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Cr(III)-entrapped Nanocapsules Obtained via W/O/W Double Miniemulsion Nanoprecipitations of Hydrophobic Polymers for Delaying HPAM Gelation

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The main objective of a gel treatment in most mature oil fields is to improve the homogeneity of the reservoir by blocking highly permeable channels or fractures without damaging productive zones. In recent decades, Cr(III)-polyacrylamide (HPAM) gels have been extensively applied as blocking agents for sweep efficiency improvement. However, the gelation time of the current gels is not long enough for in-depth placement. This study systematically describes a novel approach of using nanocapsules to entrap and delay the release of crosslinking agents (Cr(III)) to extend gelation time. The nanocapsules are successfully prepared by a controlled nanoprecipitation of hydrophobic polymers onto stable aqueous droplets in a water-in-oil-in-water (W/O/W) double miniemulsion. The stable aqueous nanodroplets are obtained by inverse miniemulsions with an aqueous Cr(III) solution dispersed in an organic medium of solvent/nonsolvent mixture containing the hydrophobic polymer for the shell formation and an oil-soluble surfactant. The nanoprecipitation occurs when heating the mixture at 50℃ which led to the evaporation of solvent and precipitation of the polymer into the interface of the aqueous droplets. Another water-soluble surfactant can also be pre-added into the aqueous Cr(III) solution to improve the precipitation efficiency of the polymer. The achieved nanocapsules show the size range from 200-1500 nm depending on the surfactant(s) type and concentration. A Cr(III) loading ratio of 5-20% is obtained by varying initial Cr(III) contents and polymer contents which is detected by Inductively coupled plasma - optical emission spectrometry (ICP-OES) measurements. Besides, the nanocapsules can be easily transferred into water and mixed with the HPAM solution. Gelation results prove that capsuled Cr(III) significant delays the formation of the HPAM gel whose modified gelation time is dependent on pH and temperature.

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References

Time Block Preference

Time Block A (09:00-12:00 CET)

Participation

Online

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