LOW-FREQUENCY ATTENUATION MEASUREMENTS OF FLUIDS

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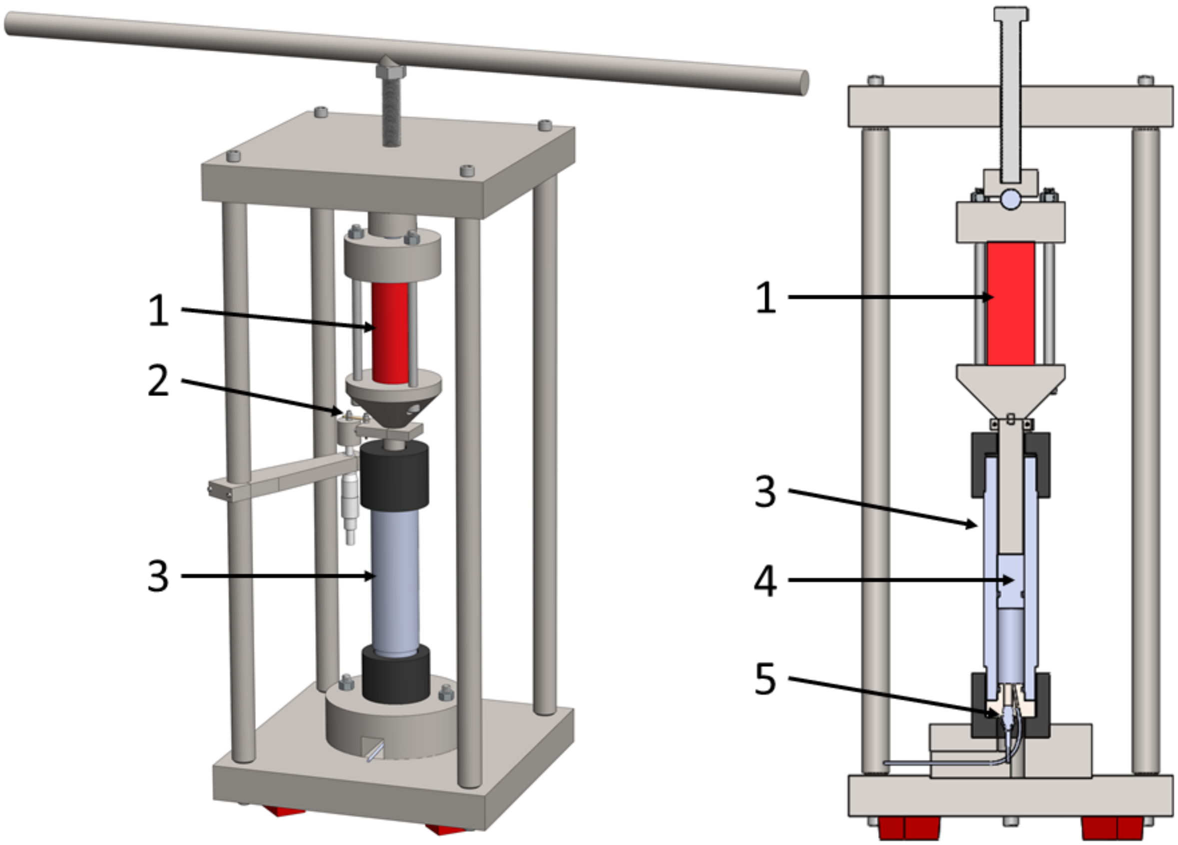
ABSTRACT

Pore fluids significantly affect the elastic responses of rocks. Rock-physics models can be used to predict how pore fluids affect the elastic responses of rocks when rocks are fully or partially saturated. Thus, to identify fluids in the subsurface, knowing the elastic properties of such fluids is useful. In addition, new technologies to assess and monitor hydrocarbon exploration rely on the precise determination of fracking fluid physical properties. Moreover, the elastic properties of rocks depend on the frequency of the wave propagating through the rock. Methodologies to measure high-frequency elastic properties of fluids have been widely reported. What have not been established are methodologies to measure the low-frequency elastic properties of fluids in a laboratory setting. Using the low-frequency properties, rather than the already known high-frequency properties of pore fluids, will provide more accurate values when calculating the low-frequency elastic properties of rocks saturated with pore fluids from rock physics models.

A machine has been designed and built to measure the low-frequency attenuation and bulk modulus of fluids at frequencies from 0.1 to 10 Hz. Deionized water and aqueous guar gum solutions have been tested. Results for measurements of attenuation and bulk modulus of water are in agreeance with reported values for water. Measurements of guar gum solutions show attenuation is greater than 0.01 with higher concentration samples having higher attenuation. The machine used for these experiments is most reliable at frequencies less than 5 Hz.



Schematic and section view of the machine used to measure the low-frequency attenuation of fluids. The major components are labeled. The fluid sits inside the pressure vessel (#3) and is brought up to the desired pressure using a fluid pump. A voltage will be applied to the piezoelectric motor (#1) which will cause the motor to expand which will then move the piston (#4) downward and compress the fluid. A pressure sensor (#5) will measure the pressure of the fluid during the experiment and a displacement sensor (#2) will be attached to the piston to measure the shortening of the fluid. Attenuation is then calculated from the phase delay between the applied pressure and resulting strain of the fluid.