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A novel reservoir protection agent with Voronoi structure to enhance shale gas recovery

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The output process of shale gas undergoes three closely connected segments of desorption, diffusion and seepage. To enhance shale gas recovery, the damage of working fluids on gas reservoir in every segment should be prevented or minimized by adding reservoir protection agent. One kind of micro emulsion agent as a shale gas reservoir protection agent is becoming more and more attractive, which has been applied in shale gas drilling and stimulation for improving the shale gas well production by changing the wettability of reservoir, decreasing water influx and decreasing the damage rate of permeability. However, desorption and diffusion of adsorbed gas should be promoted to improve the shale gas production. Therefore, it is necessary to develop a novel reservoir protection agent to improve shale gas recovery. A novel shale gas reservoir protection agent VSPA was developed and its major compositions included Gemini quaternary ammonium surfactant GTN, Tween 80, n-butyl alcohol, N-octane and water. The anti-water block behavior of VSPA in bicontinuous area was studied. A variety of methods including measurements of surface tension, contact angle, distribution of micelle size and anti-swelling ability, high temperature and high pressure adsorption experiment, spontaneous imbibition test and pressure pulse decay method were used to evaluate the reservoir protection properties of VSPA such as surface activity, wettability, inhibition, cleanup performance, effect on permeability of free gas and desorption of adsorbed gas. Results showed that the VSPA reduced the surface tension of fluid, increased contact angle, weakened pore throat shrinkage caused by hydrous swelling, decreased the capillary pressure, reduced liquid trap and water block damage by substantially decreasing liquid spontaneous imbibition, lowered the damage rate of permeability and promoting desorption of adsorbed gas from shale. The micelle blocked water incursion and slowed down transmission of pressure deforming and squeezing into micropores.

Biography

Weian Huang has graduated from China University of Petroleum in 2007 and continued his work in School of Petroleum Engineering of the same university. His research field includes the formation damage and protection, wellbore stability, deep well drilling fluids and deep-water drilling fluids. He has published more than 80 articles on drilling fluid technology in scholarly journals, been authorized several patents of invention. He has also written several monograph or teaching material on unconventional reservoir protection and oil and gas field environment protection.

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