A Metallographic Investigation Into the Effect of Sintering on an FC-0205 Premix

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Abstract

The properties of ferrous P/M materials are developed during the sintering process where metallurgical bonds are formed at particle-to-particle contacts and alloying of mixed and bonded additives occurs. Increasing either the sintering temperature or time can produce improvements in the microstructure and, consequently, the ensuing properties. In this paper, an FC-0205 premix, sintered for various times at 1120 °C (2050 °F), will be used to study the microstructural changes resulting from increases in sintering time. Features of interest include, changes to the surface-to-volume ratios at the particle boundary and pore surface areas, diffusion of the copper in the solid state and as a liquid component, and the homogenization of the microstructrue with increasing sintering times. Stereological techniques, using light optical microscopy, will be employed to examine the diffusion of the added alloying materials and to quantify the improvement in the degree-of-sinter. Additionally, electron microscopy (SEM) will be used to examine Charpy impact fracture surfaces from specimens sintered at the various times.

Introduction

Iron-copper-carbon materials, especially FC-0205 and FC-0208, have been the 'workhorse' of the North American P/M industry for many years. They probably account for greater powder usage than any other single alloy system. There are many reasons for the success of these compositions. The liquid phase from melting of the copper enhances the sintering of the matrix iron and acceptable properties can be developed with less than optimal conditions. Increasing the sintering times can lead, however, to greater stability and consistency in parts production through the development of a more homogeneous microstructure. In addition, from a property standpoint, the carbon diffuses and forms pearlite and the alloyed copper strengthens the ferrite.