



(51) International Patent Classification:

C09K 8/58 (2006.01) *C09K 8/88* (2006.01)
C09K 8/588 (2006.01) *C09K 8/508* (2006.01)

(21) International Application Number:

PCT/US2012/042948

(22) International Filing Date:

18 June 2012 (18.06.2012)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

61/498,305 17 June 2011 (17.06.2011) US

(71) Applicant (for all designated States except US): **M-I L.L.C.** [US/US]; 5950 North Course Drive, Houston, TX 77072 (US).

(72) Inventor; and

(71) Applicant : **SCORSONE, Jason, T.** [US/US]; 12331 N Gessner Dr., Apt. 426, Houston, TX 77064 (US).

(72) Inventors; and

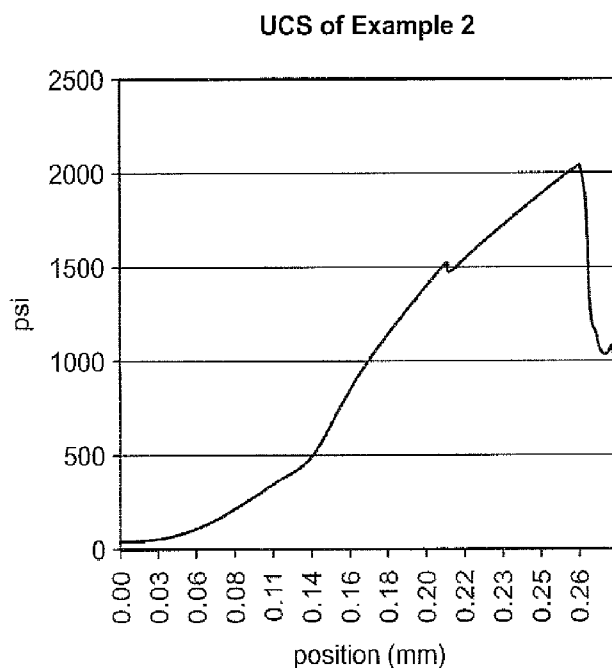
(75) **Inventors/Applicants (for US only): CHEW, Andrew** [US/US]; 4521 Hummingbird St, Houston, TX 77035-5123 (US). **STEFANO, Guido De** [IT/US]; 6206 Elmgrove Rd, Spring, TX 77389 (US). **YOUNG, Steve** [GB/US]; 14418 Laumar Court, Cypress, TX 77429 (US). **OFFTENBACHER, Matthew** [US/US]; 5950 North Course Drive, Houston, TX 77072 (US).

(74) **Agents: BURTON, Carlyn, Anne et al.**; Osha Liang LLP, 909 Fannin Street, suite 3500, Houston, TX 77010 (US).

(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, CL, 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, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

[Continued on next page]

(54) Title: COMPOSITION OF POLYBUTADIENE-BASED FORMULA FOR DOWNHOLE APPLICATIONS

**FIG. 5**

(57) **Abstract:** A method of treating a wellbore may include emplacing in at least a selected region of the wellbore a formulation that includes at least one diene pre-polymer; at least one reactive diluent; at least one inert diluent comprising an oleaginous liquid or a mutual solvent; and at least one initiator; and initiating polymerization of the at least one diene pre-polymer and the at least one reactive diluent to form a composite material in the selected region of the wellbore.



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

Published:

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(88) Date of publication of the international search report:

21 February 2013

A. CLASSIFICATION OF SUBJECT MATTER*C09K 8/58(2006.01)i, C09K 8/588(2006.01)i, C09K 8/88(2006.01)i, C09K 8/508(2006.01)i*

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

C09K 8; E21B 43

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords: subterranean, wellbore, oilfield, diene, polybutadiene, pre-polymer, reactive diluents, crosslink, network, oleaginous liquid, mutual solvent

