International Journal of Agricultural Engineering, Vol. 2 No. 2 (October 2009 to March 2010) : 285-288

Research Paper :

Determination of aquifer properties for a confined aquifer with graphical analysis in MS-Excel

A.B. DESHPANDE, B. ANJANEYULU AND **M.G. SHINDE**

Accepted : *August, 2009*

See end of the article for authors' affiliations

Correspondence to:
M.G. SHINDE
Department of Irrigation and Drainage Engineering, Mahatma Phule Krishi Vidyapeeth, Rahuri, AHMEDNAGAR (M.S.) INDIA

ABSTRACT

Hydraulic properties of a confined aquifer was determined with two methods *viz.* Jacob's method with manual graphical analysis and Theis method with interactive Theis 'type curve' in MS Excel environment. The graphical analysis in Excel was found much more convenient over the manual graphical analysis. The transmissivity and the storage coefficient for the confined aquifer were found to be 1019.80 m^2/day and 5.62 x 10^{-4}, respectively with the interactive Theis 'type curve' in MS Excel environment.

Key words : Confined aquifer, Transmissivity, Storage coefficient, MS-Excel

Proper management of groundwater resources requires an accurate evaluation of the parameters (hydraulic properties) that control the movement and storage of water. These properties are required in most groundwater supply and contaminant transport investigations. Aquifer tests are performed by pumping a well at a constant rate and observing the resulting changes in hydraulic head in the aquifer to determine the aquifer hydraulic properties. The pumping test data are studied by graphical type curve analysis, in which dimensionless 'type curves' derived from an assumed analytical model of groundwater flow to a pumped well are used to analyse time-drawdown measurements of hydraulic head in observation wells and piezometers. These analysis are done to estimate the transmissivity and storativity of confined aquifers or the hydraulic conductivity and specific yield of unconfined aquifers. Many of these aquifer test analysis methods were developed in an era when computers were not widely available and graphical matching was the only way to fit type curves to drawdown data. Although graphical matching works very well for simple aquifer models (such as Theis solution), when the number of parameters exceed 3 or 4, graphical matching becomes complicated and time consuming. This limitation is readily overcome today by using computers to analyse aquifer tests. Here an attempt has been made to find the aquifer properties for a confined aquifer with Modified Jacob method (manually) and Theis method (with interactive Excel environment). Use of the Microsoft Excel's utilities has been made to prepare an interactive 'type curve' and 'observed data curve' and to find the aquifer properties with much ease.

One of the popular methods for transient radial flow from a well tapping a confined aquifer as proposed by Theis (1935) is used in the present investigation. For a well pumping out water at a constant rate with the boundary conditions such that (h=H) for (t=0) and (h→H) at (r→∞) for (t ≥ 0) the expression appears as Theis solution.

$$s = H - h = \frac{Q}{4\pi T}\int_u^{\infty}\frac{e^{-u}}{u}du = \frac{Q}{4\pi T}W(u) \qquad (1)$$

W(u) is an exponential integral known as well function [M^0 L^0 T^0] and

$$u = r^2S/4Tt \quad [M^0\ L^0\ T^0\ ] \qquad (2)$$

where

s= drawdown [L]

H = head above the impermeable basal boundary at distance R from pumping well [L]

h = head above the impermeable basal boundary in the observation well [L]

Q = pumping rate [L^3 T^{-1}]

T = aquifer transmissivity [L^2 T^{-1}]

R = distance from pumping well at which H is measured [L]

r = distance of the observation well from the pumping well [L]

S = aquifer storativity [L^3 / L^3]

t = Time [T]

For determination of aquifer properties by Theis method a 'type curve' of Theis well function needs to be