

The Influence of Chelating Agents on Clays of the Geothermal Cap Rock: Implications for Enhancing Geothermal Reservoir Quality

Background

Geothermal energy (Figure 1) is a green renewable energy source that has potential to provide long-term energy with lower carbon footprint and maintenance costs than other renewable energy. A large portion of the world's geothermal reserves is in sandstone reservoirs often characterized by quartz grains cemented with clays. Clays form also often the impervious boundary of the reservoir rock, the so-called caprock. Many geothermal reservoirs tend to lose permeability over time during production, therefore techniques are applied to enhance the reservoir quality in terms of fluid permeability. Partial dissolution of sand grains in the reservoir is a possibility to increase porosity and consequently permeability. However, the fluids used for dissolution should have limited reactions with the cementing clay minerals as this would cause collapse of the sandstone grain skeleton reducing permeability. Biodegradable chelating agents (BCA) compared to conventional chemicals (HF and HCl) have little reaction with clay, but can dissolve the sandstone grains; hence green chemicals could be effective for enhancing reservoir quality. The emission of dissolved CO₂ from geothermal water becomes more of an issue recently. Biodegradable chelating agents could reduce CO₂ emission since they offer high chelating capacities on a large variety of minerals including calcium-rich minerals. Calcium has the capacity to bond with CO₂, proving to be effective for CO₂ sequestration.

This project investigates the influence of biodegradable chelating agents on clays making up the cap rock. The study aims to improve properties and characteristics of geothermal reservoirs. Findings on mineral alteration analysis due to chelating agents are investigated with spectroradiometric measurements complementing physical and mechanical properties.

