New converting process for fabrication of ceramic core through 3D printing technique

Hye-Yeong Park[1], Hyun-Hee Choi[1], ErdenechuluunTumenbayar[1], Geun-Ho Cho[1],

Eun-Hee Kim[1], Yeon-Gil Jung*[,1], Jing Zhang[2]

[1]School of Materials Science and Engineering, Changwon National University, Changwon, Gyeongnam 641-773, Republic of Korea

[2]Department of Mechanical Engineering, Indiana University-Purdue University Indianapolis, Indianapolis, IN 46202, USA

In a conventional converting process, the core green body prepared with starting powder and organic binder, generally called as resin, is directly dipped in the inorganic binder precursor. However, the process reduces the content of inorganic precursor by the organic binder filled on the interface between the starting particles, resulting in reduced mechanical properties of the core. In this work, a new converting process combined with 3D printing technique has been developed to fabricate core samples. The new process allows to provide sufficient amount of inorganic binder on the particle surface and at the interface between particles. Two types of poly vinyl alcohol (PVA), which have the same molecular structure with a large difference in the boiling point, were used as an organic binder. Green body with the two kinds of PVA was 3D printed, and then heat-treated at 250℃ to evaporate the PVA with the lower boiling point. The heat-treated core samples were dipped into the inorganic precursor, and dried and heat-treated at 1000℃ for organic-inorganic converting process. This series of new processes could enhance the fracture strength of core owing to the increase of the inorganic precursor infiltrated in spaces/sites of the evaporated PVA. In the new converting process, the formability of core sample was induced through the organic compounds remained and inorganic binder penetrated between particles and/or coated on the particle surfaces, and the firing strength is attributed from the glass phase generated by the inorganic precursor. Therefore, the formability and firing strength of core prepared through the new process were favorably improved. This means it would be readily applied to the production of core using 3D printing techniques, without further shrinkage in heat treatment at high temperature.