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Rheological Characterization of Clay pastes for Sustainable Pourable Clay Concrete

The quest for sustainable construction materials has fuelled research into innovative alternatives to traditional cement-based concrete. Cement production contributes around 6 % to 10 % to global CO_2 emissions, propelling the exploration of environmentally friendly alternatives. Considering the annual demand of approximately 4.1 billion tons per year, there is an urgent need for more sustainable alternative. Among these options, clay-based concrete has gained significant attention due to its abundant availability worldwide and potential to minimize environmental impact.

In this context, this study investigates the fresh properties of clay pastes with a variable chemical and mineralogical composition. In particular, rheological measurements were conducted to characterise the fresh behaviour of clay pastes. The use of rheology, particularly small amplitude oscillatory shear (SAOS), serves as a valuable tool in measuring the viscoelasticity of clay pastes “at rest” (i.e., without disrupting the existing microstructure), as well as their cohesion development over time (i.e., reactivity). This approach enables rapid assessment of clay paste performances within the initial hours, supporting the selection of promising formulations to create several clay-matrix that will be reinforced with basalt fibres for the production of low-CO_2 composites (e.g., panels, walls, two-story houses…). Indeed, this study is part of a multidisciplinary project called BasaltClayCrete whose primary objective is the development of a new and especially accessible building material, which will not be a one-to-one substitute to cement-based concrete but tailored for low to moderate performance levels while prioritizing minimal environmental impact.