Modelling of Mechanical Behavior of Porous Sintered Low Alloy Steels

H. Khorsand , M. Alizadeh

Department of Mechanical Engineering, Khaje Nasiredin Tousi University of Technology, Tehran, Iran

Abstract

The mechanical properties of sintered low alloy steels were analysed using Finite Element Methods (FEM), in which the powder is modelled as an elastic–plastic continuum material. A quantitative analysis of microstructure was correlated with tensile and fatigue behavior to understand the influence of pore size, shape, and distribution on mechanical behavior. Tensile strength, Young's modulus, strain-to-failure, and fatigue strength all increased with a decrease in porosity. The decrease in Young's modulus with increasing porosity was predicted by analytical modeling. Two-dimensional microstructure-based finite element modeling showed that the enhanced tensile and fatigue behavior of the denser steels could be attributed to smaller, more homogeneous, and more spherical porosity which resulted in more homogeneous deformation and decreased strain localization in the material. The relationship between relative density of P/M steels and mechanical behavior is also obtained from FEA and compared with the experimental data. Good agreement between the experimental and FEA results is observed, which demonstrates that FEA can capture the major features of the P/M steels behaviour during loading. The implications of pore size, morphology, and distribution on the mechanical behavior and fracture of P/M steels are discussed. It is therefore demonstrated that FEA can predict the possible mechanism of failure during loading.

Keywords : Powder metallurgy, Tensile, Fatigue, Finite element analysis, Failure