CO$_2$ EOR Research in Saudi Aramco

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Resources

722 billion bbls

50% Recoverable

Expand Resource

*with Condensates

109 billion bbls

Produced

358 billion bbls

Probable, Possible, Contingent

260* billion bbls

Current

50% Recoverable

*with Condensates
Interest in CO2-EOR Research

- Environmental concern
- Win-win
- Promote capture and sequestration technologies
- EOR Production is not needed for very long time
  - Long lead time R&D, studies and planning

- 722 billion bbls
  - 358 bil bbls (50%) Probable, Possible, Contingent
  - 109 bil bbls (15%) Produced
  - 260* bil bbls (35%) Current

*with Condensates
Recovery Methods

Primary Recovery
- Natural Flow
- Artificial Lift (Pump, Gas Lift)

Secondary Recovery
- Pressure Support (Water, Gas)

Tertiary
- Thermal: Combustion, Steam, Hot water
- Gas Miscible Immiscible
- Chemical: Alkaline, Polymer, Foam, Miscellar
- Other: Microbial, Electromagnetic

Oil Recovery
- Target mobile oil in the reservoir

Target immobile oil in the reservoir

(From SPE-SPE-84908, 87864)
CO$_2$-EOR - Basics

- Inject dense CO$_2$ → ‘liquid’ like
- Swells oil and reduces viscosity
- Applicable to light oil reservoir (miscible)
- Proven: number of commercial projects
- Estimated incremental recovery: 5-20%

Miscibility of CO$_2$ + Oil
**CO₂-EOR: Technical Challenges**

- Geological complexities
- Viscous fingering
- Gravity segregation
- Conformance, i.e. Placing CO₂ into the ‘right’ zones
- Monitoring technologies
- Corrosion and metallurgy
- Cost: CAPEX & OPEX
EOR Production: World

(Data from Oil & Gas J, SPE, and other sources)

Thermal: 69%
Chemical: 9%
HC Gas: 10%
CO2: 10%
Others: 2%

~ 3 Million b/d (4%)
Carbon Management at Saudi Aramco

- Established a multidisciplinary team
- Developed carbon management technology Roadmap
- Engaged with industry to increase awareness
- Enhanced collaboration
EOR Research Program

Screening Studies → EOR Methods Research → EOR Pilot Candidates → Evaluate and Assess

- Preliminary
  - Detailed
    - Gas (CO2)
    - Chemical
    - Thermal
    - Microbial

- Site Selection
  - Detailed Reservoir Studies
    - Pilot Test Implementation

Evaluation Period → Assessment
CO$_2$-EOR: Research Topics

- Fluid-fluid and fluid-rock interactions
  - Complex CO$_2$-oil-water phase behavior
  - CO$_2$ interaction with reservoir rock
  - CO$_2$ interaction with cements
  - Cap rock integrity
- Corrosion
- Viscosity and miscibility controls
- Increase capacity to inject more CO$_2$
- Flood performance monitoring, diagnostics surveillance and surveillance technologies
- Field studies and pilots -- Weyburn
Saudi Aramco is addressing concern over global climate change by promoting R&D in carbon capture and storage

- Established a Carbon Management team with a technology road map
- Active in conducting R&D studies in CO$_2$-EOR