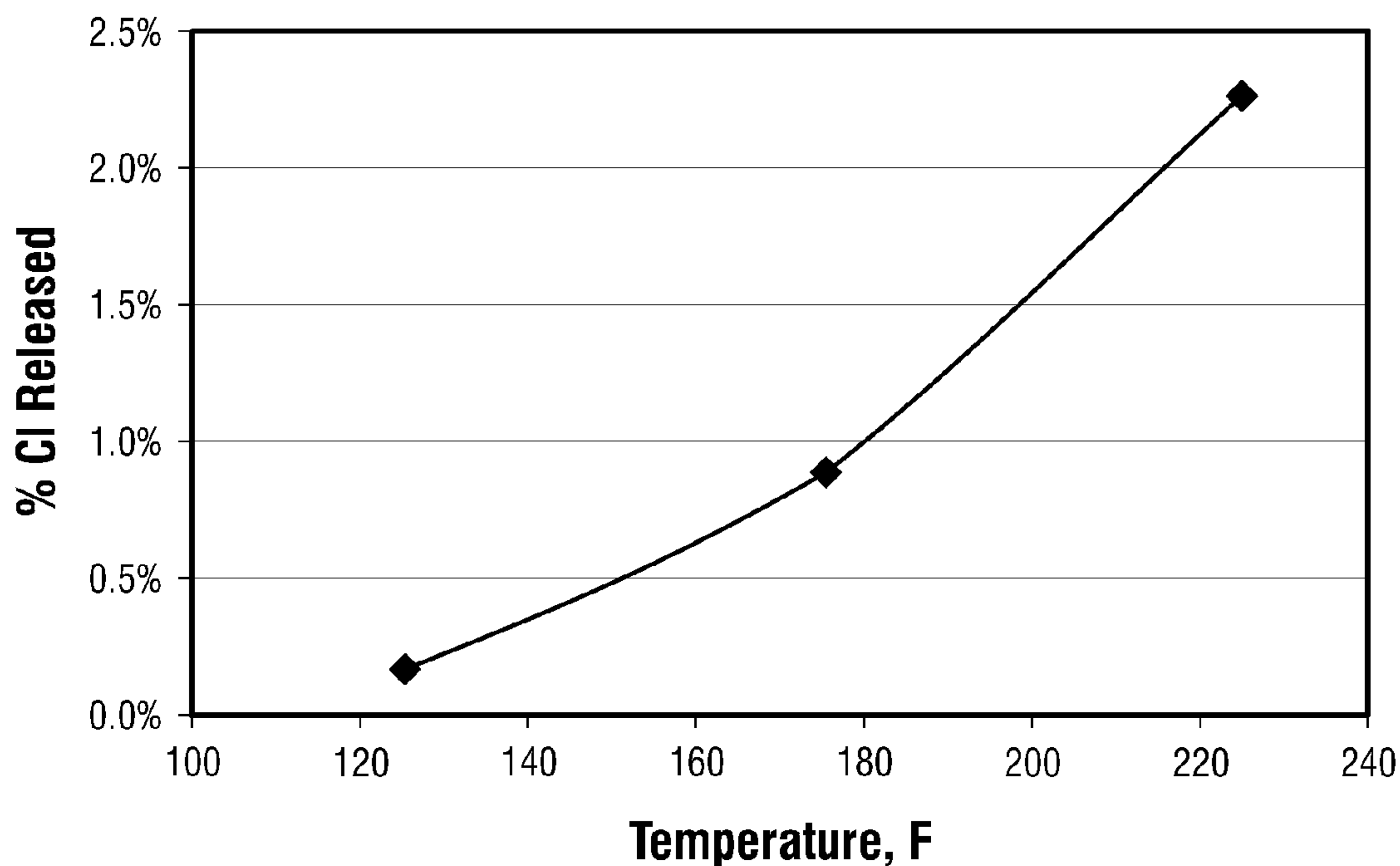




(86) Date de dépôt PCT/PCT Filing Date: 2012/03/16  
(87) Date publication PCT/PCT Publication Date: 2012/09/20  
(85) Entrée phase nationale/National Entry: 2013/09/10  
(86) N° demande PCT/PCT Application No.: US 2012/029354  
(87) N° publication PCT/PCT Publication No.: 2012/125890  
(30) Priorités/Priorities: 2011/03/16 (US61/453,243);  
2012/03/15 (US13/421,076)

