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# Deviations from Darcy's law studied by non-equilibrium molecular dynamics simulations

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It has been known for a long time that there are cases where Darcy's law does not apply, also for single phase flow with small capillary numbers [1–4]. The flow rate has for some cases been found to be proportional to the pressure gradient raised to the power 1/n where n 6 = 1. For other cases it has been found to be a threshold pressure, below which no flow occurs.

Non-equilibrium molecular dynamics simulation is an excellent tool to study flow in porous media. We have used a modified Lennard-Jones/Spline potential which makes it possible to model a wide range of systems with varying pore sizes, interface tensions and fluid viscosity. The Reflective Particle Method has been used to create a pressure difference across the porous medium [5]. The red particles are fluid and the blue particles are pore particles with a fixed
position.

We present results for single and two-phase flow varying the contect of wetting fluid, porosity, average pore diameter, and interface tensions. The results are interpreted using non-equilibrium thermodynamics for porous materials, a new theory. On this bases we propose various reasons for deviations from Darcy's law.

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**Primary authors:** Mr GALTELAND, Olav (Norwegian University of Science and Technology); Prof. HAFSKJOLD, Bjørn (Norwegian University of Science and Technology); Prof. KJELSTRUP, Signe (Norwegian University of Science and Technology); Prof. BEDEAUX, Dick (Norwegian University of Science and Technology)

**Presenter:** Mr GALTELAND, Olav (Norwegian University of Science and Technology)

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