THE ANALYSIS OF THE DENSIFICATION CURVE OF METALLIC POWDERS IN UNIAXIAL COLD COMPACTION

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ABSTRACT

Several models have been proposed in literature for decades to describe the relationships between the compaction pressure and green density. Some of them are almost empirical, others are based on a theoretical approach starting from the phenomena occurring during cold compaction. The authors of the present paper have recently (2018) proposed a model based on the investigation of the deformation experienced by the powder mix when subject to the application of the compaction pressure. In this work, the model is compared with the three most recently published ones: the Aryanpour and Farzaneh model (2015), evaluating the contribution of rearrangement; the Parilak et al. model (2017) that was validated with experimental data relevant to 205 powder mixes, and the Montes et al. equation (2018) that was developed considering the local stress and strain in the interparticle contacts. Compaction experiments were carried out on a commercial AISI 316L stainless steel powder mix, sieved in different particle size ranges, and the data collected by the compaction press control unit were used.

INTRODUCTION

The phenomenon of densification of powder mixes during compaction has been extensively studied over the years, and several equations relating density and compaction pressure were proposed, either based on experimental data or on the study of the related physical mechanisms [1-6]. However, densification is affected by a large number of variables, whose influence is difficult to predict, namely the characteristics of powder (chemical composition, crystalline structure, powder morphology, particle size distribution…) and lubricant (density, viscosity, melting temperature, admixed amount…), the complexity of geometry, and the compaction strategy.

The authors of the present papers investigated in depth the densification phenomena, also considering the related compaction mechanics, as derived from the experimental data continuously recorded by an industrial press [7-9]. The influence of several variables has been investigated, such as chemical composition [10-11], particle size [12], cylindrical and ring shaped geometry [13-14], lubricant type and amount [15]. A densification equation has been recently proposed [16-17], describing the in situ density as