Interfacially active SWNT/Silica nanohybrid used in enhanced oil recovery

Luis Villamizar*, Prapas Lohateeraparp, Jeffrey Harwell, Daniel Resasco, Ben Shiau

University of Oklahoma, Norman OK 73072
(corresponding author: luis.villamizar@ou.edu)*

Single-Walled-Carbon-Nanotube (SWNT)-Silica nanohybrid particles are a very promising material that could be used in a near future for enhanced oil recovery because of their interfacial activity. The mechanism used to recover additional oil in this case would be to deliver catalytically active nanohybrid particles to the O/W interface, where they would react with and modify the oil properties to mobilize the oil in the reservoir. To demonstrate the basic principle, aqueous nanohybrid particle dispersions were evaluated by looking at the effect of pH, salt, surfactant and polymer. The results showed that pH and salt did not have significant effect on the dispersion stability of nanohybrid particles. Although surfactant could improve the dispersion stability, it reduced the interfacial activity of the nanohybrid particles, causing them to stay in the aqueous phase. The best nanohybrid particle dispersion stability was found upon polymer addition, where the dispersions were stable for more than a week even at low polymer concentration (50 ppm).

After the best conditions for dispersions stability were determined, one-dimensional-sand-pack studies were performed to evaluate the flow of the nanohybrid particles through porous media. The results showed that the most of the nanohybrid particles could pass through a column packed with glass beads while a measurable fraction of the particles were retained in the column packed with crushed Berea. When the columns contained a residual saturation of decane, additional nanohybrid particles were retained at the oil/water interface in both media (glass bead and crushed Berea sand packs). The sand pack studies showed that not only can the nanohybrid particles flow through porous media, but also about half of the particles injected will go the O/W interface when the porous medium contains a residual saturation of hydrocarbon, where they could be used to support a catalytic conversion of components of the oil..