

Enhanced oil recovery with carbon dioxide geosequestration: first steps at Pre-salt in Brazil

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Abstract

This paper revisits the intense using of energy in the world and the role of the fossil fuels with predominance of the oil in the global primary energy supply and their effects to climate change. It also presents a new reading on the thermodynamic conditions and characteristics of CO₂ and CO₂-EOR together with oil industry advancement in the world and Brazil. The interface with chemical EOR processes involving nanoparticles (NPs), their application inside the reservoirs for EOR and understanding of fines migration reducing, among other physical phenomena is also studied. Carbon capture and storage (CCS) is a worldwide strategy for mitigating climate change. CO₂ geosequestration is also analyzed on the leakage of CO₂ and brine from aquifers and their implication to the security of the storage and environment. Recent studies show that, globally, CO₂-EOR can extract up to 375 billion of additional oil barrels and geological storage up to 360 Gt of CO₂ in the next 50 years. Pre-salt is a complex of microbial carbonate reservoirs with stromatolite framework in ultra-deep waters (1500–3000) m depth, underneath by thick salt layer (2000–2500) m. Its reservoirs are in the depth up to (5500–6500) m TVDSS and approximately (200–300) km offshore. It presents light oils and high (GOR) ranging (200–400) Sm³/Sm³ and huge CO₂ contamination (8–15)%. Due to the large CO₂ content of oil, this work investigated CO₂-EOR and CO₂ geosequestration within the reservoirs. Pilot test demonstrated that miscible CO₂-EOR with WAG is feasible and beneficial to this hydrocarbon Province. This study also calculated and validated the potential of CO₂-EOR to the CCS. It concludes that Pre-salt can contribute to recovery factor (RF) increasing about 5.7 billion of additional oil

barrels, and to CCS with about 266 Mt CO₂ to be geological stored, for the next 20 years. In this context, this work also analyses the recent changes on the Brazilian oil and gas regulation to encourage new international Companies to enter in Brazil and Pre-salt for petroleum exploring. In Pre-salt, CO₂-EOR also connects the petroleum energy system to CCS, transforming the oil reservoir in a carbon sink. These results represent a substantial role of Pre-salt to the energy efficiency of energy resources recovering from the biosphere and a high contribution to the climate change mitigation.

Keywords: Pre-salt · Additional oil · CO₂ geosequestration · Climate change