Cascade Utilization of Geothermal Energy Resources

Integrated with Hybrid System

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1. Introduction

Utilization of geothermal resources are mainly justified with their temperature, enthalpy and demand. In this study, comprehensive cascade utilization of geothermal resources was investigated and it was confirmed that it is the most sustainable direct utilization method to achieve the most optimum utilization rate. The study consists of three main sections including district heating and swimming pool design, a descriptive quantitative design for hybrid wind, solar and geothermal system to be compared with the results from simulation by ANSYS. The governing equations for the hybrid system were very similar to those of district heating and swimming pool design, and that was the main reason to have a general overview of whole direct utilization of geothermal energy. Efficiency of hybrid systems are normally low. There are many low temperature geothermal resources with zero contribution to power production, the proposed hybrid system, is a hope to upgrade low enthalpy geothermal resources to high enthalpy resources application. Figure 1, shows the proposed hybrid system, this idea will use the chimney from solar plant, to host a windmill which will rotate with heated air by the pool fed by geothermal water. Wind speed inside the chimney and temperature distribution in the system are two important parameters to be considered.

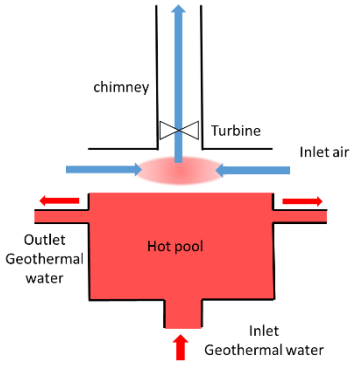

Figure 1. the system of hybrid generation

2. Methodology and results:

For proposed sample project, methods from district heating and swimming pool design were used and equations were applied. Results show that proposed tower can produce 100 kW, 400 kW and 800 kW with tower diameter of 5 m, 10 m and 15 m, respectively. It was confirmed that the key parameter is to create a temperature difference between upper and lower parts of the tower which would lead to wind velocity to rotate the windmill.

A simulation model was developed to perform numerical model using CFD in ANSYS. A gird was developed, and then boundary conditions were assigned. The simulation results are in good agreement with calculations and wind velocity and directions proved that, the developed model is credible. Results are promising and it seems that suggested idea is competitive with other renewable energy sources. Figures 2 and 3, illustrate the temperature and velocity distribution in proposed hybrid system as a result of simulation with ANSYS and they are in good agreement with calculation and will be used as a starting point for future studies.

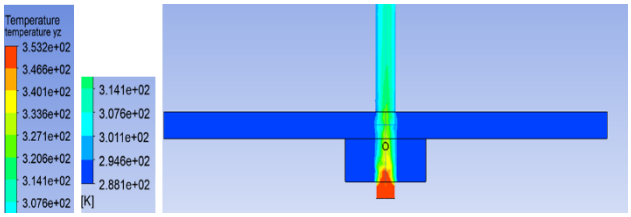

Figure2: Temperature distribution

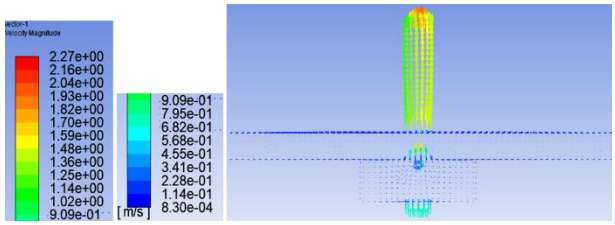

Figure3: Velocity distribution