EFFECTS OF PRODUCTION PARAMETERS ON MICROSTRUCTURE AND DENSIFICATION OF IRON/GLASS SYNTACTIC FOAM BY CONVENTIONAL POWDER METALLURGY

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Iron and steel matrix syntactic foams have received a lot of attention owing to their high strength, temperature capability, and corrosion resistance. However, high melting point of the iron and steels complicates applications of some conventional production processes. Since few casting methods were proposed to fabricate iron and steel syntactic foams embedded with the ceramic and metal hollow spheres having macro diameters, most of the foams having micro ceramic and glass hollow spheres were fabricated through powder metallurgy (PM) process, which allows reduction of temperature levels by about 30~40% compared to the casting. Metal injection molding (MIM) was mostly used toward the iron and steel matrix foams because of requiring only limited adaptations for switching from making solid parts to syntactic foams and its capabilities for producing various geometries and sizes. However, if the shape allows the production of the part by conventional PM (pressing and sintering), MIM would in most cases be too expensive. To date, detailed fundamental researches on conventional PM process to fabricate the iron or steel syntactic foams have not been reported. Difficulties of the conventional PM process to fabricate the iron and steel syntactic foams are working pressures and temperatures. For compacting powders to make green bodies, high working pressures can assist the densification of the matrix during sintering while this can deform or fracture the hollow spheres embedded. In case of the foams with the glass hollow spheres, softening of the glass occurs at high temperature thus original shape of the hollow spheres cannot be preserved. Therefore, to overcome the difficulties and to produce sound sintered bodies, the investigation on the production parameters of the conventional PM to fabricate the iron and steel syntactic foams is necessary.

In this study, the iron/glass hollow spheres syntactic foams were fabricated via the conventional PM process. Fabrications were conducted with considering different production parameters, which included the compaction pressures and sintering temperatures in conjunction with various volume fractions and particle sizes of the hollow spheres. The microstructures and densification behaviors of the fabricated syntactic foams were characterized by X-ray diffraction, optical microscope, scanning electron microscope and energy dispersion spectroscope.