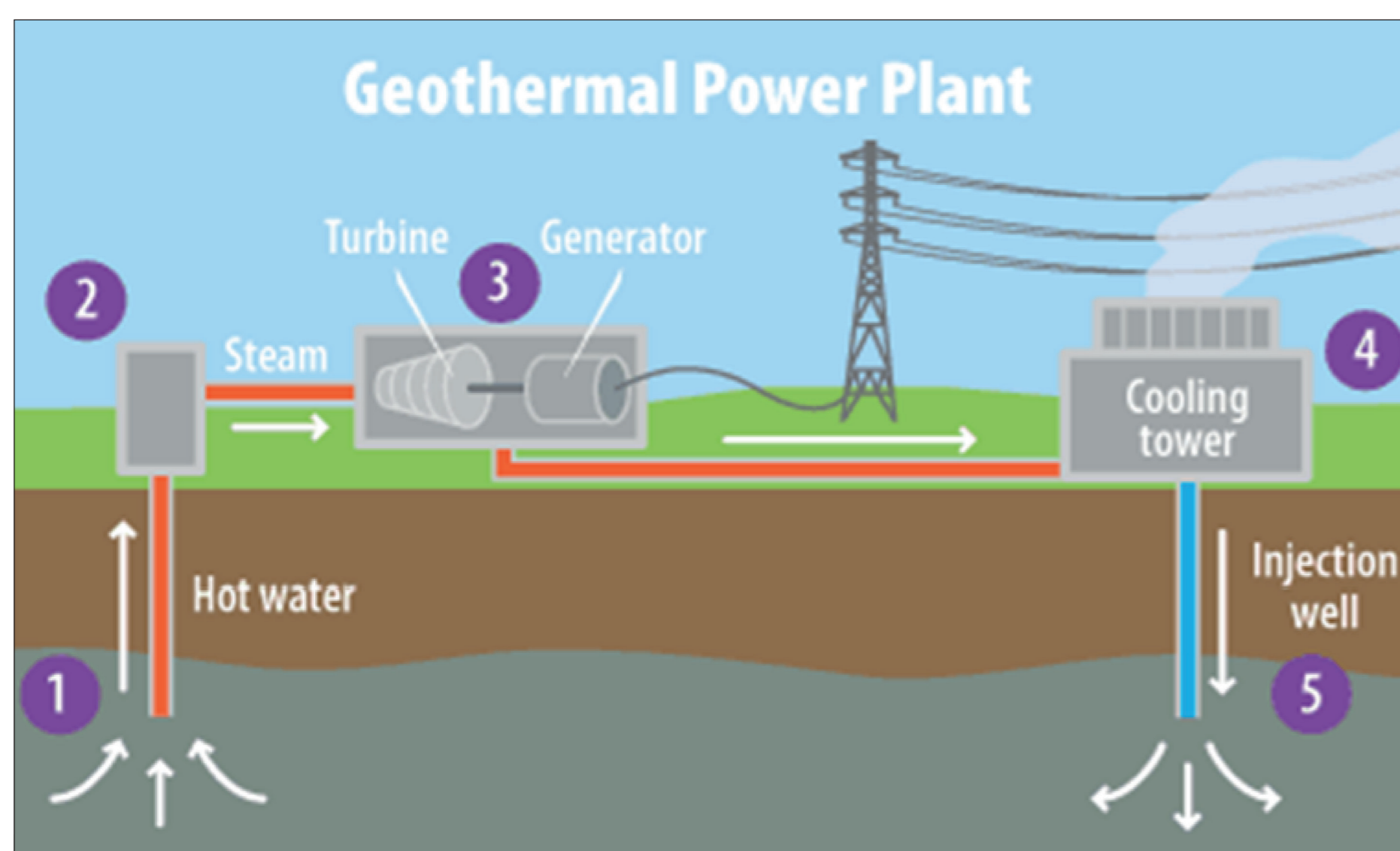


Figure 1: Geothermal Power Generation



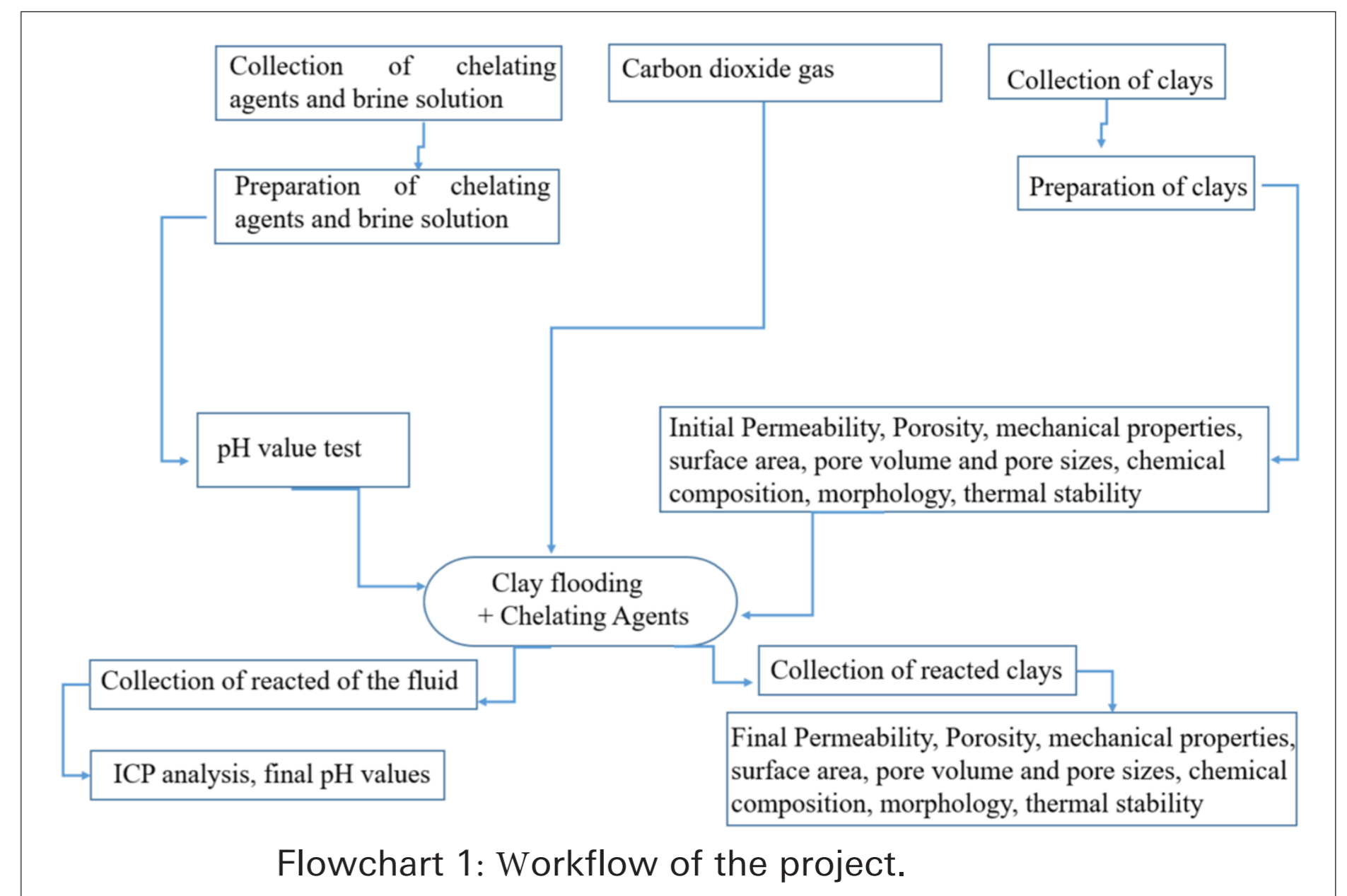
Figure 2: Desktop High Pressure Reactor

Expected Output

The expected results are to optimize production in geothermal reservoirs by obtaining information about the influence of environment-friendly chelating agents on reservoirs in terms of properties and characteristics of clays of the cap rock.

Furthermore, the project will yield the effect of different chelating agents and techniques applied during reservoir acid stimulation. Subsequently, the project is expected to provide findings on the possibilities of CO₂ sequestration in geological formations.

Flowchart 1 represents a workflow of the project. Different analytical equipment are employed XRD, Spectroradiometric (TerraSpec Halo/hyperspectral camera), porosimeter, TGA, FTIR, SEM, compressional machine (for mechanical properties) and permeability test equipment.