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4760882 A (NOVAK, LUCILLE H.) 02 August 1988 See abstract; column 1, lines 23 - 27; column 11, line 28 - column 12, line 60; column 11, lines 54 - 55.	1,2,22-24
A	See the whole document.	3,26
X	US 4768593 A (NOVAK, LUCILLE H.) 06 September 1988 See abstract; column 1, lines 21 - 25; column 11, line 12 - column 12, line 32; column 12, line 5.	22-24
A	See the whole document.	1-3,26
A	US 2010-0266348 A1 (BOULKERTOUS, NABIL et al.) 21 October 2010 See the whole document.	1-3,22-24,26
A	US 2010-0147507 A1 (KORTE, JAMES R. et al.) 17 June 2010 See the whole document.	1-3,22-24,26
A	US 2007-0161515 A1 (BICERANO, JOZEF) 12 July 2007 See the whole document.	1-3,22-24,26



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

10 DECEMBER 2012 (10.12.2012)

Date of mailing of the international search report

10 DECEMBER 2012 (10.12.2012)

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
189 Cheongsu-ro, Seo-gu, Daejeon Metropolitan
City, 302-701, Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

CHO Han Sol

Telephone No. 82-42-481-5580



INTERNATIONAL SEARCH REPORTInternational application No.
PCT/US2012/042948**Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claims Nos.: 5
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

Claim 5 is dependent on the multiple dependent claims that are not drafted in accordance with the second and/or third sentences of Rule 6.4(a).
3. ☒ Claims Nos.: 4,6-21,25
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See Extra Sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

Continuation of Box No. III.

Group I: Claim 1 and its dependent claims are directed to a method of treating a wellbore characterized in the polymerization of the at least one diene pre-polymer and the at least one reactive diluent.

Group II: Claim 22 and its dependent claims are directed to a composite material characterized in a crosslinked polymer network of a diene polymer and cycloalkyl ester of (meth)acrylate.

Group III: Claim 26 is directed to a composite material characterized in a crosslinked polymer network of a diene homopolymer, a (meth)acrylateed diene polymer, and one of other monomers.

The only common technical feature among Groups I to III is: a polymer network comprising butadiene polymer.

However, this feature lacks novelty and/or inventive step with respect to the following documents cited in this ISR:

(a) US 4760882 A and (b) US 4768593 A

Thus, there is no technical relationship left over the prior art among the claimed inventions, leaving the groups without a single general inventive concept.

Hence there is lack of unity "a posteriori"(PCT Rules 13.1 and 13.2).

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2012/042948

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4760882 A	02.08.1988	None	
US 4768593 A	06.09.1988	None	
US 2010-0266348 A1	21.10.2010	CN 102007083 A EP 2252560 A2 JP 2011-523925 A WO 2009-077591 A2 WO 2009-077591 A3	06.04.2011 24.11.2010 25.08.2011 25.06.2009 27.08.2009
US 2010-0147507 A1	17.06.2010	GB 2488075 A US 2009-0084550 A1 US 8181708 B2 WO 2011-072021 A2 WO 2011-072021 A3	15.08.2012 02.04.2009 22.05.2012 16.06.2011 20.10.2011
US 2007-0161515 A1	12.07.2007	CA 2563549 A1 CA 2688665 A1 EP 1838522 A2 EP 2142759 A2 US 2007-0021309 A1 US 2007-0066491 A1 US 2007-0181302 A1 US 2009-0286698 A1 US 2009-0305044 A1 US 2010-0319916 A1 US 2011-0105367 A1 US 7803740 B2 US 7803741 B2 US 7803742 B2 US 7902125 B2 US 8088718 B2 US 8258083 B2 WO 2006-072069 A2 WO 2006-072069 A3 WO 2008-124080 A1 WO 2009-005880 A2 WO 2009-005880 A3	06.07.2006 08.01.2009 03.10.2007 13.01.2010 25.01.2007 22.03.2007 09.08.2007 19.11.2009 10.12.2009 23.12.2010 05.05.2011 28.09.2010 28.09.2010 28.09.2010 08.03.2011 03.01.2012 04.09.2012 06.07.2006 09.08.2007 16.10.2008 08.01.2009 09.04.2009