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The influence of sulfide on the viscosity of HPAM used in oil recovery and the concerning mechanism

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Partially hydrolyzed polyacrylamide (HPAM) flooding plays an important role in enhancing oil recovery by increasing the viscosity of flooding fluid containing it. However, the viscosity of HPAM solution is found to be influenced significantly by sulfide. To better understand this phenomenon, the rheological behavior, dynamic light scattering (DLS) and ¹H NMR analysis were conducted to evaluate the influence of sulfide on viscosity of HPAM solution. The results showed that sulfide ions, even at 3 mg/L, reduced the viscosity of HPAM solution by a factor of more than 90%. The network structure of HPAM in water was apparently destroyed and the hydrodynamic radius decreased by the treatment with sulfide ions. More interestingly, the viscosity reduction could not be recovered by dialysis and the oxidizing products of sulfide ions by H₂O₂ could not significantly reduce HPAM viscosity. Further, ¹H NMR spectra indicated that the chemical environment of some protons in methylene group connected to the amide group in HPAM molecules were changed by sulfide ions. These results imply that sulfide ions reduce hydrodynamic radius and destroy three dimensional network structure of HPAM in solution by binding two side chains intra-/inter- HPAM molecules and consequently decrease the viscosity of its solution. The present studies are of referential value in researches on the interaction between sulfide and HPAM. Also, as sulfate reducing microorganisms universally inhabit in oil reservoirs, these results are important in guiding the way to promote the efficiency of HPAM flooding by reducing sulfide in oil reservoir via inhibiting SRB production activity.

Biography

Jin-Feng Liu received his PhD from East China University of Science and Technology. He has published more than 15 papers in peer review journals.

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