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The Chevron LECTURE ON ENERGY 2017

"Enhancing Carbon Dioxide Enhanced Oil Recovery"

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Thursday 03 23 2017

5:00pm Poster Competition by ChBE Graduate Students, Networking, and Hor D'oeuvres

6:00pm Lecture by Dr. Hirasaki

7:00pm Dinner (RSVP required) and Poster Competition Results

Duncan Hall

McMurtry Auditorium & Martel Hall

Visit http://bit.ly/ricecampusmap for direction.

ABSTRACT

Waterflooding recovers only about 35% of the original oil in place. This is because oil and water does not mix and oil will stop flowing when it is disconnected. At pressures above the minimum miscibility pressure (MMP), CO_2 acts as a miscible solvent for oil and it can be injected into depleted oil reservoirs with CO_2 be trapped in place of oil. However, this is usually a challenge because super-critical CO_2 has the density and viscosity more like that of a gas and it tends to over-ride and bypass the (more dense and viscous) oil and water. A method to overcome the low viscosity of CO_2 is to add surfactants to disperse CO_2 in water as a CO_2-foam. The choice of surfactant was simple for a West Texas carbonate reservoir with low reservoir temperature and low salinity. A nonionic surfactant with 12 carbon chain and 22 EO (ethylene oxide groups) resulted in effective mobility reduction and low adsorption on the carbonate rock material. The conditions required for the Middle East is more demanding. They are also carbonate formations but the temperature is over 100 °C and the salinity is greater than 20% total dissolved solids (TDS). Nonionic surfactants became insoluble (reached cloud point) below the reservoir temperature. Anionic surfactants (commercially available) would precipitate and/or chemically degrade under these conditions, in addition to having high adsorption. The current candidate surfactants are switchable nonionic-to-cationic surfactants. They are ethoxylated or methyl amines or diamines. They have limited solubility in supercritical CO_2 and are soluble in the high-salinity brine when equilibrated with CO_2 (carbonic acid). They have low adsorption on pure calcite but can have significant adsorption if silica or clay are present.

ABOUT

Professor Hirasaki joined the Rice faculty after a 26 year career with Shell Development and Shell Oil Company. His research in fluid transport through porous media ranged from the microscopic scale intermolecular forces governing wettability to the megascopic scale numerical reservoir simulators for field-wide modeling. A reoccurring theme throughout this research is the dominance of interfaces in the determination of fluid transport processes. Fluids flow through rock and soil in pore spaces that are on the order of microns. The relative transport of phases and components are governed by the degree of wetting of the solid by the fluid phases and the sorption of species on the fluid and solid surfaces in addition to the usual transport coefficients such as viscosity and diffusivity.

Professor Hirasaki's research program is sponsored by an industrial consortium, USDOE, and industrial contracts. In 2016, Professor Hirasaki received the SPE Anthony F. Lucas Gold Medal and the 2016 OTC Heritage Award.

RSVP at bit.ly/2017chevronlecture