros fluidos descados.

Esta invención puede ser realizada de otras maneras y llevada a cabo de otras formas sin alejarse de su espíritu y sus características esenciales. Consecuentemente, la presente modalidad debe considerarse en todos sus aspectos como de carácter ilustrativo y no restrictivo. Las reivindicaciones anexas indican el alcance de la invención y pretenden abarcar todos los cambios que encuentren cabida en el significado y rango de equivalencia de la presente invención.

REIVINDICACIONES

LO QUE SE REIVINDICA ES:

1. Una emulsión de aceite en agua como fluido de fraccionamiento que comprende:
 - una fase dispersa de aceite; y
 - una fase continua de agua que comprende una solución de polímero reticulable en agua.
2. La emulsión de la reivindicación 1, donde dicha emulsión tiene una viscosidad de entre 90 y 150 cP a 511 s⁻¹ y 80 °F.
3. La emulsión de la reivindicación 1, donde dicho polímero es reticulado y dicha emulsión tiene una viscosidad de entre 150 cP y 750 cP a 170 s⁻¹ y 180 °F.

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4. La emulsión de la reivindicación 1, donde dicha fase de aceite se selecciona a partir del grupo que consiste de gasoil, aceite mineral y sus mezclas.

5. La emulsión de la reivindicación 1, donde dicha fase de agua contiene dicho polímero en una cantidad entre 10 y 70 libras de dicho polímero por 1 000 galones de agua.

6. La emulsión de la reivindicación 5, donde dicho polímero se selecciona a partir del grupo que consiste de polisacáridos, derivados celulósicos, goma xantan y sus combinaciones.

7. La emulsión de la reivindicación 6, donde dicho polímero es hidroxipropil guar.

8. La emulsión de la reivindicación 1, que comprende además un material de soporte llevado por dicha emulsión.

9. Un método para preparar una emulsión como fluido de fraccionamiento, el cual comprende los pasos de:

proporcionar una fase de agua que comprende una solución de un polímero reticulable en agua;

proporcionar una fase de aceite;

formar una emulsión de aceite en agua a partir de dicha fase de agua y dicha fase de aceite;

ajustar el pH de dicha emulsión a un pH de entre 9,0 y 13,0,
y

reticular dicha solución polimérica con el fin de obtener una emulsión reticulada.

10. El método de la reivindicación 9, donde dicha emulsión reticulada tiene una viscosidad de entre 150 y 750 cP a 170 s⁻¹ y 180 °F.

11. El método de la reivindicación 9, donde dicha fase de aceite se selecciona a partir del grupo que consiste de gasoil, aceite mineral y sus mezclas.

12. El método de la reivindicación 9, donde dicha fase de agua contiene dicho polímero en una cantidad de entre 10 y 70 libras de dicho polímero por 1 000 galones de agua.

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13. El método de la reivindicación 12, donde dicho polímero se selecciona a partir del grupo que consiste de polisacáridos, derivados celulósicos, goma xantan y sus combinaciones.

14. El método de la reivindicación 13, donde dicho polímero es hidroxipropil guar

15. El método de la reivindicación 9, donde dicho paso de reticulación comprende mezclar dicha emulsión con el agente de reticulación.

16. El método de la reivindicación 15, donde dicho agente de reticulación se selecciona a partir del grupo que consiste de compuestos de aluminio, titanio, zirconio, antimonio, cromo, borato y sus mezclas.

17. Un método para fracturar una formación subterránea comprende los pasos de:

obtener una emulsión aceite en agua como fluido de fraccionamiento que comprende una fase dispersa de aceite y una fase continua de agua que comprende una solución de polímero reticulable en agua; y un agente de soporte transportado por dicha emulsión;

bombear dicha emulsión en un pozo que se comunica con una formación subterránea con el fin de formar las grietas en dicha formación; y

remover dicha emulsión luego que dicho agente de soporte este posicionado en dichas grietas.

18. El método de la reivindicación 17, donde dicha emulsión es reticulada y donde dicho paso de remoción comprende romper y degradar dicho polímero con el fin de obtener una emulsión con una viscosidad reducida, y remover dicha emulsión con la viscosidad reducida de dicho pozo.

19. El método de la reivindicación 18, donde dicha emulsión con la viscosidad reducida encapsula dicho polímero, por lo cual dicho paso de remoción remueve dicho polímero.

EXTRACTO

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Una emulsión de aceite en agua como fluido de fraccionamiento incluye una fase dispersa de aceite; y una fase continua de agua en forma de una solución de polímero reticulable en agua. Se divulga también un método para preparar la emulsión así como un método de fraccionamiento usando la emulsión.

ES TRADUCCIÓN FIEL Y COMPLETA DEL DOCUMENTO ANEXO
TERMINADA ESTE 18 DE ENERO, 2002.