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Borehole testing methods using a new temporary polyacrylamide packers technology

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Range of options for investigation of hydraulic behavior of aquifers from boreholes has been limited to rigid, cumbersome packers, and inflatable sleeves. Here we propose a new temporary polyacrylamide packers (TAMP) technology that uses soft grains of polyacrylamide gel as a borehole sealing material and discuss its possible applications. Polyacrylamide gel, also called hydrogel or water-absorbing polymer, consists of long chains of molecules that can absorb over a hundred times their weight in liquids. Soft gel grains are mainly made of water, but the water inside these particles does not contribute to the flow of the suspension. The gel packing (permeability similar to open gravel) placed to a well suppresses free convection, allowing for local temperature and chemical sampling through free-flowing gel. Minimizing the effect of free convection within the well column would be beneficial for active thermal tests where free convection often dominate flow and create thermal disequilibrium between the water in the borehole and the surrounding media. Preliminary laboratory experiments and the literature suggests that as the polyacrylamide pack is subject to modest compressive stress to the gel media (of order 0.1 ATM), the permeability transitions from of the order of 10 to 7 millidarcys to 0.01 millidarcys, illustrating the remarkable ability to transition from highly permeable to nearly impermeable grouting. Though yet to be confirmed in the field, by locally injecting water at pressure greater than the compressive stress, local voids can be formed which can act as local pump test sources, with all other locations in the borehole hydraulically isolated where local response pressure from the formation can be measured. This arrangement could be valuable for tomographic study of aquifers wherein hundreds of injection zones could be tested by simply pulling an injection pipe vertically through the packed borehole. The gel grains can be of the scale of cm, so do not pass through well-screens or enter fractures of mm scale. When compressive stress is relieved, the PAM media is easily pumped out of a well with standard equipment.