**TITLE**: Influence of recycled Inconel 718 powder on pulsed laser powder bed fusion additive manufacturing material.

*Spell out words, do not use abbreviations. Use sentence case, avoid all caps. Max characters are 150.*

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**Introduction:**

Additive manufacturing (AM) is a family of processes used to manufacture components with complex shapes. Laser powder bed fusion (L-PBF) uses metal powder and a laser heat source to create engineering components. Metal powders are mainly produced via gas atomisation process [1]. To date, research has been focused to effect of recycled Ti6Al4V powder on the properties of manufactured parts [2]. However, there is little published work on recycling of Inconel 718 powder used in L-PBF process [3].

**Methods:**

Samples from virgin and 5 times recycled Inconel 718 powder have been characterised in terms of chemistry, morphology, microstructure, powder size distribution (PSD), flowability and density. Powder morphology and microstructure was characterised using scanning electron microscopy (SEM) along with an electron backscatter diffraction (EBSD) detector. PSD analysis was performed using a laser light scattering analyser.

Specimens have been manufactured using the virgin and recycled powders in a pulsed L-PBF machine. All specimens were manufactured using previously optimised L-PBF process parameters. The specimens were characterised in terms of porosity, microstructure and mechanical properties. Porosity analysis was performed using image analysis method. The microstructure was determined using SEM and EBSD analysis whereas hardness was determined using microhardness tester.

**Results:**

Powder characterisation shows insignificant differences in chemistry, morphology and microstructure. PSD of recycled powder shows bigger average particle size than the virgin. Flowability of recycled powder was 15% higher and the apparent density was 6% higher than the virgin. The porosity and hardness of the manufactured samples differs by less than 5%.

**Conclusions:**

* Little variation exists in morphology and microstructure of virgin and recycled powders. The same is true for L-PBF material.
* Variation in physical properties, between the different powder types, is due to different PSD.
* Porosity in manufactured specimens is influenced by process parameters.
* Hardness varies due to the presence of porosity in the manufactured specimens.

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**References:**

[1] J. Dawes, R. Bowerman, and R. Trepleton, “Introduction to the Additive Manufacturing Powder Metallurgy Supply Chain Exploring the production and supply of metal powders for AM processes,” *Johnson Matthey Technol. Rev.*, vol. 59, no. 3, pp. 243–256, 2015.

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