DEVELOPMENT OF WATER ATOMIZED 4600 LOW ALLOY STEEL POWDER FOR LPBF APPLICATIONS

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ABSTRACT

The need for using low alloy steel powders for laser powder bed fusion (LPBF) has grown as the importance of additive manufacturing (AM) grows for prototyping and manufacturing of structural and automotive parts. Selecting an alloy that can be processed to cover a wide range of properties is important as this limits the development of build parameters and material changes in the LPBF equipment. An AISI 4600 low alloy steel, which is used in multiple powder and wrought metallurgy processes, was chosen because of the properties achievable through both carbon variation and heat treatment. The mechanical properties of the LPBF specimens are evaluated using variations in carbon content in both water and gas atomized powders. Various heat treatments show the range of mechanical properties that can be achieved with this alloy. Microstructure is evaluated for both powder types and discussed in relation to build parameters and the mechanical properties.

INTRODUCTION

The progression of the AM industry has increased the demand for a wide variety of suitable metal powders. Powder characteristics such as morphology, size, flowability, and chemical composition are strictly controlled for the AM process which drives up the cost compared to typical powder grades used in standard powder metallurgy (PM).[1] Accordingly, the market mostly consists of small-batch, specialized components that can absorb these high production costs. Conventional prototyping can become very expensive due to the cost of manufacturing new tooling for PM parts as well as new molds for injection molding parts during the development process.[2] AM could be used for this application to decrease costs as well as shorten the lead time. There has been a move towards using AM in the automotive industry for prototyping and structural components, hence new alloys that can be processed to provide a wide range of strength and toughness combinations need to be qualified for use in the LPBF process. In the case of prototyping the performance of the material after LPBF processing must be understood in relation to the intended final microstructure and mechanical properties of the part.