ABSTRACT

Investigation on Workability and Mechanical Properties of Fe-C-Ni-Mo and Fe-C-Cr-Ni-Mo Sintered Low Alloy Steels.

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Densification, plastic deformation, formability and mechanical properties of sintered low alloy steels containing Cr, Ni and Mo as alloying elements have been studied in the present research work. Elemental powders of atomized iron, graphite, chromium, nickel and molybdenum were mixed in suitable mass proportions using a ball mill, compacted and sintered in order to yield the following alloy compositions which are close compositions of conventional wrought steels: Fe-0.2% C, Fe-0.2% C-2% Ni, Fe-0.2% C-2% Ni-1.5% Mo, Fe-0.2% C-2% Ni-3% Mo, Fe-0.2% C-1% Cr, Fe-0.2% C-2% Cr, Fe-0.2% C-1% Cr-2% Ni and Fe-0.2% C-1% Cr-2% Ni-1.5% Mo. The sintered cylindrical preforms were subsequently subjected to cold & hot upsetting and cold repressing tests. Addition of Ni, Cr and Mo as alloying elements to the plain carbon steel preforms promotes better densification characteristics during cold upsetting. However, the plastic deformation of the alloy preforms with Ni and Cr is found to be sluggish compared to that of the plain carbon steel preforms. The experimental results were used to train an Artificial Neural Network (ANN) and the trained network was validated using new set of experimental data. A correlation coefficient value close to unity was observed for the ANN predicted results. For the present research mixed elemental route has been adopted due to the low cost compared to prealloyed powders.
Microstructures of the alloys were examined for correlating with the plastic deformation, densification, formability behaviors and mechanical properties. Fractographs of the fractured surfaces of the tensile specimens were analysed using a scanning electron microscope.

From the present study, it is contended that the alloying elements Cr, Ni and Mo have strong influence on the tensile and impact properties of the low alloy steels studied. Among all the eight alloys considered, the steel with Cr addition has exhibited the highest tensile strength with the corresponding impact strength being the least. The hardness of the same alloy has also been found to be the highest, compared to the rest of the alloys. These new alloy compositions prepared out of elemental powder mix sintered at low temperature posses superior mechanical properties even without adopting extensive repressing resintering cycles.