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Comparative Study of Tensile Properties of Cast and Hot Forged Alumina Nanoparticle Reinforced Composites

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Abstract : Particle reinforced Metal Matrix Composite (MMC) succeeds in synergizing the metallic matrix with ceramic particle reinforcements to result in improved strength, particularly at elevated temperatures, but adversely it affects the ductility of the matrix because of agglomeration and porosity. The present study investigates the outcome of tensile properties in a cast and hot forged composite reinforced simultaneously with coarse and fine particles. Nano-sized alumina particles have been generated by milling mixture of aluminum and manganese dioxide powders. Milled particles after drying are added to molten metal and the resulting slurry is cast. The microstructure of the composites shows good distribution of both the size categories of particles without significant clustering. The presence of nanoparticles along with coarser particles in a composite improves both strength and ductility considerably. Delay in debonding of coarser particles to higher stress is due to reduced mismatch in extension caused by increased strain hardening in presence of the nanoparticles. However, higher addition of powder mix beyond a limit results in deterioration of mechanical properties, possibly due to clustering of nanoparticles. The porosity in cast composite generally increases with the increasing addition of powder mix as observed during process and on forging it has got reduced. The base alloy and nanocomposites show improvement in flow stress which could be attributed to lowering of porosity and grain refinement as a consequence of forging.

Keywords : aluminium, alumina, nano-particle reinforced composites, porosity
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