(51) Cl.Int./Int.Cl. *E21B 43/27* (2006.01),  
*E21B 49/08* (2006.01)  
(71) Demandeur/Applicant:  
SCHLUMBERGER CANADA LIMITED, CA  
(72) Inventeurs/Inventors:  
MIRAKYAN, ANDREY, US;  
HUTCHINS, RICHARD D., US;  
WILLIAMSON, DON, US;  
CLUM, ERIC, US  
(74) Agent: SMART & BIGGAR

(54) Titre : BIOCIDES A LIBERATION PROLONGEE DANS APPLICATIONS DE CHAMP DE PETROLE  
(54) Title: CONTROLLED RELEASE BIOCIDES IN OILFIELD APPLICATIONS



**FIG. 1**

(57) Abrégé/Abstract:

Described is a method for treating a subterranean formation penetrated by a wellbore, the method including the introduction of a well treatment fluid containing at least an encapsulated biocide. Once the encapsulated biocide is introduced and after a predetermined period of time, a biocide is released from an encapsulation material and treats the wellbore and the subterranean formation.



(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property  
Organization  
International Bureau



WIPO | PCT



(10) International Publication Number

**WO 2012/125890 A3**

(43) International Publication Date  
20 September 2012 (20.09.2012)

(51) International Patent Classification:  
*E21B 43/27* (2006.01) *E21B 49/08* (2006.01)

(21) International Application Number:  
PCT/US2012/029354

(22) International Filing Date:  
16 March 2012 (16.03.2012)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
61/453,243 16 March 2011 (16.03.2011) US  
13/421,076 15 March 2012 (15.03.2012) US

(71) Applicant (for CA only): **SCHLUMBERGER CANADA LIMITED** [CA/CA]; 525-3rd Avenue Southwest, Calgary, Alberta T2P-0G4 (CA).

(71) Applicant (for FR only): **SERVICES PETROLIERS SCHLUMBERGER** [FR/FR]; 42 rue Saint Dominique, 75007 Paris (FR).

(71) Applicant (for GB, JP, NL only): **SCHLUMBERGER HOLDINGS LIMITED** [GB/GB]; P.O. Box 71, Cragmuir Chambers, Road Town, Tortola, Virgin Islands, British GB 1110 (GB).

(71) Applicant (for AL, AM, AU, AZ, BF, BG, BJ, BY, CF, CG, CI, CM, CO, CZ, DE, DK, GA, GN, GQ, GR, GW, HU, ID, IE, IL, IT, KG, KP, KR, KZ, LT, MD, ML, MR, MX, MY, NE, NO, NZ, OM, PL, QA, RO, RU, SI, SK, SN, TD, TG, TH, TJ, TM, TN, TR, TT, UZ, ZA only): **SCHLUMBERGER TECHNOLOGY B.V.** [NL/NL]; Parkstraat 83-89m, NL-2514 JG The Hague (NL).

(71) Applicant (for all designated States except AU, CA, CO, CZ, DE, DK, FR, GB, GR, HU, ID, IE, IL, IT, KR, LT, MX, MY, NL, NO, NZ, OM, PL, QA, RO, SI, TN, TR, TT, US, UZ, ZA): **PRAD RESEARCH AND DEVELOPMENT LIMITED** [GB/GB]; P.O. Box 71, Cragmuir Chambers, Road Town, Tortola, Virgin Island, British GB 1110 (GB).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **MIRAKYAN, Andrey** [RU/US]; 24039 Northshire Lane, Katy, TX 77494 (US). **HUTCHINS, Richard, D.** [US/US]; 17507 Sunny Trail Lane, Sugar Land, TX 77479 (US). **WILLIAMSON, Don** [US/US]; 1611 Morning Park, Katy, TX 77494 (US). **CLUM, Eric** [US/US]; 1802 Concho River Court, Sugar Land, TX 77478 (US).

(74) Agents: **WRIGHT, Daryl** et al.; 10001 Richmond Avenue, IP Administration Center of Excellence, Room 4720, Houston, TX 77042 (US).

