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Determination of Optimum Process for Thermal Debinding and Sintering using Taguchi Method

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Debinding involves long and delicate processing periods of removing binder components from a green body after injection moulding; failure to completely remove the binder components results in distortion, cracking, blisters and contamination at elevated temperatures. This study focuses on optimising thermal debinding process parameters on the basis of obtaining a defect-free part after sintering and also determining a sintering time that gives high sintering density. Thermal debinding was conducted after solvent debinding. The feedstock used to produce green compacts composed of Ti6Al4V powder and a wax-based binder. The binder's backbone component is a low density polyethylene (LDPE). Careful selection of thermal debinding parameters was guided by thermo-gravimetric analysis (TGA) results. The Taguchi method was used to determine an optimum debinding process. Thermally debound compacts were analysed for residual binder using a TGA. Archimedes' principle and optical microscopy were done to analyse the sintering density and microstructure of the sintered product, respectively. Optimum debinding and sintering conditions were identified. The study demonstrated that heating rate during debinding was the most influential factor that contributes to minimum residual binder followed by debinding dwell time and temperature. Longer sintering time of 4 h favoured higher density of 91.6 ±1.55%. A typical radial shrinkage level of 11.1 ±0.0816% was determined.