Kremford Sinusoidal Slug Test Kit

This set of practical field equipment has been developed by Kremford Pty Ltd in a collaborative project with Flinders University and Australian scientific organisations. It uses groundbreaking research and know-how in sinusoidal slug testing to perform aquifer characterisation tests to determine the hydraulic properties of confined, unconfined, leaky, and fractured rock aquifers.

The equipment includes an electronically controlled winch, slugs, tripod and cables, along with all test monitoring and control equipment in a single integrated system. Slug tests performed using this new system can require considerably less time than traditional slug tests while providing greatly improved estimates of aquifer storage. Tests using the new system are considerably shorter than traditional pumping tests, and consequently incur lower costs. The system can be used to identify and characterise subsurface hydraulic barriers, such as faults or dykes, and can be used to characterise hydraulic connectivity between aquifers and surface water features.

The system allows measuring aquifer pressure responses in the production well and two observation wells simultaneously. The observations are made, displayed, and recorded in real time, allowing the technician to adjust the test parameters while testing is underway.

Periodic oscillations of a solid cylindrical slug in a production well create water level fluctuations as a series of sinusoidal waves that propagate to nearby observation wells. Pressure sensors in all wells during testing provide time-based measurements over a wireless network at user-specified sample intervals and are automatically recorded by the test equipment. Calibrated and auto-scaled graphics update at every sample to display the sensor readings along with the current slug position in a visual indication of how the test is proceeding. The recorded pressure head fluctuations from all wells serve as inputs to aquifer test analysis software. Because the results to date can be copied to the user's computer at any time, an analysis can present results in near real-time. Typical results include estimates of aquifer transmissivity, storativity, and other important hydraulic properties. Together these provide an accurate and current picture of the aquifer's hydraulic characteristics.

The operator chooses the sine wave parameters based on their knowledge of the water table position and aquifer type at that location. Up to three different sine waves can be combined with the frequencies, amplitudes, and phases chosen to suit prior knowledge of the test site and its geological characteristics.

During a slug test, the cyclic immersion of the slug in the production well changes the volume of water displaced, and the corresponding pressure change is recorded by the production well sensor. The sensors in the nearby observation wells record how far and how quickly this pressure change propagates.

The specific data recorded for each sample interval is in the form of a CSV table and includes the elapsed time, current slug position, and the corresponding pressures and temperatures recorded in each well. Any standard pressure unit can be used such as PSIG, PSIA, cmH_2O, etc. The metadata describing the test parameters, well physical characteristics, and other geo- and hydro-logical data are also recorded.

There are many standard and well-known algorithms currently in use for combining this well data with other environmental parameters to arrive at a test result including storage, flow, porosity, etc. In addition, there is considerable scientific interest in the higher fidelity results produced by sine wave excitation that is driving a wealth of new research and how it can be used.