



US009410405B2

(12) **United States Patent**  
**Ayers et al.**

(10) **Patent No.:** **US 9,410,405 B2**  
(45) **Date of Patent:** **Aug. 9, 2016**

(54) **COMPOSITIONS AND METHODS FOR ENHANCED HYDROCARBON RECOVERY**

(75) Inventors: **Jeffrey T. Ayers**, South Windsor, CT (US); **George E. Hoag**, South Windsor, CT (US); **Douglas K. Anderson**, South Windsor, CT (US); **John B. Collins**, South Windsor, CT (US)

(73) Assignee: **Ethical Solutions, LLC**, South Windsor, CT (US)

(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **14/361,685**

(22) PCT Filed: **Nov. 30, 2011**

(86) PCT No.: **PCT/US2011/062697**  
§ 371 (c)(1),  
(2), (4) Date: **May 29, 2014**

(87) PCT Pub. No.: **WO2013/081609**  
PCT Pub. Date: **Jun. 6, 2013**

(65) **Prior Publication Data**  
US 2014/0332212 A1 Nov. 13, 2014

(51) **Int. Cl.**  
**E21B 43/16** (2006.01)  
**C09K 8/58** (2006.01)  
**C09K 8/584** (2006.01)

(52) **U.S. Cl.**  
CPC . **E21B 43/16** (2013.01); **C09K 8/58** (2013.01);  
**C09K 8/584** (2013.01)

(58) **Field of Classification Search**  
CPC ..... C09K 19/56; C09K 8/58; C09K 19/408;  
C09K 8/584; E21B 43/16  
See application file for complete search history.

(56) **References Cited**  
U.S. PATENT DOCUMENTS

4,688,637 A 8/1987 Theis  
5,238,066 A 8/1993 Beattie et al.  
5,934,390 A 8/1999 Uthe  
2006/0169455 A1 8/2006 Everett et al.  
2011/0214868 A1 9/2011 Funkhouser et al.

FOREIGN PATENT DOCUMENTS

WO 2011047059 A1 4/2011

OTHER PUBLICATIONS

International Search Report and Written Opinion dated Mar. 21, 2012 (PCT/US2011/062697).

*Primary Examiner* — Zakiya W Bates

(74) *Attorney, Agent, or Firm* — Alix, Yale & Ristas, LLP

(57) **ABSTRACT**

A method of using a fluid formulation for increasing flow, production, or recovery of oil and gas hydrocarbons from a subterranean formation. Components including a peroxygen, surfactant, alkali metal chelate, and a cosolvent into a hydrocarbon bearing subterranean formation having a blockage or accumulation of material. Oxygen or carbon dioxide gas is generated by decomposition of the peroxygen which creates gas pressure in the formation. The formed gas pressure mobilizes, degrades, removes, releases, realigns or redistributes the material causing the blockage or accumulation physically. The aggregate pH of the components is less than about 10 or a concentration of alkali metal chelate is greater than about 0.2% and less than about 5% by weight of non-water components.

**18 Claims, 10 Drawing Sheets**