The Effect of Preparation Techniques and Storage Conditions on the Flow Properties of Additive Manufacturing (AM) Feedstocks

John Yin[1], Rajeev Dattani[2], Jamie Clayton[2], Yun Bai[3], John P. Reidy[3], Christopher Craven[3], Steve Hudelson[3], Gavin A. Winter[3], Michael A. Gibson[3], Animesh Bose[3]
[1]Freeman Technology, 4356 Communications Drive, Norcross, GA 30093, USA
[2]Freeman Technology Ltd, Tewkesbury, Gloucestershire, GL20 8DN, UK
[3]Desktop Metal Inc., Burlington, MA, USA

Abstract
Additive manufacturing is rapidly gaining acceptance in a number of industries due to the ability to manufacture complex components quickly and precisely. As industrial implementation of the technology increases, so does the diversity of environmental and storage conditions which feedstocks are subjected to. This can significantly impact process performance and product quality. This study investigates the relationships between the flow properties of two batches of a stainless steel powder, with varying particle sizes, and their preparation process and subsequent storage conditions. The results demonstrate how different baking processes can influence flow properties that are known to affect AM performance and also highlight how powders with different particle sizes respond differently to the same preparation and storage conditions.

Introduction
Additive manufacturing (AM) covers a range of processes in which material is added a layer at a time to form a three-dimensional object. Initially AM was used for prototyping and development, however there are now production ready printers available [1-3]. The rapid expansion of AM is in part due to the ability to manufacture complex components both quickly and precisely.

Binder Jetting is a commonly used AM process, and can be 40 times more productive than laser-based processes [4]. During a binder jetting process, a liquid binder is deposited alongside the powder particles. Layers of powder and binder are bonded to form an object as the printhead drops the binder into the necessary areas to form the desired object. After the binder has been added, a new layer of powder is spread and again the binder is added where necessary. Subsequent layers of powder and binder are added, and the part is then built up over time. The binder jetting process can be used with a range of materials including metals and ceramics.

The behavior of the powder is vital in achieving high efficiency and productivity, whilst at the same time meeting the necessary quality attributes of the final product. If there are variations in the feedstock such as those arising from different storage or processing conditions, or even transporting powder from one location to another, this could lead to inefficiencies within the manufacturing process. As AM increases in popularity, material handling will play a key role in the outcome of the manufacturing process, as such, understanding the impacts of different pre-treatments and storage conditions on the powder's flow properties is crucial.