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Degradable polymers for the oil and gas industry

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Degradable polymers have been applied in the oil field for proppant pack stabilization, improved facture geometry, fluid diversion and lost circulation mitigation in drilling and cementing. As the market moves to shale gas formations that have ultra-low temperature (ULT), the demand for degradable materials that can "disappear" rapidly at temperatures <60°C is increasing. Polylactic acid (PLA), a bio-based degradable polymer, is particularly useful for multistage hydraulic fracturing. The rate of PLA degradation depends on the rate of ester hydrolysis, which is significantly reduced below the glass transition temperature (Tg) of PLA. This limits the applications of PLA in rock formations at high temperatures. A simple, readily up scalable chemistry using zinc oxide nanoparticles to catalyze the hydrolysis of PLA results in rapid degradation of PLA and extends its applications in low-temperature shale formations. Furthermore, for the first time, a non-destructive analytical method of ^{1}H T_2 nuclear magnetic resonance (NMR) relaxometry is being applied to measure the apparent rate constants of PLA hydrolysis in solid, heterogeneous/composite systems that have multiple and complex reaction kinetics. The demonstrated activation energy for ZnO-catalyzed PLA hydrolysis is about 38% lower than that of pure PLA hydrolysis.

Biography

S Sherry Zhu completed her PhD at the University of Pennsylvania and Postdoctoral studies from MIT. She is a Senior Research Scientist at the Schlumberger-Doll Research Center. She has published more than 10 papers and holds 5 patents and 19 patent applications.

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