Analytical solution to a sea-water intrusion problem with a fresh water zone tapering to a triple point

Kacimov A., Obnosov Y., Sherif M., Perret J.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

A new explicit analytical solution is obtained to a steady-state abrupt interface problem concerning sea-water intrusion into a coastal unconfined homogeneous aquifer with a horizontal impermeable bed and uniformly distributed losses along a phreatic surface. Two free surfaces (encroachment tongue and groundwater table) intersect with a horizontal water table of the resting sea water propagated inland. In the hodograph plane the image of the physical domain is a curvilinear triangle. Conformal mappings of the physical domain and of an unknown complex-potential domain onto an auxiliary half-plane are obtained by a modified method of Polubarinova-Kochina, which is mathematically reduced to a vector Riemann boundary-value problem. Free surfaces are reconstructed for different values of losses, densities of the two fluids, sea water and incident groundwater hydraulic heads. Comparisons with the Dupuit-Forcheimer (hydraulic) model are made and practical implications for catchment-scale groundwater management in Oman and UAE are discussed. © Springer 2006.

Keywords

Boundary-value problems, Complex potential, Hodograph, Phreatic surface, Sharp interface