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Smart Solutions for Oil and Gas industry Challenges

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Abstract:

Crude oil is the most attractive source of energy. It is formed at high temperatures and pressures deep down in the earth. Extraction of this energy resource, involves expensive drilling and extraction processes. The composition and physical characteristics of the oil depends on the source of the organic material, the temperature, and heat. The greater the viscosity of the oil the more difficult it is to extract. Heavy oil, is the name given to oil with API gravity between 10 and 20, and high viscosity <10,000 cP. It is technologically challenging and expensive to extract. Many solutions have been explored owing to the high financial returns in this business. In this study, we propose new smart solutions, utilizing unique properties of nanoparticles of different shapes and sizes to reduce the viscosity of heavy oil to make it easier to extract. Nanoparticles are 1- 100nm in size, have high surface to volume ratio, high heat capacity, excellent heat conductivity, low thermal expansion, and high melting temperatures. A combination of some of these properties was utilized to explore solutions for drilling and heavy oil viscosity problems. In drilling, problems like pipe sticking, lost fluid circulation, formation damage, erosion of the borehole, thermal instability of drilling fluids and their insufficient gel properties, lies in controlling and optimizing the rheology of the drilling fluid. Therefore, to advance the performance of water based drilling fluids in such a harsh reservoir conditions, a simple treatment based on nanotechnology was utilized by synthesizing in-house nano-addtives. 1-3 wt% of nano-additives increases fluid density by~ 5% and dynamic viscosity by~ 20% and reduces fluid loss by 50%. In addition to this, it forms a thin smooth Mud Cake with the surroundings of the formation. At ambient temperatures, crude oil and bitumen are resistant to flow through reservoir rock because of their high viscosities. Consequently, the energy expended to produce and upgrade a barrel of oil can be as high as 40% of the total energy available from the crude oil resource. Thermal enhanced oil recovery techniques such as steam assisted recovery and also in situ combustion are employed to upgrade and save the physicochemical properties of the oil. All these recovery techniques are expensive, complicated and need periodic maintenance; therefore, direct and cheap solutions are the main targets for high in situ upgrading. Our study provides alternative method that can help in production and upgrading of such heavy oil by cracking it. For the heavy oil cracking process, iron oxide Nano-Rods (IONRs) were synthesized by an environmentally friendly method. These rods were embedded and well mixed with 1 L of heavy oil (12 API) and subjected to direct microwave radiation. The radiation causes a reduction in dynamic viscosity of crude oil due to the presence of dipole water molecules. This reduction increased up to 50% when controlled amount of IONRs additives were added at the same temperature.

Biography

Majid Salim Al-Ruqeishi is a Researcher in graphene and nanomaterials fabrication field at physics department, faculty of science, Sultan Qaboos University. He holds a bachelor in science education (physics) from the Sultan Qaboos University, Sultanate of Oman, 2001 and a Master Degree in applied physics (Radiation and Plasma) from University of Malaya, Malaysia, August 2006. He acquired his PhD with full fellowship and a minimum completion period certificate in solid state physics (Nanotechnology) from the

same university, August 2010. He worked as a Scientific Researcher in Science division of Oman National Commission for Education, Culture and Science, MOE, 2010-2012.

Speaker Publications:

Experimental investigation of drilling fluid performance as nanoparticles
Influence of Zn2+ ions on the structural and electrical properties of Mg1− xZnxFeCrO4 spinels
Green synthesis of iron oxide nanorods from deciduous Omani mango tree leaves for heavy oil viscosity treatment
Direct synthesis of β-silicon carbide nanowires from graphite only without a catalyst
Piezoelectric nanogenerator based on ZnO nanorods

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