Current Research Project/Interests of Prof. Hemanta Sarma

(For further details and enquiries for Graduate and Post-Doctoral Research opportunities in the projects listed below, please contact Prof.Sarma at: hsarma@pi.ac.ae)

Current and Recently Completed Research Projects/Interests

1. **CO2 Flooding and CO2 Sequestration: CO2 EGR and EOR cum sequestration using CO2 from stationery industrial sources.**

   Specific topic areas of interest:

   - CO2-oil-rock interaction studies, including viscosity and IFT reduction, swelling, extraction
   - CO2-water interaction
   - Relationship between CO2 dissolution and pressure
   - Displacement studies at reservoir conditions of P and T and the effect of heterogeneities
   - Relative permeabilities for CO2-Water, CO2-Oil and Oil-Water systems
   - Wettability alteration and likely impact on CO2 escape and migration
   - CO2 PVT/Phase behaviour studies and modelling
   - Study of conformance control using gels and foams using a simulation approach
   - Experimental visualization of possible asphaltene problems due to CO2 and determination of onset conditions
   - Emulsification characteristics
   - Establishing Minimum Miscibility Pressure and its implication on the recovery factor
   - Simulation studies to evaluate impact of flood pattern and alignment, and gravity-stable injection reservoirs with vertical relief.
   - Simulation studies to evaluate efficiency of injected CO2 to evaluate process efficiencies: continuous injection versus WAG injection?
   - Quantification of CO2 "lost (i.e., sequestered)" in the formation and recirculated through injection-production system
   - Estimate CO2 utilization factor, in terms of Standard Volume injected per equivalent Standard Unit Volume of oil or gas recovered.

2. **Modelling of CO2 and Green-house gas (GHG) Miscibility and Interactions with Oil**

3. **Feasibility study of HC gas floods in selected Australian reservoirs**

4. **Potential of CO2 flood in Tight Reservoirs in Cooper Basin, Australia**

5. **Carbon Sequestration/Enhanced Coal-Bed Methane Potential in Australian Coals**

6. **Reaction of Organic Acids with Calcite/Dolomite during Well Stimulation in Saudi Arabian Reservoirs**

7. **Screening of Selected Australian Reservoirs for Air Injection Process**

Other Research Projects on Anvil

1. **Investigation of the Potential of Microbial EOR Process in Australian Reservoirs**

   Project Level: MS/PhD

   MEOR using naturally-occurring microbes is a low-cost approach to improve waterflood efficiency and conformance control. Our preliminary study suggests that the process may have a potential in several Australian reservoirs that are relatively shallow and are at lower temperature. The objective of this study will be to conduct a thorough screening study in collaboration with the industry and research organizations active in this process.

2. **Enhanced coal-bed methane recovery using CO2 and N2 (or air)**

   Project Level: MS/PhD

   Project looks into an experimental and simulation approach to investigate reservoir engineering aspects with regard to matrix shrinkage, enhanced gas recovery, CO2 storage and permeability variation due to injection in CBM reservoirs.

3. **Using CO2 to produce methane from methane-hydrate reservoirs and to sequester green-house CO2 gases**

   Project Level: MS/PhD

   This project will look into theoretical (phase behaviour) aspects associated with recovering the methane held in hydrates through replacement with CO2, thus also providing concomitant CO2 disposal in methane hydrate. Given the vast methane hydrate reservoirs around the world, this project offers significant potential in our efforts to understand the exploitation of this relatively up-taped vast energy resource.

4. **Development of tight-gas reservoirs: A study of the reservoir engineering and production aspects**

   Project Level: MS

   The objective of this project is to investigate, through a detailed simulation study, the challenges that operators face in terms of reservoir and production engineering aspects when developing a tight-gas reservoir. A series of parametric sensitivity studies will be undertaken. Time permitting; the study will also consider gas reservoirs in fractures shales and coals.

5. **Investigation and modelling of asphaltenes precipitation and deposition in gas injection processes**

   Project Level: MS/PhD

   Asphaltene content in the oil could be deceptive as certain oils with high asphaltene content pose no problem whereas lighter oils with even a minute content could cause

severe problems. In general, field data suggest that light oils with small asphaltene content are more prone to asphaltene problems than heavy oils.

Asphaltenes could cause serious and severe operational problems in primary depletion as well as in EOR processes. In particular, it is a big concern during gas injection into light oil reservoirs. During gas injection, changes occur in composition of the reservoir fluids resulting changes in densities, pH balances and pressures, and all such changes affect asphaltene stability in the reservoir oil. Therefore, prior investigative laboratory and simulation studies are a must before any gas injection process is applied in a reservoir that contains even a minute content of asphaltene. In this project, we intend to investigate asphaltenes problem with particular emphasis on the gas injection projects.

6. **Use of polymer to improve waterflood efficiency through improved mobility and conformance control**

   Project Level: MS

   Polymer flood is also often referred to as a variation of waterflood. The main objective of a polymer flood is to control the mobility of the displacing phase so that the mobility ratio between the displacing and displaced phase becomes favourable. A favourable mobility ratio yields higher areal and vertical sweep efficiencies and help suppress viscous fingering. This is, indeed, the primary feature that makes it more efficient than a conventional waterflood. At microscopic level, however, both waterflood and polymer flood has the same efficiency as far as their ability to reduce the S_o is concerned.

   Compared to other chemical methods, the polymer flood has been reasonably successful. Daqing oilfield in China and Marmul oilfield in Oman are good examples of highly successful polymer flood applications. Even by a conservative estimate, the polymer flood has helped achieve a 12% incremental oil recovery in Daqing oilfield (Oil viscosity = 7cP, k = 300mD, Salinity <8000 ppm and T<70^{o}C).

   As general overview of polymer project performance data reveals that both the molecular weight (MW) of the polymer and its concentration are the key to the success of the process. The dictum seems to be: *"Use higher concentration of low to medium MW polymer rather than a lower concentration of high MW polymer"*. These aspects will be investigated using open-file data using a commercial reservoir simulator. Efforts will also be made to further extend this study using some Australian waterflood field data.

7. **Investigation of the potential for acid gas (H2S+CO2) injection in Middle Eastern reservoirs** *(Project scope to be developed in consultation)*

   Project Level: MS