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CO₂ : MSc Thesis topics

Topics on CO₂-flooding and CO₂-storage are described below.

CO₂-flooding

Background

Carbon dioxide (CO₂) flooding has been reported to improve the oil recovery in many oil reservoirs. The leading mechanisms that favour CO₂-flooding are oil swelling, reduction of oil viscosity and mass transfer between phases which can lead to miscible CO₂-flood. Diffusion of CO₂ from fracture to the remaining oil in the matrix can be important for the CO₂ transport in fractured reservoirs. Diffusion processes are rather slow. Gravity, capillary forces and viscous forces can also contribute to transport of CO₂.

The solubility of CO₂ in water is much greater for CO₂ than for hydrocarbon gases. When CO₂ is injected to water-flooded reservoirs, carbonated water (CW, water saturated with CO₂) will be formed inside the reservoir. During co-injection and alternating injection of CO₂ and water (CO₂-WAG), the water will become saturated with CO₂.

Thesis topics CO₂-flooding

1. Wettability alteration during CO₂-floods

The objective is to determine whether CO₂ can alter the wettability of chalk.

CO₂ can decrease the solubility and increase the aggregation of asphaltene molecules. This may alter the wettability conditions and thereby also the relative permeability and capillary pressure curves. The wettability conditions will be characterised before and after flooding with CO₂ and carbonated water. Core plugs of outcrop chalk will be used in the experiments.

One MSc-student can work on this subject.

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CO₂ – storage

Background

Poor macroscopic sweep efficiency has been a problem in CO₂-EOR flooding of many oil reservoirs, and this will also give low CO₂-sequestration. The macroscopic sweep efficiency can be low due to the combination of high mobility ratio, gravity segregation and heterogeneity. Reduction of the mobility ratio in CO₂-flooding has the potential to improve the macroscopic sweep efficiency and thereby improve the oil recovery and the CO₂-sequestration capacity. Macroscopic sweep efficiency usually includes vertical sweep, horizontal sweep and linear sweep. In fractured reservoirs the sweep of matrix blocks is also important. Improvement of macroscopic sweep will increase the total sweep efficiency (recovery factor) and delay CO₂-breakthrough. The mobility ratio in CO₂-flooding can be increased in several ways, e.g. CO₂-WAG, CO₂-foam and CO₂-soluble polymers. Macroscopic sweep efficiency can also be increased by optimizing well geometry (placement, type, path, size)/completion and injection strategies, and blocking of high permeability zones by polymer gel. Wettability alteration during CO₂-floods will change the saturation functions, capillary pressure curves and relative permeability curves, and can thereby change the macroscopic sweep efficiency.

Thesis topics CO₂ – storage

1. Improvement CO₂-sequestration capacity by improving macroscopic sweep efficiency

The objective is to determine the potential for improving the CO₂-sequestration capacity of the different parts of oil reservoirs by improving the macroscopic sweep efficiency. The focus will be on reduction of CO₂-mobility. The commercial simulator Eclipse will be used in the work.

One MSc student can work on this subject.

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2. Wettability alteration during CO₂-sequestration

The objective is to determine the effect of wettability alteration on CO₂-sequestration in the aquifers and reservoirs parts with low oil saturations. The wettability conditions will be characterised before and after flooding with CO₂ and carbonated water. Core plugs of outcrop chalk will be used in the experiments. It will be determined whether wettability alteration during CO₂-sequestration will affect the CO₂-sequestration capacity.

One MSc student can work on this subject.

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CO₂: MSc thesis topics 2010,
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Page 4

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