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Miniature Fiber-Optic MOMS Piezometer

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Piezometers are widely used to measure pore-water or other fluid pressures in civil and geotechnical engineering. Currently available piezometers are based on different sensing technologies, including vibrating wire, fiber-optic Fabry-Perot, pneumatic and water level (standpipe). The mostly widely used models have a diameter of 19 mm or higher and a length of 150 mm or more, which sometimes limits their applicability. In some applications it would be advantageous to install piezometers in smaller diameter pipes, integrate them in geotextiles or combine several piezometers in a string without increasing the overall diameter of the installation borehole.

The present piezometer design is based on non-contact deflection measurement of a miniature MOMS (Micro Optical Mechanical System) pressure sensor fabricated using photolithographic techniques. The pressure transducer has a flexible diaphragm assembled on top of a sealed vacuum cavity and the pressure measurement is based on Fabry-Perot white-light interferometry. Pressure creates a variation in the length of a Fabry-Perot cavity consisting of the inner surface of the flexible diaphragm on one side and a reference optical surface attached to a lead optical fiber on the other. Since fiber-optic readout units and dataloggers can consistently and accurately measure the cavity length under all conditions of temperature, EMI, humidity and vibration, the system delivers reliable pressure measurements in the most adverse conditions [1-3]. The mechanical robustness is assured by the stainless protection sleeve and a porous filter which protects the sensing element from solid particles, allowing this model to sense only the fluid pressure to be measured. The total diameter of the sensor, including the housing is only 5 mm and its total length is only 54 mm for, which makes it the smallest piezometer for geotechnical applications currently available. The paper presents the sensor design and its laboratory testing.

Ключевые слова:

Содержание.

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