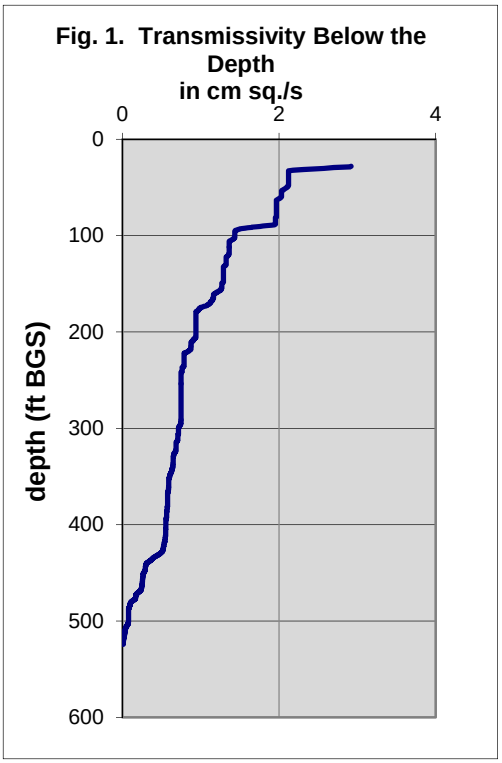
Head Profiles Using a Liner

A very new method, just being field tested, uses the continuous profile of the transmissivity (Fig. 1) and the stepwise removal of a liner after that profile is completed to obtain the formation head distribution. This technique is also best performed with a recording transducer in the bottom of the borehole. The method involves the inversion of the blank liner uncovering discrete borehole intervals with the measurement of the steady state borehole equilibrium pressure, Bh_i, after each interval is uncovered. By using each new "blended head" beneath the liner, writing the flow equations for each increment that has been uncovered, defining the net flow into and out of the hole to be zero, and using the transmissivity, T_i, measured for each increment in the hole, one has only the formation head as an unknown for each newly exposed interval of the hole. For the first open borehole interval beneath the liner:



$$T_1(Bh_1-FH_1) = 0,$$

Hence the formation head, FH_1, equals the blended head, Bh_1, in the borehole. The transmissivity for each interval, T_i, is obtained from the continuous transmissivity integral (Fig. 1). Upon inverting the liner to uncover a second increment of the borehole:

$$T_1(Bh_2-FH_1) + T_2(Bh_2-FH_2) = 0,$$

Solving for FH_2,

$$FH_2= [\ T_1(Bh_2-FH_1)+ T_2\ Bh_2\ ]/T_2$$

Note that for each new position, a new blended head, Bh_i, is measured.

Solving for the formation head each time the liner is inverted allows theoretical determination of the head distribution in the formation while removing the same liner that was used to measure the transmissivity and to seal the borehole. The equation for solution of the formation head of the current interval, i, is:

$$FH_i = [\ T_1(Bh_i-FH_1) + T_2(Bh_i-FH_2) + \ldots\ldots +T_i\ Bh_i\ ]/T_i$$

Where T_i is the transmissivity of the i^{th} interval in the hole determined from the liner continuous transmissivity profile, FH_i is the calculated formation head of the i^{th} interval, and Bh_i is the blended head measured in the borehole after each new i^{th} interval is uncovered. Watching the transducer measurement beneath the liner allows one to judge when a steady-state head has been achieved beneath the liner.

Patent pending on this method