INTERPRETATION OF A STEP-DRAWDOWN TEST TO PLAN FOR A CONSTANT RATE PUMP TEST IN ST-PETERSBURG

Client: Municipal government of St-Petersburg, Russia (Vodokanal)

Objective: Determine well efficiency and optimal pumping rate for a constant rate pump test

Solution: Interpretation of step-drawdown tests in ANSDIMAT+

To optimise water production from the well field in the St-Petersburg region, the production wells were tested by constant-rate pump tests for a duration of 9 days.

Step-drawdown tests were routinely conducted prior to each constant-rate aquifer test to determine well efficiency and choose the optimal pumping rate for a longer test.

The optimal pumping rate needs to be sufficiently high in order to induce noticeable drawdown. However, when the discharge rate becomes too high, the flow in a well becomes turbulent and borehole effects start to affect significantly measured drawdowns. This induces a noticeable decrease in the pumping well efficiency and, for reliable interpretation of test results, this situation must be avoided.

Well efficiency is commonly decreasing as pumping rates increase and its minimum recommended value for constant-rate pump tests is 70%.

The current step-drawdown test was conducted in one of the production boreholes at St-Petersburg. It was comprised of 4 pumping steps of 30 minutes each. The pumping rate was gradually increased from 30 to 161 m^3/day (Fig.1). The final drawdown at the end of the 4-th step was 16 m. Drawdown measurements during the tests are presented on Fig.2.

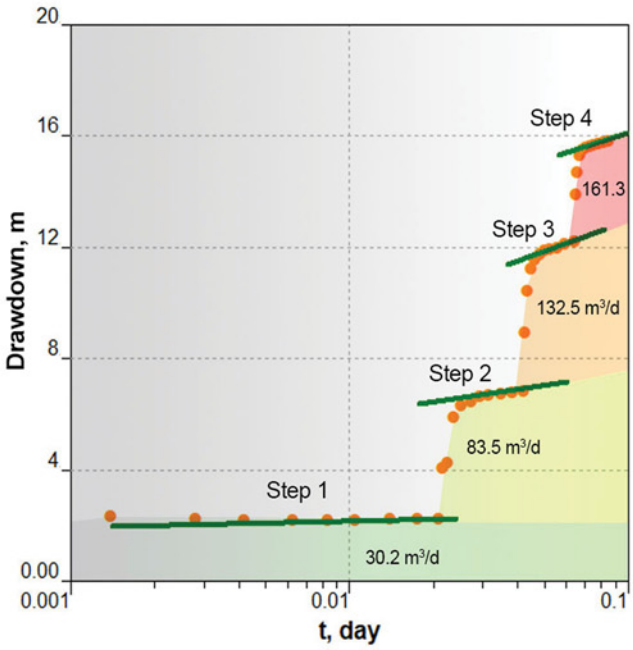

Fig. 1. Time-drawdown plot of field data from a step-drawdown test.

Interpretation of the step-drawdown test with ANSDIMAT was conducted in two stages. During the first stage, the program automatically determined a number of steps and approximated the variation of drawdown vs time at each step by straight lines – Fig.1. Location of straight lines can be manually amended, if required. During the second stage (Fig.2), ANSDIMAT calculated aquifer/well losses and determined well efficiency for pumping rates at all steps.

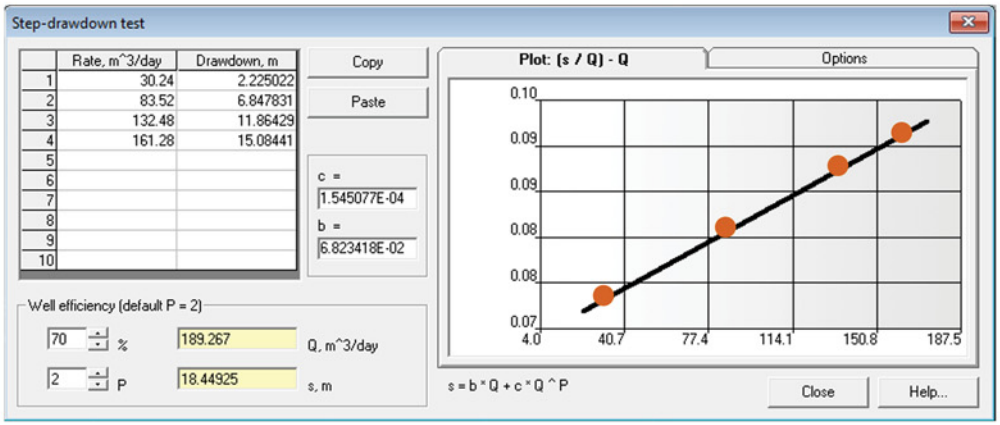

Fig. 2. Dialog window for step-drawdown test. Diagnostic plot of s/Q versus Q and calculated well efficiency.

The case study interpretation results are presented on Fig.2 that shows relatively low well losses (1.55E-4 day^2/m^5), indicating good hydraulic connection between the aquifer and the borehole space. The Table and Fig.3 below present well efficiency values for different pumping rates and suggests that the rate of 100 ^{3}/day is recommended for a constant-rate pump test.

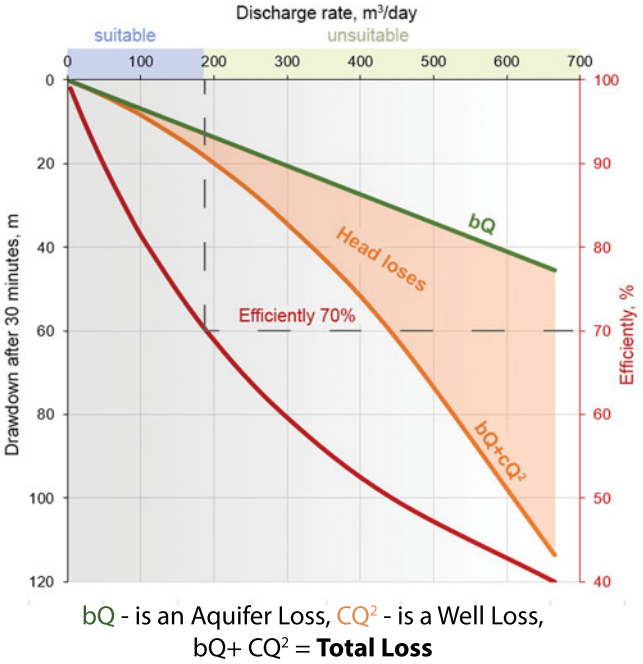

Fig. 3. Specific capacity diagram

Table. Calculated well efficiency for production wells and recommended yields for constant rate pumping tests

	unsuitable		suitable			
Well efficiency, %	50	60	70	80	90	95
Discharge, m^3/day	441	294	189	110	49	23