Nano-stabilized foam for enhanced oil recovery using green nanocomposites and anionic surfactants: An experimental study

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https://authors.elsevier.com/a/1iN5s1H%7Ec%7ELm8s

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پوختە
کاریگەری نانونی ژینگە دوست لەسەر جێگیرکردنی فوم surfactant flooding بە بەکارهێنانی گازی CO2 بو زیادکردنی بەرهەمهێنانی نەوت.

الملخص
مع انخفاض موارد الهيدروكربون في جميع أنحاء العالم، أصبح استخدام طرق تحسين استرداد النفط (EOR) المختلفة أكثر جاذبية. في الآونة الأخيرة، اعتبر الباحثون الرغوات الغازية واحدة من أكثر الطرق فعالية لزيادة استرداد النفط. على الرغم من وظائفها، تتمتع الرغوات التقليدية بثبات منخفض. في الآونة الأخيرة، تم استخدام المواد النانوية كوكلاء مناسبين لزيادة استقرار الرغوات في تحسين استرداد النفط. في هذه الدراسة، تم استخدام النانوكومبوزيتات المركبة (NCs)، مركب SiO2/KCl/Xanthan، لتثبيت الرغوات المحضرة من مواد التشحيم السطحي (SDS) وبروميد سيتيل تريميثيل الأمونيوم (CTAB). بالتالي، تم فحص التأثير التآزري للمواد التشحيمية والنانوكومبوزيتات مع تركيز الأملاح وجودة الرغوة والقلوية وخصائص النفط. تم إجراء قياسات تجريبية لتوصيل الكهرباء ودرجة الحموضة والتوتر السطحي والتوتر الحدودي وزاوية الاتصال وتحليل النفط. أظهرت النتائج المتحصل عليها أن SDS و CTAB لديهما تركيز المايسل الحرج (CMC) يبلغ 2000 و 300 جزء في المليون على التوالي. من حيث استقرار الرغوة، أظهرت كل من المواد التشحيمية نفس السلوك للثبات المتساوي، في حين تحسنت تحت تأثير NaCl و NaOH في تراكيز مختلفة مع تقليل التوتر السطحي والتوتر الحدودي وزمن توليد الرغوة (tg). بالإضافة إلى ذلك، كانت تراكيز NCs الأمثل لمواد التشحيم SDS و CTAB، التي قللت بشكل كبير من استقرار الرغوة، وقللت زاوية الاتصال بنسبة 73.27 وتحسنت استرداد النفط بنسبة 20٪ من الزيت الأصلي في المكان (OOIP) هي 1000 و 500 جزء في المليون على التوالي. تم تأكيد ذلك أيضًا من خلال التحليل الماكروسكوبي لأنظمة النانو-مواد التشحيم الصيغية. من ناحية أخرى، كان لزيادة لزوجة السائل والكثافة ومعدل الغاز تأثير عكسي على استقرار الرغوة.

Abstract
With the decline in hydrocarbon resources around the world, the use of different enhanced oil recovery (EOR) methods became more attractive. Recently, gas foams have been considered by researchers as one of the most effective ways to increase oil recovery. Despite its functions, the conventional foams have low stability. Recently, nanomaterials, as appropriate agents, are used to increase the stability of foams in enhances oil recovery. In this study, the synthesized nanocomposites (NCs), SiO2/KCl/Xanthan NCs was used to stabilize the foams obtained from sodium dodecyl sulfate (SDS) and cetyltrimethylammonium bromide (CTAB) surfactants. Thus, the synergic effect of the surfactant and NCs was investigated along with the salinity, foam quality, alkalinity and oil properties. The experimental measurements of conductivity, pH, surface tension (ST), interfacial tension (IFT), contact angle (CA) and oil displacement were performed. The obtaining results showed that the SDS and CTAB surfactants have the critical micelle concentration (CMC) of 2000 and 300 ppm, respectively. In terms of the foam stability, both surfactants demonstrated the same behavior of equal stability, while it is improved under the influence

of NaCl and NaOH at different concentrations with reducing the ST, IFT and foam generation time (tg). In addition, the optimal NCs concentrations for SDS and CTAB surfactants which improved the foam stability significantly, reduced the CA by 73.27 and improved the oil recovery by 20 % original oil in place (OOIP) were 1000 ppm and 500 ppm, respectively. This was also confirmed by macroscopic analysis of the formulated nano-surfactant systems. On the other hand, the viscosity, density and the gas rate had the inverse influence on the foam stability.



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About Soran University

Soran University (SUN) is located in the city of Soran, which is about a two-hour drive north-east of Erbil (Arbil, Hewlér), the capital of the Kurdistan Region of Iraq (KRIQ). The city is flanked by the famous Korek, Zozik, Henderén, and Biradost mountains. The medieval mountain village of Rewandiz (Rawanduz, رەواندز) is a stone-cast away, and the two cities share this lovely, harmonious upland. While waiting for its green, environmentally friendly building to be erected on a hilltop overlooking the cities of Soran and Rewandiz, its existing city campus has been meticulously set out to accommodate the lovely natural landscape. The new campus will be the first of its type, being walkable, balanced, powered by renewable energy, and compliant with all international environmental regulations. There are 5 Faculties in SUN; Faculty of Arts (FAAR), Faculty of Science (FSCN), Faculty of Education (FEDU), Faculty of Law, Political Science, and Management (FLAW/PSM), and Faculty of Engineering (FENG). Also, there is SUN research centre. Moreover, at SUN, there is a Language Center. SUN signed many Memoranda of Understandings (MoU) with many International Universities,

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