

Design and Extrusion Process of Water Atomized 17-4 PH Stainless Steel Powder

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ABSTRACT

In this study, water atomized 17-4 PH stainless steel powder was extruded using a customized extrusion system. Different content of metal powder (62.5, 65, 93, and 57 vol.%) was used for the feedstock and the remaining (37.5, 35, 7, and 43 vol.%) was made up of the binder materials. The binder system consists of paraffin wax, polyethylene, and stearic acid. The materials were mixed in a heated bed mixer in steps to form the slurry. The feedstock was then loaded into a heated customized extrusion chamber, which was mounted on a customized 3D printer. Different extruder designs are presented. Several extruded samples are demonstrated.

1. INTRODUCTION

1.1 Extrusion-based 3D printing

Solid freeform fabrication of metal parts is desirable for accurate prototyping and fabrication of intricate geometries impossible through other methods [1]. A method that is compatible with a wide range of materials and multi-material combinations is the robocasting process which deposits powdered material in a slurry form and then sinters them afterward to create solid parts with high densities. The binder materials used must have lower viscosity to make it suitable for molding as well as to have extractability by de-binding [2]. Mixing of metal powder and binder involves dispersion of metal powders in a polymer binder to form a highly filled compound called feedstock [3]. The feedstock will be loaded into a heated extrusion chamber, which will be mounted on a computerized controlled Delta printer.

1.2 Design and fabrication of heating extruder

An extruder to heat and extrude slurry of water atomized 17-4 PH stainless steel powder was designed using SolidWorks. Taking a reference to a conventional injection molding extruder,