# Predicting the rheological behavior of hydrating cement systems

*Luiza Miranda[1], Flávio H. Marchesini[2], Karel Lesage[1], Geert De Schutter[1]*

[1]Department of Structural Engineering and Building Materials, Ghent University, Ghent, East Flanders 9000, Belgium
[2]Department of Materials, Textiles and Chemical Engineering, Ghent University, Zwijnaarde, East Flanders 9052, Belgium

The prediction of time-dependent rheological behavior of concrete is a challenging task of crucial importance to many applications in the construction industry. In particular, the advent of 3D printing with concrete highlighted the importance of a more comprehensive understanding of the rheological behavior of cement systems undergoing hydration reactions. In this work, a recently proposed constitutive model [Marchesini et al., J. Rheol. 63(2), 247-262 (2019)] is used to describe the rheological behavior of a cement system employed in 3D printing applications. The model is based on a single structure parameter that describes the instantaneous structuring level of the material's structure, considering both reversible and irreversible effects simultaneously. To validate the model, the flow curve of the fresh cement system is constructed from thixotropic equilibrium data observed before the hydration effects become significant. The parameters of the model are estimated from the flow curve, constant shear rate tests, DSC tests, as well as mechanical tests performed with solid samples obtained after the final equilibrium state is achieved. The predictive capability of the model is improved to better describe the hydration effects on the rheological behavior of concrete. It is shown that an excellent agreement between experiments and model predictions is achieved, which can impact the way 3D printing applications with concrete are designed nowadays.