Field and Laboratory Comparison of an Innovative Velocity Tool with Other Methods for Velocity Measurement in Aquifers

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Background/Objectives. French regulations on polluted sites require the study and treatment of pollution including both the technical and economical aspects. Efficiency of this treatment depends on the localization of source zones, which are the most important discharge of pollutant. Indeed, several studies showed that 90% of the pollution discharge is located on only 10 or 15% of the total surface of the site. It is therefore important to have efficient method to measure the direction and magnitude of the contaminant fluxes. Passive flux meters are presently the major tools to measure flux magnitude, and have been tested at several sites. However, this tool requires the apparatus to remain in the well during 2 or 3 weeks. Other solution could be developed with a combination of water velocity measurement and contaminant concentration.

Approach/Activities. The innovative tool allows measuring the magnitude and direction of groundwater velocity in the well rapidly by a dilution test. This tool is based on a thin but long window that limits the entering of the groundwater to only a single place in a well, its surroundings being sealed. Then the velocity is measured in a small tube that is the only output of the groundwater entering the window. This allows for measuring the velocity in some tens of minutes. The measuring window is isolated with packers (30 cm) so it is possible to have a vertical distribution of velocity on the screen length. By varying the angle of the window, it is possible to identify the major direction of the groundwater movement, but well screens do not span the whole perimeter of the well which introduces a certain degree of error. Several tests of both were done in the laboratory and in the field.

Results/Lessons Learned. The innovative velocity tool measurement takes only a few minutes for each measurement. This tool has been tested in the laboratory in a sand tank, showing a linear response to changes in velocity in the range of 5 to 60 cm/d for the pore velocity. It is thus relevant technique for slow velocities for which few tools are available.

For validation purpose, the tool has also be compared to tracer test and PFM measurements during a controlled low flow pumping test at the meter scale in a well characterized aquifer. The tool has also been tested in the field, and particularly at a site with very high variations in the velocities. The measurements were compared to Passive Flux Meter and Tracer test. The comparison shows results with the same order of magnitude and improves the reliability of the innovative tool measurement of water velocity.

The innovative velocity tool can be combined with a targeted sampler. The targeted sampler measures contaminant concentrations in a selected interval. The combination of the innovative velocity tool and the targeted sampler allow the measurement of contaminant fluxes in aquifer and could be an innovative solution for source characterization in a polluted site within a short period of time.