[Continued on next page]

(54) Title: CONTROLLED RELEASE BIOCIDES IN OILFIELD APPLICATIONS

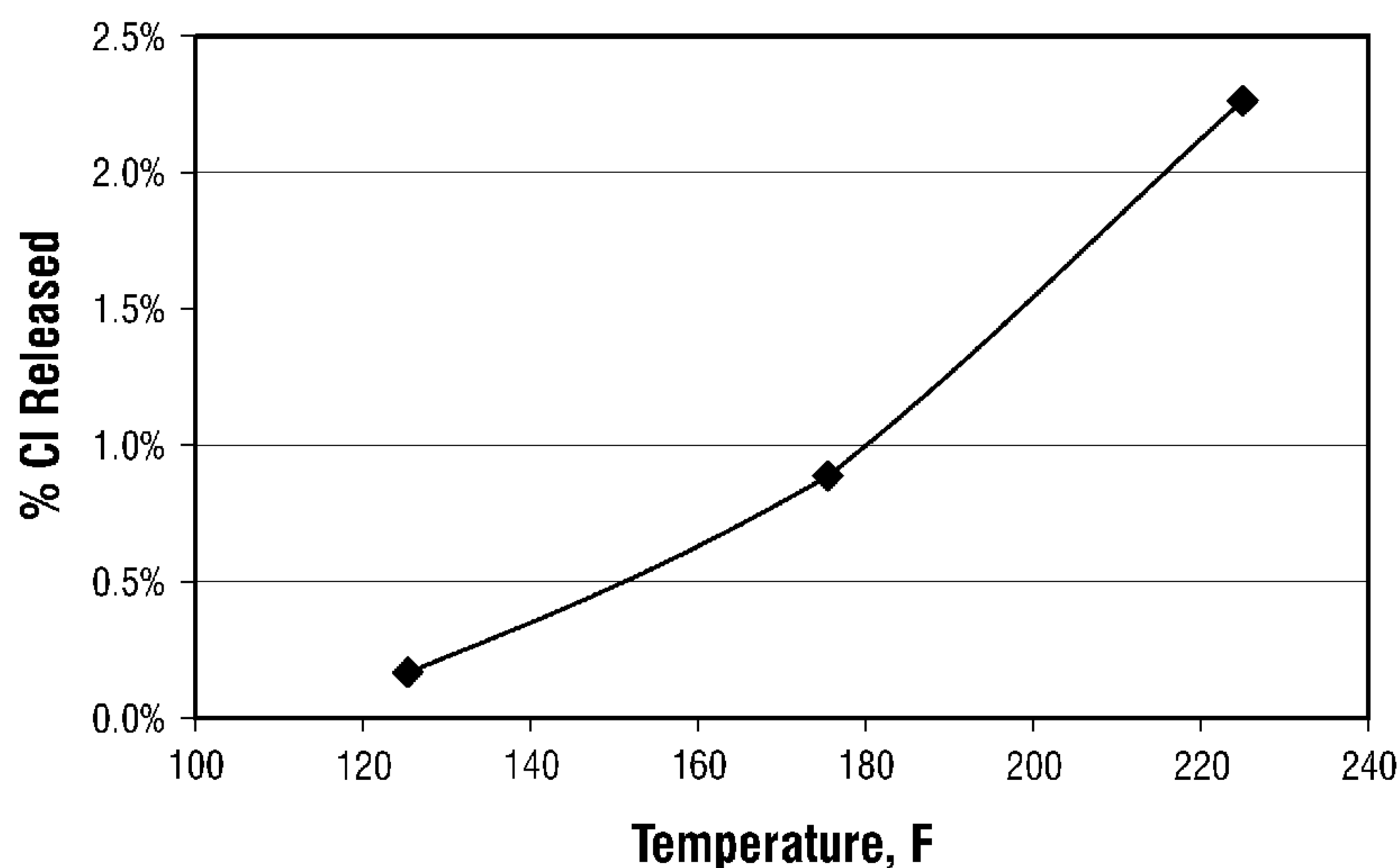


FIG. 1

(57) Abstract: Described is a method for treating a subterranean formation penetrated by a wellbore, the method including the introduction of a well treatment fluid containing at least an encapsulated biocide. Once the encapsulated biocide is introduced and after a predetermined period of time, a biocide is released from an encapsulation material and treats the wellbore and the subterranean formation.

