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FACULDADE DE CIÊNCIAS E TECNOLOGIA
UNIVERSIDADE NOVA DE LISBOA

Department of Chemistry / Chemical Engineering

Flow in Porous Media

LA REQUIMTE

CQFB, FCT-UNL

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2006-2013 IP REQUIMTE
1997-2005 Schlumberger
1995-1997 P-Doc Princeton
1995 PhD Princeton
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Objectives

Investigation of tracer spreading and dispersion in flow through porous media, by low field Nuclear Magnetic Resonance

Fluids can be non-Newtonian or Newtonian, single phase and multi-phase. The porous media may be heterogeneous. The interaction of fluid properties & matrix geometry is relevant to understanding and optimizing:

1. remediation of contaminated soils,
2. improving or developing separation applications in chemical engineering,
3. understanding and optimizing enhanced oil and gas recovery.

Also: (1) Smart fluids, w. DQ-FCT and ISEL. (2) Fluid invasion in civil engineering.

Methodology

A low field permanent magnet NMR system and flow/pumping equipment were acquired with financial support from REQUIMTE, the FCT-UNL, the department of civil engineering (DEC), and project funds from the FCT-MCTES. This equipment was set up in the DEC and modified with customized precision temperature control developed here, and specialized pulse sequences and analysis code were written. The equipment became fully operational in 2012, in use since then.

Three series of experiments were completed in Q1-Q3 2012, measuring the longitudinal and transverse dispersivity of packed beds (1) with Newtonian flow, (2) non-Newtonian flow, and (3) Newtonian flows in packings with controlled heterogeneity. Data analysis and the writing of papers are in progress.

Expected Results

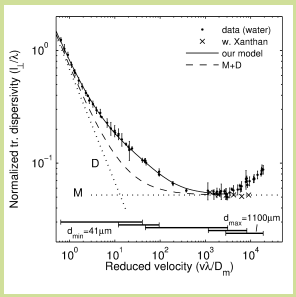
Currently under review:
"*Pore-scale Mixing and Transverse Dispersivity of Randomly Packed Monodisperse Spheres*"

In progress:
Data analysis, papers & additional experiments addressing flow in heterogeneous pore spaces, and non-Newtonian flows.

Planned:
Publications on PFG-NMR and data-analysis methods permitting rigorous determination and analysis of dispersion in artificial and natural porous media

New B=0.9T NMR magnet installed in the DEC, for research with fluids in heterogeneous matrices. Permanent magnet bonus: no cryogen costs.

Flow cell filled with packed glass spheres, which was placed inside the magnet depicted above, to measure dispersivity with flow of water through the packing.



Transverse dispersivity of sphere packings, determined using the new FCT-UNL low field NMR facility. Submitted for publication, under review.

Funding: REQUIMTE, FCT-UNL, PTDC/ENR/65170/2006

Related publications: "Dispersion in Non-ideal packed beds", Scheven UM, AIChE Journal, 56, 289-297 (2010); "Intrinsic dispersivity of randomly packed monodisperse spheres", Scheven UM, Harris R, Johns, ML, Phys. Rev. Lett. 99, 054502, (2007); "Quantitative nuclear magnetic resonance measurements of preasymptotic dispersion in flow through porous media", Scheven UM, Verganelakis D, Harris R, Johns ML, Gladden LF, Physics of Fluids 17, 117107 (2005)