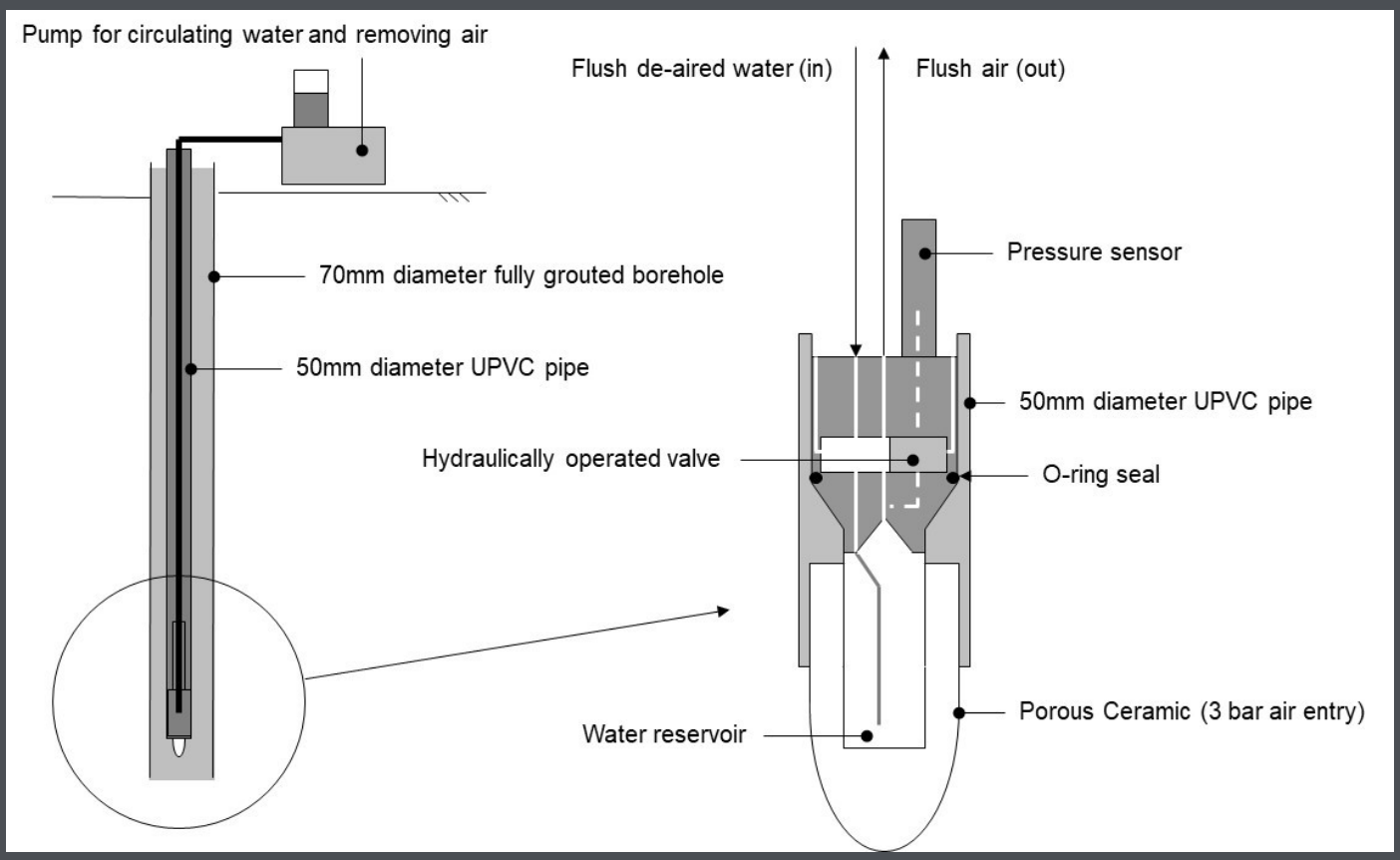
Can a vibrating wire piezometer measure negative pore water pressure? It's a simple question…or is it?

A piezometer consists of three essential components, a pressure sensor, a fluid (normally water) filled reservoir and a porous filter to allow the water in the reservoir (which is where the pressure will be measured) to make contact with the water in the ground. When a piezometer is placed in the ground, inside a borehole for example, it is necessary for the porous filter to make contact with the ground, either directly or with the aid of a backfill material placed between the porous filter and the ground. For a piezometer to measure pore pressures accurately, all parts of the piezometer including the backfill material, the porous filter and the fluid reservoir, need to be saturated and the water in the piezometer always needs to be in contact with the water in the soil. When negative pore water pressures are present in the ground the water inside the piezometer (i.e. in the reservoir, the porous filter and the backfill material) will be in tension and there is a tendency for air to form. When air is present in the reservoir, the porous filter or the backfill material, the volume of air will increase or decrease in response to changes in the pore water pressure in the ground and the measurement recorded by the piezometer will not necessarily be an accurate reflection of the pore water pressure in the ground.

Sand is not suitable for use as a backfill material when negative pore water pressures are being measured because it desaturates when very low values of negative pore water pressure are encountered and continuity is therefore lost between the water in the piezometer and the water in the soil. High air entry porous filters are designed to remain saturated when there are negative pore water pressures but if they are fitted to a normal vibrating wire piezometer, which is then placed in a borehole and the filter is surrounded by sand, it is the sand that will desaturate first. Cement grout mixed with a water/cement ratio between 0.5 and 1.5 will remain saturated to -200 kPa. So replacing sand with cement grout is an option. There is however evidence that using high air entry porous filters with the fully grouted method causes air to form inside the fluid reservoir, possibly because as a grout sets it exerts a tension to the porous filter and the reservoir. This air is trapped inside the piezometer and a normal vibrating wire piezometer doesn't have a way of removing the air and restoring the saturation. Therefore, normal vibrating wire piezometers should not be used with the fully grouted method if they are fitted with a high air entry porous filter because if air forms inside the piezometer it cannot be

removed. If you are placing a normal vibrating wire piezometer into a fully grouted borehole you should always insist that it is fitted with a low air entry filter so that air can escape.



GeO flushable piezometers (pictured) are fitted with high air entry porous filters, allow air inside the piezometer to be removed and now they are fitted with vibrating wire sensors. The answer to the question is therefore yes, vibrating wire piezometers can be used to measure negative pore water pressures, providing they are those used in GeO flushable piezometers.

For more information about piezometers including GeO flushable piezometers visit our website at www.geo-observations.com.

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