**WO 2012/125890 A3**

**(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.

**(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, MD, 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:**

27 December 2012

Inventors: Andrey Mirakyan, Richard Hutchins, Don Williamson, Eric Clum

## **CONTROLLED RELEASE BIOCIDES IN OILFIELD APPLICATIONS**

### **TECHNICAL FIELD**

[0001] This present disclosure relates generally to the field of biocides for oilfield application, and relates more particularly, but not by way of limitation, to methods of controlling the release of biocides in various oilfield applications.

### **BACKGROUND**

[0002] To enhance or increase the production of oil and gas hydrocarbons from wells bored into subterranean-formations, it has been common practice to pump a viscous fluid at high pressure down into the well bore to crack the formation and force the fracturing fluid into those cracks. The fracturing fluid is also used to carry sand or other types of particles, called proppants, to hold the cracks open when the pressure is relieved. The cracks held open by the proppant provide additional paths for the hydrocarbons, such as oil or natural gas, to reach the wellbore, which, in turn, increases the production of oil and/or natural gas from the well.

[0003] However, while recovering these hydrocarbons, the process of water flooding is used in the petroleum industry to increase the recovery of oil. This process increases the total yield of oil present in a formation beyond what is usually recovered in the primary process. It is desirable in this process to maintain a high rate of water injection with a minimum expenditure of energy. Any impediment to the free entry of water to oil-bearing formations seriously reduces the efficiency of the recovery operation.

[0004] However, water flooding systems provide an ideal environment for growth and proliferation of biofilms due to the large amount of water being transported through these systems and injected into oil bearing formations in an effort to maintain reservoir pressure and/or to increase the mobility of oil through the formation to producing wells. The large surface area of the water distribution network encourages biofouling, which is the attachment and growth of microbes and/or bacteria on the pipe walls.

[0005] Biofouling caused by anaerobic bacteria is compounded in water floods by the practice of removing oxygen from the water before injection. The removal of oxygen is done to minimize



Inventors: Andrey Mirakyan, Richard Hutchins, Don Williamson, Eric Clum

(2) delaying the release of the biocide, which allows a higher loading of oxidative biocides that can react with gelling agents and other ingredients in the injected fluid, (3) allowing delivery of naturally liquid biocide in a solid form, (4) eliminating noxious odors that permeate the well site and equipment, and (5) preventing reactive interactions with other active additives in the wellbore.

[0009] The above and other issues are addressed by the present application, wherein in embodiments, the application relates to a method for treating a subterranean formation penetrated by a wellbore, the method comprising: introducing a well treatment fluid comprised of at least an encapsulated biocide, wherein upon the introduction of the encapsulated biocide and after a predetermined period of time, a biocide is released from an encapsulation material and treats the wellbore and the subterranean formation.

[00010] In embodiments, described herein is a method for treating a subterranean formation penetrated by a wellbore, the method comprising: introducing a well treatment fluid comprised of at least an encapsulated biocide and a hydratable polymer, wherein upon the introduction of encapsulated biocide and after a predetermined period of time, a biocide is released from an encapsulation material and treats the subterranean formation.

[00011] In embodiments, described herein is a method for hydraulic fracturing a subterranean formation penetrated by a horizontal wellbore, the method comprising: isolating at least a portion of the horizontal wellbore, and introducing a well treatment fluid comprised of at least an encapsulated biocide and water, wherein upon the introduction of encapsulated biocide and after a predetermined period of time, a biocide is released from an encapsulation material and treats the subterranean formation, and wherein the horizontal wellbore is not flowed back for about 1 day to about 1 year.

#### BRIEF DESCRIPTIONS OF DRAWINGS

[00012] Figure 1 represents the delayed release profile of chlorine from encapsulated trichloroisocyanuric acid after 1 hour of exposure at various temperatures.

[00013] Figure 2 represents the delayed release profile of chlorine from encapsulated trichloroisocyanuric acid in deionized water at 125°F (51.6°C).























































