

Abnormal drawdown behavior in pumping tests with exponentially decayed rates of abstraction in confined aquifers

*Zhang Wen¹, Hongbin Zhan, Quanrong Wang, Yiqun Gan

1. China University of Geosciences, Wuhan

Actual field pumping tests often involve variable pumping rates which cannot be handled by the classical constant-rate or constant-head test models, and often require a convolution process to interpret the test data. In this study, we proposed a semi-analytical model considering an exponentially decreasing pumping rate started at a certain (higher) rate and eventually stabilized at a certain (lower) rate for cases with or without wellbore storage. A striking new feature of the pumping test with an exponentially decayed rate is that the drawdowns will decrease over a certain period of time during intermediate pumping stage, which has never been seen before in constant-rate or constant-head pumping tests. It was found that the drawdown-time curve associated with an exponentially decayed pumping rate function is bounded by two asymptotic curves of the constant-rate tests with rates equaling to the starting and stabilizing rates, respectively. The wellbore storage must be considered for a pumping test without an observation well (single-well test). Based on such characteristics of the time-drawdown curve, we developed a new method to estimate the aquifer parameters by using the genetic algorithm.

Keywords: Analytical solutions, Variable rate, Pumping test, Laplace transform