Contribution ID: **89** Type: **Oral Presentation**

Sol-gel transition in porous media by drying

Thursday, 2 June 2022 13:45 (15 minutes)

An important part of our cultural heritage, such as artefacts, statues or historical monuments, is exposed to chemical and physical degradation over time. The degradation can lead to fractures and loss of cohesion among the individual particles forming the porous materials used for their construction. Nowadays, the most promising route for consolidation of such weakened porous materials is the addition of colloidal solutions which undergo a sol-gel transition through evaporation of the solvent [1][2][3][4]. The consolidation treatment should not only restore the mechanical properties of the stone but also not change their physical appearance and other properties such as porosity or permeability. Therefore, an homogeneous distribution of the gel in the porous network of the material is very important. While the kinematics of transport and drying of Newtonian fluids in porous media have been widely studied by both experimental and theoretical approaches [5], the case of non-Newtonian fluids remains largely unexplored. This work focuses on viscoelastic fluids which undergo sol- gel transition upon drying.

Here, we present a multiscale study of the drying kinetics of solutions during the sol-gel transition in different type of porous materials. At the microscale, 2D micromodel porous media are fabricated and used to follow the dynamics of gelation during drying [6]. At the macroscale, the drying kinetics are studied on real stone samples of different porosities and pore size distribution. Highly advanced techniques such as NMR imaging and X-ray microtomography are used (Figure 1). The saturation profiles during drying and the localization of the sol-gel transition zones in the stones are investigated. Different drying regimes compare to Newtonian fluids are identified. Our results show that the duration of these different regimes remains strongly dependent on the intrinsic properties of the stones. Based on our NMR and X-ray micro tomography results, we discuss how a front that separates the liquid region from the gelified region can develop in the porous network and progress from the surface to the inner part of the stones. We show that the porosity, the pore sizes and the evaporative surface are strongly influencing the dispersion of the dry gel in the materials. Environmental factors (relative humidity and temperature) have also a big impact on the mechanisms of the gel formation, which can result in a non-homogenously distribution of consolidant in the treated stone.

We will also discuss the macroscopic mechanical properties such as the Young Modulus and the stress at break of the material before and after treatment. They reveal a significant mechanical strengthening and hence an efficient consolidation of the treated porous media.

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Country

Netherlands

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Time Block Preference

Time Block B (14:00-17:00 CET)

Participation

In person

Primary author: LE DIZÈS, Romane

Co-authors: PEL, Leo (Eindhoven University of Technology); Dr JABBARI FAROUJI, Sara (University of Amsterdam); SHAHIDZADEH, Noushine (University of Amsterdam -Institute of Physics)

Presenter: LE DIZÈS, Romane

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