

## **Effects of Debinding Conditions on Mechanical Properties and Porosity of Ceramic Vat Photopolymerization Prints**

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Thermal debinding of ceramic parts, with a possible pre-conditioning step, can require a week of time. However, it is an essential and carefully controlled processing step that is necessary to prevent part deformation and cracks caused by pressure gradients from evaporating substances. The use of ceramics in e.g., dental applications, which require unique characteristics from ceramic forming, has been challenging due to the difficulty of manufacturing parts with minor deviation in properties. Nowadays, ceramic dental restorations are mostly milled into final shape from ceramic blocks, which is cost effective, but the material waste percentage can be even 95 %. Additive manufacturing (AM) methods, such as vat photopolymerization, have become an alternative to milling providing better user safety, lower waste generation, and increasingly lower price range due to increasing popularity of AM methods. Supercritical carbon dioxide (scCO<sub>2</sub>) extraction was used to study if by extracting some of the slurry substances prior to thermal debinding and creating flow channels for gases to exit the structure, the thermal debinding of ceramic 3D printed parts could be made faster. Samples were postprocessed in differing debinding conditions, varying gas atmosphere, heating rate and dwell times. Samples were characterized before and after postprocessing steps by thermogravimetric analysis, dilatometry, and optical microscopy. Sample mass and dimensions were measured to observe changes in sample density and size. Mechanical properties were studied by 3-point bending and Vickers hardness testing. The effect of scCO<sub>2</sub> pre-debinding and shorter thermal debinding on mechanical properties and sample structure are presented.