Flowchart 1: Workflow of the project.

Objectives

The main objective is to investigate compatibility of clays and chelating agents, as key step towards acid selection for enhancing geothermal reservoir qualities (pore structure characteristics and properties). More importantly, chelating agents are investigated as effective chemicals to enhance CO₂ sequestration in subsurface geological formations, i.e. geothermal reservoirs.

Methodology

The study is carried out under a 500 mL desktop high pressure reactor (Figure 2) with the pressure 22 MPa max and temperature 300 °C to simulate geothermal environments.

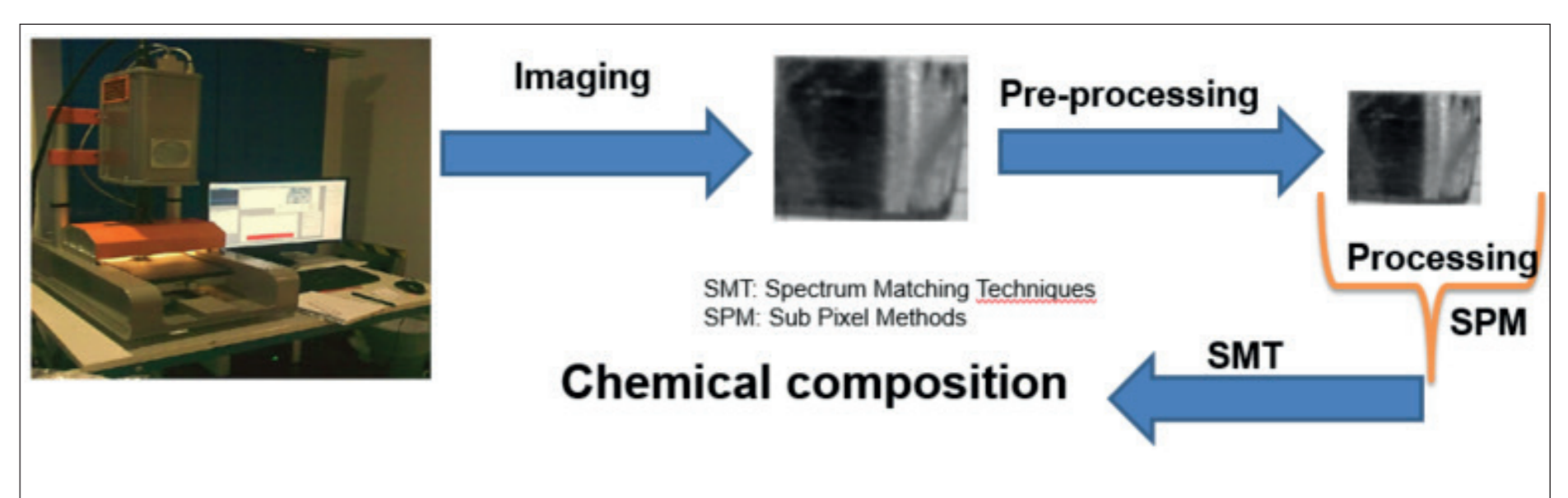


Figure 3: Measurement of mineral composition (alteration) with hyperspectral camera

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For more information

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