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Inertial solution for high-pressure-difference pulse decay measurement through microporous media

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We present a theoretical asymptotic solution for high-speed transient flow through micro-porous media in this work by considering the inertia effect in the high-pressure-difference pulse decay process. It includes all three gas related effects, that are the inertia effect, the slippage effect, and the compressibility effect. Capillary model, in which a bundle of straight circular tubes whose radius is much smaller than length is used to represent the internal structure, is adopted and the flow is described by the unsteady-state incompressible Navier-Stokes equation with mean density in two-dimensional case, capturing the main characteristic of mass flow rate. By order of magnitude analysis and asymptotic perturbation, our inertial solution along with its dimensionless criterion for high-pressure-difference pulse are derived. The theoretical results are verified using our self-built experimental platform, by comparing the permeabilities calculated by our inertial solution and the benchmark steady-state measurement. Our inertial solution can shorten the measurement time and is expected to be used in measurement of extremely low-permeability samples.

Participation

In-Person

References

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