Seasonal thermal Storage in Shallow Aquifers with Low Temperature Resources

Marziyeh Kamali, Zeinab Movahedzadeh, Erik Nickel
Petroleum Technology Research Centre

Summary

A significant portion of total energy requirement in residential settings goes back to supplying domestic heating and hot water which is majorly provided by fossil fuel burning. Relying on the conventional method, in particular utilizing fossil fuels would only contribute to more CO_2 emission, and it is not sustainable at all. In the last decades, renewable energy resources have attempted to secure some of the demanded load of energy. Geothermal energy has got much more interest in both generating electricity and low enthalpy thermal energy. Seasonal thermal storage as one form of geothermal energy can be a beneficial approach in transforming towards efficient renewable resources and fulfilling the higher energy demand in populated urban areas. Aquifer thermal energy storage (ATES) operates in the way that waste energy is injected and stored into the aquifer to charge the reservoir especially during the high energy supply period (summertime) and then energy is extracted from the reservoir during the demand or cold seasons. This supply energy can absorb solar energy into the circulating underground water in the open loop system produced from a shallow aquifer or it can be the excess heat from deep geothermal production.

Theory / Method / Workflow

A well-known aquifer in WCSB is the Mannville Aquifer, located at a shallower depth around 850 m in the Regina area, Saskatchewan. The Mannville Formation consists of interbedded sandstone and shales formation with southwest to northeaster regional flow of groundwater. The Mannville Aquifer is the most permeable aquifer within the Mesozoic group of aquifers.

In this study, we built a numerical model of Mannville formation and inject heated water from solar thermal and excess heat of deep geothermal to the reservoir and charge it for the low demand time. This study focuses on better understanding of the temperature variation of the reservoir during the charge and discharge seasons. Also, we would like to have a deep investigation into the possibility of including solar thermal energy into the open-loop shallow aquifer storage.

Results, Observations, Conclusions

These results are part of our previous study on utilizing shallow aquifers to manage heat production from a deep geothermal reservoir. Instead of producing at the highest flow rate from the deep reservoir, production was proportionally relying on both deep and shallow geothermal during high demand months, and at the time of high energy supply, part of production from deep geothermal reservoir was sent to shallow aquifer to stabilize the storage reservoir temperature.

The reservoir temperature reduction rate is very minimal by incorporating storing of excess heat from deep geothermal. In this way, it was concluded that cumulative produced energy reduces significantly.

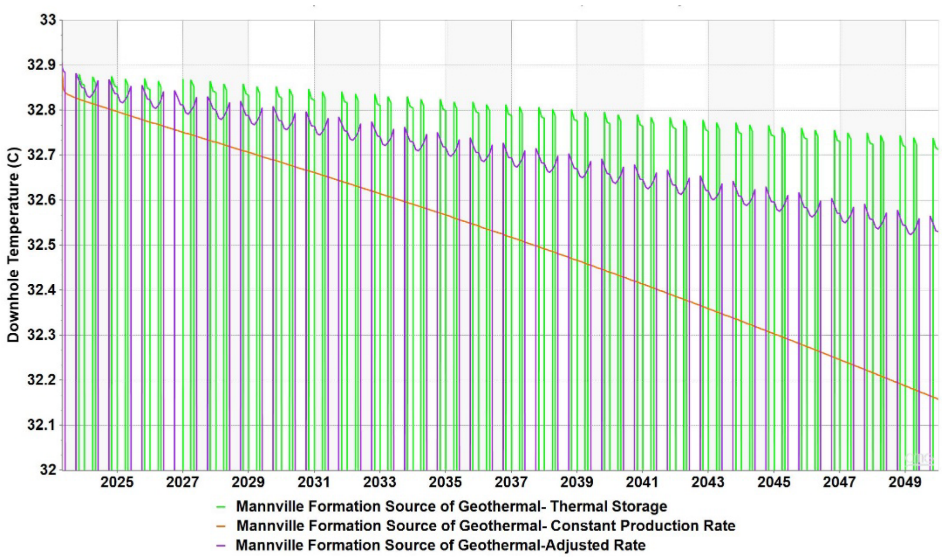

Figure 1. Reservoir temperature for three different conditions of the shallow aquifer production

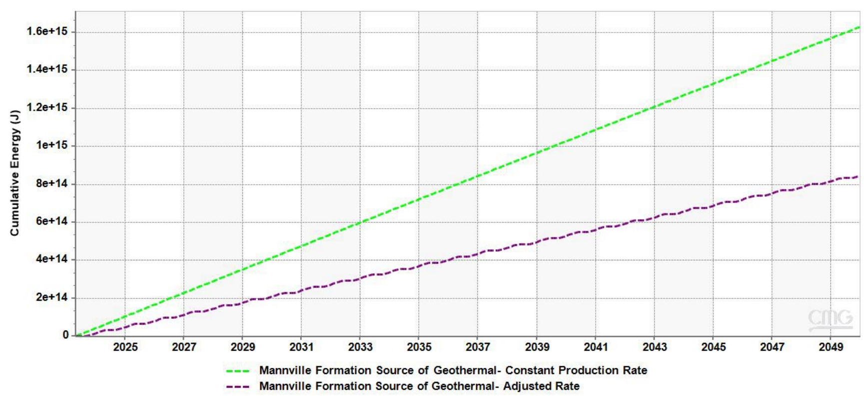

Figure 2. comparison of cumulative energy production between constant production and storing the energy in shallow aquifer

Novel/Additive Information

The study aims to combine two developed technologies which are solar and geothermal to take advantage of renewable energies at the highest.

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