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Imaging particle transport in thin, porous media using high-speed NMR.

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The transport of particles in porous media has received growing attention in the last decades due to environmental concerns in for example the printing industry, the filtration of drinking water and the transport of pollutants in soil. The migration of particles is a complex process which depends on different physicochemical phenomena such as the liquid-particle and particle-media interaction, flow dynamics and the pore morphology. Experimental studies on fast penetration with high resolution are still challenging. In this research, a closer look is taken towards the printing process of water-based inks. One of the most important ingredients which also determine the print quality are latex particles. Therefore, this study aims to follow the transport of latex particles in a variety of water-glycerol mixtures. In this study it is shown that a previous introduced high-speed NMR technique [1] based on the GARField method [2,3] is an ideal tool for studying latex particle penetrations with a temporal resolution of 10 ms and a resolution of 14.5 µm. In order to follow the latex particles within the NMR-setup, magnetic cores are introduced that will modify the signal intensity. The signal intensity is calibrated with respect to the particle concentration, where increasing the particle concentration will decrease the signal intensity. Secondly, penetration experiments with different particle concentrations on porous Nylon membranes with a pore radius of 380 nm were performed. NMR profiles taken at the moment when the fluid reaches the bottom of the membrane are shown in figure 1a. The profiles reveal a splitting of the particle and liquid front which can be seen by the signal increase within the membrane. The positions of the particle front are marked with circles in the same figure. The penetration depth of the particles could also be verified by scanning electron microscopy (SEM) measurement, see figure 1b.
Experiments with varying particle concentrations revealed that increasing the particle concentration will slow down the carrier fluid penetration speed and increase the particle penetration depth. Finally, it will be shown that the method allows to track ink ingredients during capillary uptake by paper sheets.

Participation

In-Person

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