Experimental Analysis of Polymer-CO_2-Rock Interactions in PAG Deployment Case Study in Niger Delta Sandstone

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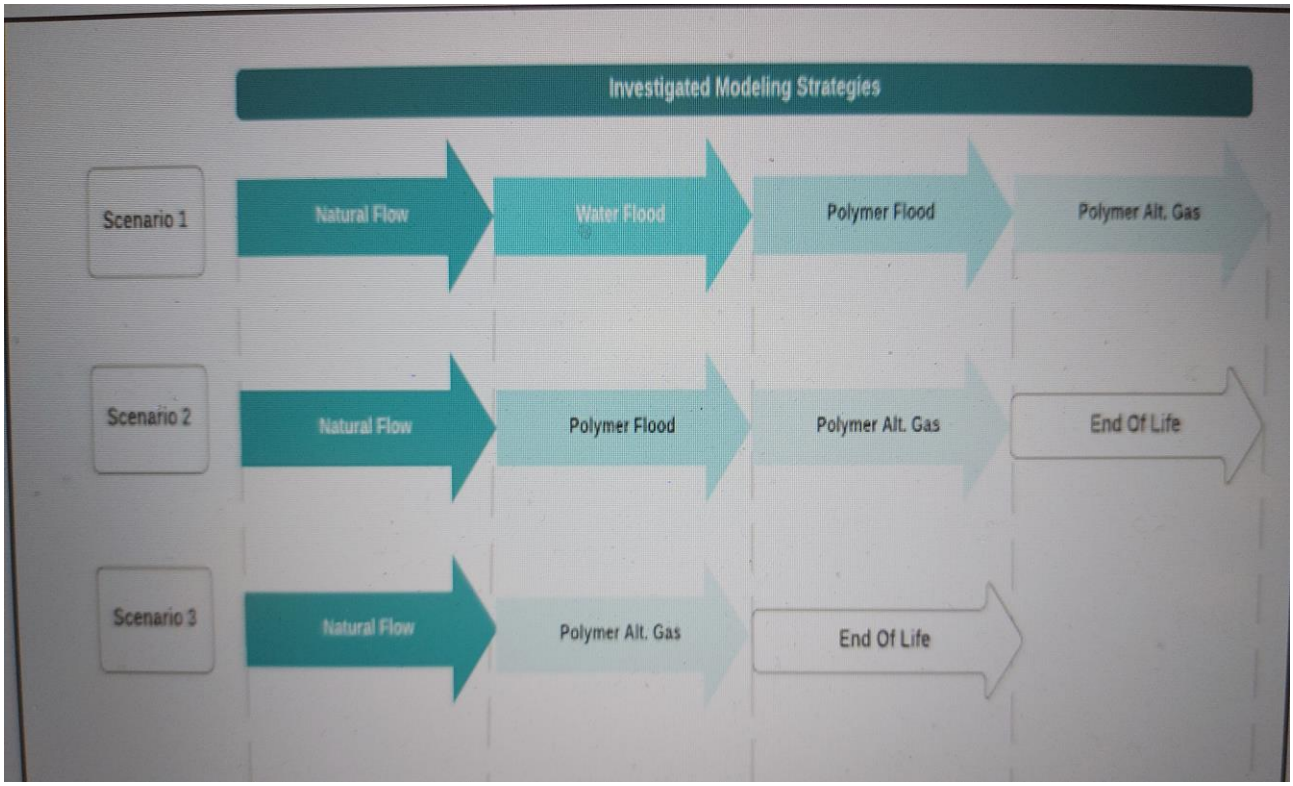

Figure 1: Investigated Modelling Scenarios

The advent of clean energy requires deep changes in the E&P industry. A critical part in that may be the use of CO_2 in oil recovery, thus also reducing effective emissions. The objective of this research is to investigate interactions between polymer, CO_2 and rock to enhance polymer selection via experimental analysis to be used in different simulation scenarios. Rheology results from these interactions presented at the conference last year, costs and polymer availability are also influencers of this selection. A case study from a Niger Delta sandstone objective sequence has been used. The laboratory investigations started with the interactions between the selected polymer and CO_2 in terms of rheology. Afterwards, two-phase flow in porous media was investigated to judge the compatibility of the entire system. In this study, two types of polymers (bio-polymer and synthetic-polymer) and analogous rock material representing the Niger Delta reservoir were used.
Three-dimensional simulation scenario modelling capturing mid, late and end of life of the production cycle (Reference modelling scenario in Figure 1) was helpful in the definition of an initial polymer concentration of 2.8 g/l. Using this concentration, core flood experiments were performed. The aim of the flooding analysis was to investigate the polymer, CO_2 and rock interaction such as determining - 1.) the effectivity/applicability of polymer in presence of CO_2 2.) the resistance and residual resistance factors (RF and RRF) associated with the separate injection of polymer solutions and CO_2 which is also an indication of the property changes associated with the reservoir post flooding 3.) the benefits and economic viability of Polymer slug sizes with the addition of CO_2 (Polymer Alternating Gas-PAG) 4.) the Residual Resistance Factor for the EOR options. Core flooding experiments with both polymers show favourable RRF slightly higher than 1. During injection, depending on the applied polymer, RF largely differ between 4 and 100, raising concerns about the injectivity of biopolymer. For synthetic PAG flooding, the experiments suggest that using large polymer and CO_2 slugs would be favourable for such deployments as they yield lower RRFs. A combination of small polymer slugs + large CO_2 gives a more economically viable option. The injection data associated with the experimental outcome for biopolymer in PAG suggest a revision of the chosen concentration for PAG EOR.