

Why using the Limax Sinusoidal Slug Tester is Critical for Accurately Measuring Aquifer Hydraulic Conductivity, Storativity and Transmissivity.

The science of Hydrology uses several standard parameters when characterising aquifers. Hydraulic conductivity (K) measures how quickly water flows through an aquifer, storativity (S) measures how much water an aquifer can store, and transmissivity (T) is a measure of an aquifer's ability to transmit water.

The Limax Sinusoidal slug test is not a traditional slug test. Traditional slug tests for measuring K, S and T, often using ad hoc or temporary equipment, do not give practitioners full confidence in the validity of the data. However, multi-well sinusoidal testing using the Limax Sinusoidal Slug Tester coupled with the more recent analytical methods provided in the included professional analysis software can reliably give a robust account of an aquifer's characteristics.

Estimating hydraulic conductivity (K) in aquifers is important because it helps with a variety of applications, including:

- **Groundwater resource management:** used in groundwater resource management plans along with storage capacity.
- **Modelling:** Hydrologists use K values in modelling.
- **Soil health:** Researchers use K to determine soil health.
- **Irrigation rates:** Agricultural decisions use K to determine irrigation rates.
- **Erosion and nutrient leaching:** Agricultural decisions use K to predict erosion or nutrient leaching.
- **Contaminant transport:** Recent work has focused on measuring spatial variations in K to understand how contaminants are transported.
- **Remediation systems:** Recent work has focused on measuring spatial variations in K to understand how effective remediation systems are.
- **Changes in dynamics and aquifer interconnectivity:** Coal seam gas extraction may increase the risk of interconnectivity between groundwater aquifers. This can reduce the quantity and quality of water in aquifers. Changing interconnectivity between aquifers can also affect surface water resources.

Conductivity K, also known as permeability, is a measure of how easily water flows through soil and sediments. It is a function of the soil's texture, grain size, density, and macrostructure. Porous materials with high K transmit water easily, while those with low K transmit poorly.

Robustly estimating storativity (S) in aquifers is important because it helps to characterize an aquifer's ability to release groundwater, which is essential for water resource management. Storage-related aquifer properties (or storage parameters) are porosity, effective porosity, specific retention, specific yield, storage coefficient, and specific storage.

- **Water resource management:** Storativity is used in water resource management to assess the variability of aquifer water storage.
- **Reservoir rock characteristics:** Storativity can be used to evaluate the characteristics of reservoir rock.
- **Petroleum fluids:** Storativity can indicate the storage and flow potential of petroleum fluids.
- **Hydraulic diffusivity:** Storativity can be used to calculate hydraulic diffusivity, which measures how quickly a pressure pulse moves through an aquifer.

Storativity is a dimensionless quantity that represents the volume of water released from storage per unit decline in hydraulic head, per unit area of the aquifer. It ranges between zero and the aquifer's effective porosity.

Sinusoidal slug tests measure Transmissivity (T) in aquifers by regularly and repeatedly changing the water pressure in a driving well and measuring the resulting time-delayed water pressure response in observation wells.

Hydraulic Conductivity (K) has units with dimensions of length per time (m/s, ft/day).

Storativity (S) is a measure of an aquifer's ability to transmit water with dimensions expressed in length squared per time.

The Limax Sinusoidal Slug Tester Operation

Change the water pressure in the driving well: the Limax Sinusoidal Slug Tester raises and lowers a known volume in the drive well following a sinusoidal pattern consisting of one or more frequencies. When multiple frequencies are used, they can be harmonically or arbitrarily related and can have user defined relative amplitudes and phases.

Measure the water pressure response in all wells: The consequent water pressure change is measured both in the driving well and adjacent observation wells using highly sensitive pressure sensors.

Record the Results: The Limax Sinusoidal Slug Tester both displays these pressure change results graphically and dynamically on an operator's laptop and also records the results for replay at some later time. The operator can download the results so far at any point during the test, allowing a quick and in-detail analysis of how the test is proceeding.

Analyse the data: Time wasted due to incorrect or inadequate test setup or parameters can be quickly eliminated as the downloaded pressure data can be plotted and analysed in real time using either the professional software supplied with the Limax package or the operator's own software.

Limax slug tests offer a simple technique for estimating aquifer properties. The results can be used to indicate well performance and are particularly useful at groundwater contamination sites.

Please see www.kremford.com.au for further information.