Examples of MSc Petroleum Engineering student projects

Investigating the challenges for oil recovery from unconventional reservoirs
Low-cost drilling, production and processing have led natural gas and light crude oil to be the prominent hydrocarbons recovered first from producing fields. However, high oil prices have increased interest in recovering oil and gas from challenging resources called unconventional resources. The project focuses on challenges encountered in extracting and producing hydrocarbon from unconventional resources such as heavy and extra heavy oil, tight sand and shale gas and oil.

Assessing the reservoir rock and fluid interactions using a zeta analyser
Understanding rock and fluid interaction is essential to describe the oil recovery mechanisms. This will be more crucial when oil companies plan to execute any enhanced oil recovery and improved oil recovery projects. Rock surface characterisation, namely surface potential ions, play an important role in adsorbing or desorbing the polar species onto and from the rock surfaces. This depends on the surface potential, rock types, polar species and the strength and change of interaction. This project deals with different types of interaction between oil, water and rock using a zeta analyser.

Studying surfactant injection in an oil reservoir to improve the recovery using powder technology
Proper management over oil production from reservoirs requires proper lab data for interpretation. For both heavy oil and unconsolidated reservoirs (challenging reservoirs) conventional flow experiments such as steady state relative permeability, centrifuge and wettability measurements are subjected to several operational problems, for example, coring, blocking, sand production, equipment damages. In many of these cases the experiments are abandoned with lots of unwanted costs and wasted time.

In the proposed methodology, we focus on surface characterisation where we extract useful data from powder such as rock wetting preferences and strength of wettability alteration, reservoir response to various water compositions, contact angle. By developing new methods and applying all methods correctly we can significantly reduce costs and save time, both in the lab and in the field. This will bring confidence to oil field management for future field development planning.

Reducing CO_2 emissions in the oil and gas industry: carbon capture, reservoir rock challenges
Amidst global warming concerns, caused by the excessive amount of greenhouse gases (especially CO_2) in the atmosphere, carbon capture systems (CCS), which involve capturing CO_2 produced at primary CO_2 sources, are continually being embraced worldwide as the most viable way to reduce CO_2 emissions. In this project, the screening of the reservoirs suitable for CO_2 storage will be reviewed. The results will be evaluated using a simplified model.

Assessing the asphaltene precipitation in oil fields (lab-based (zeta analyser) and modelling project)
Petroleum fractions have very useful alternative purposes but asphaltenes are very complex fractions with critical challenges. If well managed, asphaltenes do have prospective applications. Simply, the presence of asphaltenes in a media due to precipitation is not a challenging issue, rather the coagulation of the precipitated asphaltenes lead to deposition in reservoirs, oil and gas pipelines and storage tanks. The asphaltenes precipitation on rock surfaces can change the rock surface characterisation. The change in surface charge is one important aspect of the asphaltenes' interaction with rock. This project focuses on the reversibility of asphaltenes adsorption on rock surfaces using a zeta analyser.

Investigating the enhanced oil recovery using nano-fluids (lab-based project)

New types of fluids, usually called smart fluids, have become more accessible for the oil and gas industry (Zitha 2005). Due to special behaviour of these types of fluids, nano-fluid properties often exceed the properties of conventional fluids. The interaction between reservoir fluids and rocks can be altered by adding the nano-fluids to the injected fluids. In this study the interfacial properties of oil and water are studied through measurements of interfacial tension and wettability alteration.

Studying the effect of clay in water-based enhanced oil recovery techniques (high- and low-salinity water injection)

Water injection techniques are widely used by oil companies to increase oil recovery. The main mechanism enveloped in water injection is reservoir presser maintenance. The performance of reservoir-to-water injection varies by the rock composition, specifically clay content. Presence of clay content in the rock can have a positive impact on the water injection if the proper water composition is selected before the injection. In this project the effect of clay content on water injection performance is investigated through different types of lab activities such as contact angle and thermo-gravimetric measurements.

Microbial enhanced oil recovery (lab-based project)

According to surveys, more than half of the oil reserve in the oil reservoirs remains unrecovered. This remaining oil is the target of advance recovery techniques such as steam injection, low-salinity water injection as well as microbial enhanced oil recovery. This involves injecting and growing microbes into the reservoirs. These microbes can consume the oil as food and produce gases, bio surfactants and bio polymers, where these products can ease the trapped oil from the reservoirs. In this project, microbes, neutrinos and their by-products will be selected to investigate this technique.

Modelling asphaltene precipitate formation using PVTi

Asphaltene precipitation and deposition can cause severe problems in different stages of hydrocarbon production and processing. Sudden changes in pressure, temperature and composition of reservoir fluids are known to cause asphaltene precipitation. Understanding the conditions under which asphaltene precipitate forms and accounting for it in the reservoir fluid models is of great importance. This study uses PVTi software to look at effects of gas injection on asphaltene precipitation.