Engineering Design and Analysis on Geothermal Resources

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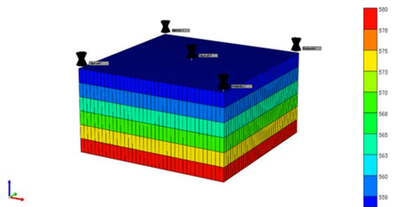
Background

Thermal recovery method as one of the most mature enhanced oil technology which is being widely applied in all around the world. In contrast with other EOR method, the implementation of thermal energy from geothermal sources helps to provide an environmentally-friendly way on oil recovery as eliminating burns of natural gas and oil. Due to the high cost of geothermal wells construction fees, it is a good way to convert abandoned wells into geothermal wells. Nowadays, there are about 30 million abandoned wells in the world and the huge economic potential can be discovered.

Geologic Modelling

The grid top 3D geological builder and the enthalpy transfer process has been shown below.

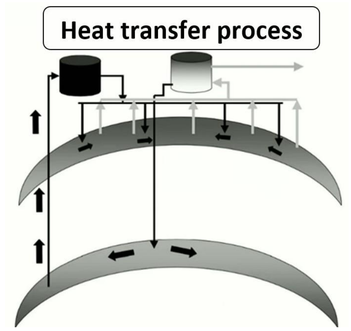


3D Geological Model Builder

Oil Reservoir Location

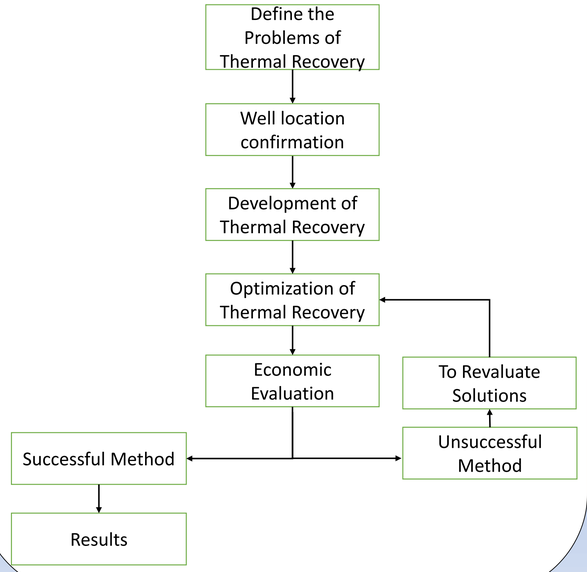
Project Goals and Methodology

- To consider the most feasible way of applying thermal recovery from abandoned oil well in central Canada
- To contrast and analysis the simulation result of different types of thermal recovery
- To re-invest on abandoned oil wells in order to recover geothermal resources
- AccuMap: The data of wells which came from the AccuMap software in order for building and simulating a 3D geological model
- CMG WinProp: To create PVT diagram and reservoir fluid model
- CMG STARS: To build up a 3D geological model and run the thermal fluid simulator.
- The image below shown the the heat transfer process.



(John M. Pederson, SPE, and Jayadi H. Sitorus, 2001)

Workflow of Design Process



Thermal Energy Management

The utilization of injecting thermal fluid from abandoned well into depleted oil reservoir will make contributions on reducing carbon dioxide emissions. Many wells are suspended because of they no longer producing enough oil to be economical, but they can still produce a large amount of hot water. It has a great potential to reuse it rather than permanently abandoning them. Some of key factors have been listed below which denoted the amount of energy saving from heat transfer process.

——To burn up natural gas will need **38000 kj/m^3**

——Energy saved from abandoned wells is going to be **504000000 kj/d**

——Which is equivalent to **13263.75 m^3** of natural gas

——Totally saved natural gas worth **CA$802.2316**

——Carbon dioxide emission coefficient is **0.4483**

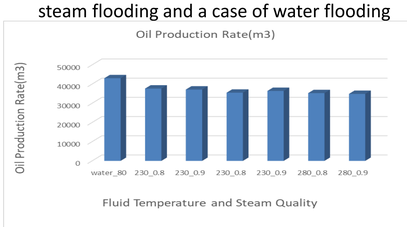
——To burn up 1m^3 will produce **2kg** of CO2

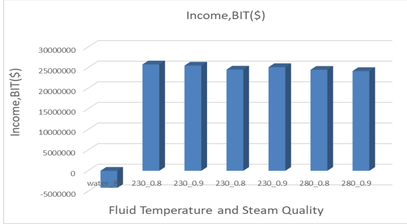
——Reduced **26526.31kg** carbon dioxide emission

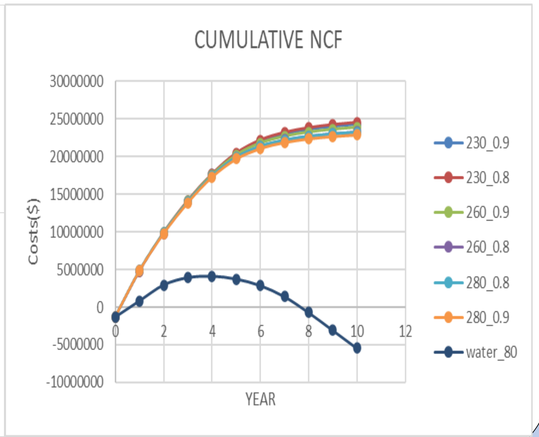
- More oil company has started considering to apply renewable sources to replace burning natural gases in consideration of increases carbon taxes to $50 per tones in 2022 and it will rising $15 per year until it reaches $170 per ton in 2030
- The costs for plugging each abandoned well will spend around 25,000 CAD in average, while full decommissioning costs an average of 95,000 CAD

Economic Analysis

- The tables below which have shown the oil production, income (BIT) and NPV value in a total of six cases of steam flooding and a case of water flooding







Conclusions

1) The temperature and injection rate will determine the efficiency of oil recovery. To contrast with water flooding, steam flooding is more efficient but greater costs. The best case of scenario for heavy oil recovery is accomplished by steam injection at the temperature of 230 degrees Celsius with steam quality of 0.8
2) A 3D geological model was built with the data from CMG STARS which was applied to estimate and foresee the performance of thermal fluid injection. As results illustrated that the injection rates plays an important role for oil production and it can determine the production rate. .

Acknowledgments

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Mr. Runzhi Li, Graduate Student(Faculty of Petroleum System Engineering)
All faculty members of petroleum system engineering

References