A DESIGN PROCEDURE ACCOUNTING FOR THE ANISOTROPIC DIMENSIONAL CHANGE ON SINTERING OF FERROUS PM PARTS

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ABSTRACT

The anisotropic dimensional change on sintering can be detrimental to the precision of PM parts if not properly considered in the design step. Ferrous axial-symmetrical parts sintered at different temperatures have been investigated in this work. The anisotropy of dimensional change in height and in the internal and external diameter, and their relationships, were analysed in depth. An anisotropy parameter has been identified, depending both on geometry and on sintering conditions, and it has been used to define a model for the anisotropic behaviour. A design procedure accounting for anisotropic dimensional changes has been proposed. The data coming from measurement of industrial multilevel parts (measured both in the green and in the sintered state) have been used to compare the real dimensional changes to the dimensional changes predicted by means of the design procedure based on the anisotropy model.

INTRODUCTION

Anisotropic dimensional change on sintering is a well know phenomenon in the PM industry, which has to be considered in the design step. Precision of PM parts may be strongly affected by anisotropic dimensional changes.

In the conventional press and sinter process, the dimensional change on sintering along the directions parallel and perpendicular to the direction of compaction may significantly differ. The mechanism responsible for the anisotropic dimensional change during sintering of cold compacted ferrous parts has been investigated by dilatometry, also highlighting the relationship with the inhomogeneous plastic deformation of particles due to uniaxial prior compaction [1]. Dilatometric analysis also allowed showing the prevailing effect of early stages of sintering on anisotropy of Fe-C-Cu alloys [2], and highlighting the influence of the liquid phase [3].

Previous studies highlighted how anisotropy of dimensional changes depends both on material and on the geometry of the parts [1,4-7], and a model to describe these correlations has been proposed [8, 9]. The model is used in this work to propose a design procedure accounting for anisotropic dimensional changes. The data coming from measurement of ferrous multilevel parts (differing for geometry and sintering temperature) have been used to calculate the real dimensional changes, which have been compared to the dimensional