Pump Test Analysis: Application of Petroleum Industry Techniques as a Diagnostic Tool

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ABSTRACT

Aquifer stressing through pumping tests is a commonly used method to assess well behaviour and obtain aquifer parameters. Often poor conceptual understanding and the complexity associated with aquifers, makes the use of classical analysis techniques elusive for the interpretation of hydraulic tests. Also the presence of various type flow boundaries is often not noticeable in a simple drawdown versus time graph. Derivative analysis is a well-established tool in the petroleum industry. The introduction of derivative analysis to pumping test data has allowed the development of complex interpretation models accounting for geological features and aquifer heterogeneity (finite, infinite, homogeneous, dual porosity, dual permeability, skin and fractures, bore storage, etc.). Diagnostic plots have revolutionised well test analysis and have been evolved to a very powerful tool for aquifer characterisation. A diagnostic plot is a scatter plot of drawdown and its logarithmic derivative plotted against time. The logarithmic derivatives are more sensitive to slight variations in drawdown behaviour and can reveal characteristic behaviour of the aquifer depending on the hydraulic constraints. Few case studies are presented which demonstrate the use of derivatives analysis to identify hydrogeological conceptualisation and aquifer test fit for purpose in different hydrogeological systems. The study of drawdown derivative is therefore considered a fundamental first step in a pumping test analysis. Consequently it is possible to identify heterogeneity in diagnostic plots, a considerable advantage compared with the conventional analysis, in which boundaries are often not seen or difficultly inferred. This enhances the hydrogeological conceptualisation and assists to the selection of the appropriate solution for the calculation of realistic hydraulic parameters. It has a significant impact on the ability to certify aquifers with true rather than plausible aquifer characterisation. Furthermore, this method converges to a unified and systematic approach for aquifer test interpretation.