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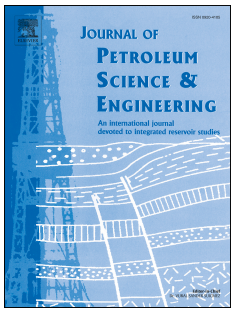

Using DSC technique to investigate the non-isothermal gelation kinetics of the multi-crosslinked Chromium acetate (Cr^{3+})-Polyethyleneimine (PEI)-Polymer gel sealant

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ACCEPTED MANUSCRIPT

Using DSC technique to investigate the non-isothermal gelation kinetics of the multi-crosslinked Chromium acetate (Cr^{3+})-Polyethyleneimine (PEI)-Polymer gel sealant

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Abstract Polymer gel based on multi-crosslinking is aroused great interesting in the aspect of oil/ and or gas well water shutoff and temporary plugging in well completion and workover. While the complex gelation mechanism is not well understood. Most previous studies focus on using a coarse method such as rheological techniques or simple bottle test to investigate the gelation kinetic. This work presents the first attempt to use the DSC technique to study the non-isothermal gelation kinetic of the multi-crosslinking gel system. The target polymer gel is reported in our previous study, which is a multi-crosslinked Cr^{3+}-PEI-SPAM gel. The DSC curve shows an endotherm peak followed by an exotherm peak, indicating the multiple reactions taken place during the heating of Cr^{3+}-PEI-SPAM gel system. The endothermic process shows that the first gelation reaction occurs between the SPAM and Cr^{3+}. And the exothermic process can be regarded as the secondary gelation reaction between the SPAM and PEI. Non-isothermal gelation kinetic parameters were determined by Jeziorny model, Mo's model and Rate model, respectively. All results show a good linear relationship with the experimental data. The non-isothermal gelation kinetic parameters from the Jeziorny model indicate that the gelation mechanism between Cr^{3+}-SPAM and PEI-SPAM is very different. The results of Mo's model show that the gelation process becomes difficult as the gelation progresses. Non-isothermal gelation kinetic parameters calculated from the Rate model indicate that the crosslinking between SPAM and Cr^{3+} is a multistage reaction including three stages, while the crosslinking between SPAM and PEI only has two stages.

Key words: Polymer gel; Multi-crosslinking; Gelation kinetic; Polyethyleneimine; Water shutoff; Temporary plugging

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