Repurposing Oil and Gas Reservoirs for Blue Hydrogen Production

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What we know

- ❖ Hydrogen is critical to achieving the NetZero Target set by the UK government in 2050.
- ❖ There has been concerted efforts to produce more hydrogen from renewable sources (green hydrogen) to reduce the impact on the environment. The arguments have been that hydrogen produced from hydrocarbon sources contribute largely to CO₂ emission in the atmosphere therefore causing global warming.
- ❖ While this is true, the reality however is that with the increasing demand projections for Hydrogen cannot be met by Green Hydrogen. At present, nearly all industrial hydrogen are produced from hydrocarbon sources (Muradov 2017).
- ❖ CO₂ emission is a major by-product of blue hydrogen production. However, there is a need to reverse engineer the hydrogen process from hydrocarbons, explore hydrogen production directly from the reservoir and retain the accompanying CO₂ from being released into the surface.
- ❖ Using a depleted reservoir as feedstock, one method of doing this, is by in-situ hydrogen production through thermal combustion of the hydrocarbon reservoirs.

What we want to know

- ✓ How much hydrogen can be produced using this process?
- ✓ What key factors control hydrogen production using this process?
- ✓ How do you model in-situ hydrogen production from oil and gas reservoirs?

Steps we are taking

1. Conceptualize the process. Modified existing oil and gas production process to accommodate hydrogen
2. Identify key areas of technical safety concern:
 - ❑ Chemistry of hydrogen production (thermal reaction properties)
 - ❑ Reservoir Caprock Integrity (Failure analysis)
 - ❑ Exergy analysis

Key Results

- ❖ Hydrogen is produced and is quickly consumed during the simulation
- ❖ Hydrogen production varied with cell location.
- ❖ Thermal cracking, Partial oxidation reactions observed during simulation

Conclusion and Further Work

- ✓ Box model was built to simulate laboratory conditions.
- ✓ Preliminary results from Box model simulation show that at reservoir temperatures of about 500°C, hydrogen forming reactions are activated
- ✓ Injection of oxygen for in-situ combustion of hydrocarbon increases the reservoir temperature, but not to hydrogen forming range.
- ✓ Hydrogen produced quickly reacted with injected oxygen to form steam at reservoir conditions
- ✓ Parametric studies needed to understand the key factors affecting in-situ hydrogen production

References

Muradov N. Low to near-zero CO₂ production of hydrogen from fossil fuels: Status and perspectives. Int. J. Hydrogen Energy [Internet]. Elsevier Ltd; 2017;42(20):14058–88. Available from: <http://dx.doi.org/10.1016/j.ijhydene.2017.04.101>