Asociación Argentina
de Mecánica Computacional

Mecánica Computacional Vol XL, págs. 671-671 (resumen)
F.A. Avid, L.C. Bessone, P. Gamazo, J.J. Penco, M.A. Pucheta, M.A. Storti (Eds.)
Concordia, 6-9 Noviembre 2023

THERMO-HYDRAULIC MODELING OF AN AQUIFER THROUGH ADAPTATION OF A SOLUTE TRANSPORT MODEL

Pedro A. Galione[a], Alfonso Flaquer[a], Armando A. Borrero[b], Julián Ramos[b], Lucas Bessone[a], Federico González Madina[a] and Pablo Gamazo[b]

[a] *Facultad de Ingeniería, Universidad de la República, Uruguay*

[b] *Departamento del Agua, CENUR LN, UdelaR, Uruguay, http://agua.unorte.edu.uy/*

Keywords: HVAC systems, Subsurface heat, Geothermal, Energy storage, Aquifer modeling.

Abstract. In building HVAC (Heating, Ventilation, and Air Conditioning) systems that exchange heat with the subsurface, it is of interest to assess the thermal behavior of the subsurface when heat is injected or extracted. For instance, in the utilization of geothermal heat pumps, the modification of subsurface temperatures over the medium in the long term is evaluated, as it directly impacts the thermal performance of the system as well as its environmental footprint. Similarly, in seasonal energy storage systems, the recoverable energy quantity depends directly on the resulting temperature distribution. This work is part of a research project on seasonal energy storage in aquifers, involving the development of an experimental setup for injecting and extracting hot water, as well as the thermal and fluid-mechanical modeling of the system. In aquifers, heat transport is influenced by conduction/diffusion processes in the porous medium and by advection due to groundwater movement. In this work, water flow is modeled using the MODFLOW code, while heat transport is modeled using MDT3DS. Although the latter code was originally developed for solute transport, the analogy between solute and energy balance equations allows them to be solved using the same algorithm under certain conditions. Given the widespread use of MODFLOW and MDT3DS within the hydrogeological community, their application to heat transport problems is of particular interest. This work begins with a validation of the applicability of these codes by comparing heat transport problems for which analytical solutions are available. Subsequently, the codes are applied to generate a model of an experimental case for which both hydraulic and thermal observations are available.