Application of Metallic Nanoparticles as Catalysts for In-Situ Heavy Oil Recovery

PhD candidate: Kun Guo
Supervisors: Prof. Zhixin Yu
Prof. Svein M. Skjæveland

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1. Introduction

- Poor mobility
- Heavy hydrocarbons (SARA)
- Heteroatoms: S, N, O and metals


- Conventional Oil: 30%
- Heavy Oil: 15%
- Extra-heavy Oil: 55% (incl. oil sands and bitumen)
2. Background Knowledge

Heavy Oil EOR

**Thermal Injection**
- Temp.-induced viscosity reduction
- SAGD, ISC, CSS, steam flooding, ...
- Energy Intensive
- Capital Intensive
- GHG emission

**Chemical Injection**
- IFT reduction
- Mobility control
- Alkali, surfactant, polymer, ASP, ...

**Gas Injection**
- CO₂, methane, N₂, WAG, ...
- Insufficient sweep efficiency
- Poor displacement efficiency
- Unsuitable for extra-heavy oil

**STEAM**
- Heat
- Water

**Physical Changes**
- Chemical Reactions

**Aquathermolysis**

**In-situ Upgrading**
3. Project Objectives

Heavy Oil

Aquathermolysis

Catalysts

- Water soluble catalyst
- Oil soluble catalysts
- Amphiphilic catalysts
- Minerals and zeolites
- Solid superacids
- Carbon nanomaterials
- Metallic Nanoparticles

Metallc Nanoparticles

- Heteroatom Removal
- Viscosity Reduction

Upgraded Products

- Improved Mobility and Quality

- Active
- Selective
- Reliable
4. Research Approach

Reservoir Simulation

- Temperature
- Pressure
- Hydrogen donor

Catalyst Parameters
- Metal Type
- Particle Size
- Composition
- Particle Shape
- Support
- Concentration

Optimization

Heavy Oil Property
- Viscosity
- C/H ratio
- Heteroatoms
- SARA
- Distribution
4. Research Approach

Schematic diagram of Core flooding setup

Injectivity Analysis

NP suspension
- Stability
- Retention

Core
- Permeability
- Wettability

Oil & Gas
- Quality
Preliminary Results

Cobalt NPs


Thanks for your attention!