Abdon Atangana, Hydrol Current Res 2012, 3:4
http://dx.doi.org/10.4172/2157-7587.S1.006

OMICS Group Conferences
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International Conference on
Hydrology & Ground Water Expo

September 10-12, 2012 Hilton San Antonio Airport, USA

Groundwater flow model described by prolate spheroid coordinates and new analytical solution for flow model in a confined aquifer under theis conditions

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In this paper, we described groundwater model with prolate spheroid coordinates. We introduced new parameter namely τ the shape factor to the groundwater flow equation. We first supposed that the shape factor tend to zero, under this assumption the new version of groundwater flow equation collapsed to the standard version. We proposed an analytical solution to the standard version of groundwater as function of time, space and uncertainty factor α. This analytical solution was compared to the existing solutions including, Theis and Cooper Jacob solution using several set of experimental data, one hand we used experimental data from the pumping test performed by the Institute for Groundwater Studies on one of their borehole settled on the campus test site of the University of the Free State. The test consisted of the pumping of the borehole at the constant discharge rate =4.5 and monitoring the piezometric head at 32.0395062895 m for 60.5 minutes. One the other hand we used the experimental data from a pumping test conducted in the polder 'Oude Korendijk', south of Rotterdam, the Netherlands. For this last set, the well screen was installed over the whole thickness of the aquifer, and piezometers were placed at distances of 30, 90, and 2 15 m from the well, and at different depths. The well was pumped at a constant discharge of 9.12 I/s for nearly 14 hours. The proposed solution shows a good agreement with experimental data than Theis and Cooper Jacob solutions. We presented a good approximation to exponential integral. We obtained an asymptotic solution to the new groundwater flow equation by mean of Adomian Decomposition and Variational Iteration methods.

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