Ali Fahrettin Kuyuk et al., J Fundam Renewable Energy Appl 2017, 7:5 (Suppl)
DOI: 10.4172/2090-4541-C1-032

Heat transfer analysis of single and multiple geothermal heat extraction boreholes, numerical versus analytical comparison

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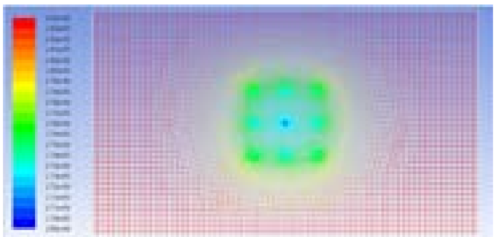
Numerical appreciation of any heat extraction scenario can be reliable yet it may cost escalated computational times due to the complex nature of three-dimensional gridding. Accordingly, simplified one-dimensional analytic solutions of such problems could ease this requirement. In the light of this, heat transfer responses of three discrete installation scenarios of cylindrical heat extraction boreholes are studied analytically and discussed in this present study. Each scenario is modeled in a computer aided environment aiming to validate driven analytic solutions. Contemporary unsteady state, time dependent heat transfer equations are modified and related governing differential equations are introduced to Wolfram's Mathematica. Gathered analytic responses from these scenarios on specified boundary conditions are then contrasted with their corresponding numerical representations, modeled in ANSYS, Fluent. It is shown that, 1-D analytic representation of such cylindrical heat extraction scenarios yield sufficiently approximate results in comparison to their complex numerical equivalents, while understanding time dependent energy extraction rates and source depletion. Consequently, findings of this study demonstrate that similar heat flux results can be obtained with faster computational times in heat transfer modeling of cylindrical heat extraction boreholes.



Biography

Seyed Ali Ghoreishi-Madiseh is an Assistant Professor at Norman B Keevil Mining Engineering Institute of The University of British Columbia, Vancouver, Canada. Prior to joining UBC, he did his PhD and Post-doctoral studies at McGill University. His research includes the study of various mechanical and energy systems with a specific emphasis on mining and petroleum industries. His research team focuses on developing novel solutions for maximizing energy efficiency, improving system performance, preventing waste of energy, and replacing fossil fuels with renewable energies.

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