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## Gas injection enhanced oil recovery: A profitable path for emissions control

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The current commercial practice of gas-based enhanced oil recovery processes involves either continuous gas injection (CGI) or water-alternating-gas (WAG) injection. Over 60 commercial projects in West Texas and other parts of the world have amply demonstrated that these CGI and WAG processes have been technically successful and commercially profitable. However, the oil recoveries from the CGI and WAG processes fall in the range of 5-15% of the remaining oil. The gas-assisted gravity drainage (GAGD) process, invented and patented at LSU, has yielded oil recoveries in the range of 65-95% in laboratory experiments conducted at realistic reservoir conditions. The GAGD process involves utilizing several vertical wells for injection of  $CO_2$  in addition to drilling long horizontal wells for production. Injected  $CO_2$  accumulates at the top of the payzone due to gravity segregation and displaces oil, which drains to the horizontal producer. This maximizes the volumetric sweep efficiency. The gravity segregation of  $CO_2$  also helps in delaying, or even eliminating,  $CO_2$  breakthrough to the producer as well as preventing the gas phase from competing for flow with oil. GAGD enables sequestering injected  $CO_2$  in addition to yielding much higher recoveries of trapped oil from depleted reservoirs. This presents a unique opportunity for  $CO_2$  emitters and oil companies to synergize their resources to enable higher profits in the form of improved oil recoveries in addition to sequestering  $CO_2$  to ensure a cleaner environment. This workshop will focus on the development of the new GAGD process through laboratory experimentation and reservoir simulation of actual field case applications in addition to presenting.

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## Contact angle and IFT measurements at elevated temperatures for evaluating wettability in a selected carbonate reservoir in the UAE

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Water-flooding is considered as the most common method in the secondary recovery phase of field development. Extensive research in recent years on crude oil/brine/rock systems has revealed that the composition of the injected water can change the wetting properties of the reservoir during a water-flood in a favorable way to improve oil recovery. It has also been found that injection of "smart water" that consists of favorable ionic composition and salinity can act as a tertiary recovery method. The chemical mechanism of wettability alteration that is promoted by the injected water has been a topic for discussion both in carbonates and sandstones. In this work, the interfacial tension (IFT) of oil/brine system was measured at ambient conditions and at high pressure-high temperature (HPHT) conditions. The brine that exhibited the least IFT was used as the non-wetting phase with aged trims of rock in oil, for the measurement of contact angle at high pressure-high temperature conditions. The results of this work have shown that sea water of salinity 57,539 mg/l should be used as base brine for improved oil recovery process. All the measurements were conducted on carbonates. Extensive IFT and contact angle studies were performed for diluted and sulphate-spiked sea water, but none of those seemed to have the capability of changing the wettability of rock. Because of its least IFT with oil at HPHT and its ability to change rock wettability as indicated by the least contact angle, sea water is considered to be the smart water for use in the EOR flooding for the selected carbonate reservoir.

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