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Porcelain Paste Processing by Robocasting 3D: Parameters Tuning

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Abstract : Additive manufacturing technologies (AM) experienced a remarkable growth in the latest years due to the development and diffusion of a wide range of three-dimensional (3D) printing techniques. Nowadays we can find techniques available for non-industrial users, like fused filament fabrication, but techniques like 3D printing, polyjet, selective laser sintering and stereolithography are mainly spread in the industry. Robocasting (R3D) shows a great potential due to its ability to shape materials with a wide range of viscosity. Industrial porcelain compositions showing different rheological behaviour can be prepared and used as candidate materials to be processed by R3D. The use of this AM technique in industry is very residual. In this work, a specific porcelain composition with suitable rheological properties will be processed by R3D, and a systematic study of the printing parameters tuning will be shown. The porcelain composition was formulated based on an industrial spray dried porcelain powder. The powder particle size and morphology was analysed. The powders were mixed with water and an organic binder on a ball mill at 200 rpm/min for 24 hours. The batch viscosity was adjusted by the addition of an acid solution and mixed again. The paste density, viscosity, zeta potential, particle size distribution and pH were determined. In a R3D system, different speed and pressure settings were studied to access their impact on the fabrication of porcelain models. These models were dried at 80 °C, during 24 hours and sintered in air at 1350 °C for 2 hours. The stability of the models, its walls and surface quality were studied and their physical properties were accessed. The microstructure and layer adhesion were observed by SEM. The studied processing parameters have a high impact on the models quality. Moreover, they have a high impact on the stacking of the filaments. The adequate tuning of the parameters has a huge influence on the final properties of the porcelain models. This work contributes to a better assimilation of AM technologies in ceramic industry.
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