A Comparison of FC0208 to a 0.30% Molybdenum Pre-alloyed Low Alloy Powder with 0.80% Graphite

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Abstract

Iron copper steels are the most widely used structural PM materials. Although the elemental copper addition melts during initial sintering, complete homogenization of the copper is not achieved at conventional sintering temperatures and sintering times. This lack of microstructural homogeneity coupled with the potential for large pores can often lead to reduced strength and greater dimensional variability during sintering and subsequent heat treatments, if required. A proposed alternative to the FC02XX materials is a 0.30% molybdenum pre-alloyed material. This material has nearly identical compressibility compared to the iron copper materials but has the added benefit of a homogeneous microstructure. This paper will focus on a comparison of FC0208 to a 0.30% molybdenum material with 0.80% added graphite. The materials will be compared in both the as-sintered and heat-treated conditions. Additional testing will evaluate the dimensional stability and variability of these two materials in both the as-sintered and heat-treated conditions.

Introduction:

Iron-copper steels (FC-02XX) are the most widely used structural PM materials. Current applications include main bearing caps, powder forged connecting rods, carrier assemblies, etc. Although FC 02XX series are most frequently used in the as-sintered condition, they are occasionally heat-treated to increase strength or improve wear resistance. One intrinsic drawback of the iron-copper-carbon system is that copper is added elementally. This elemental copper results in part growth during sintering (positive dimensional change, DC) coupled with a potential for large voids after sintering. [1] A review of the iron copper phase diagram shows that the room temperature solubility of copper in iron is <2% [2]. However production experience shows that large free copper particles are rarely seen in 2% copper steels. Copper contents above 2% show copper precipitates in either the grain boundaries or at prior particle boundaries.
Although copper melts at ~1080 °C (1980 °F), the diffusivity of copper into iron is such that complete alloy homogenization is not achieved unless long sintering times or high sintering