Controlled hydrodynamic cavitation erosion with abrasive particles for internal surface modification of additive manufactured components

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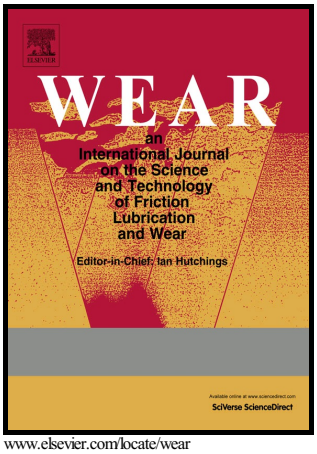

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Controlled hydrodynamic cavitation erosion with abrasive particles for internal surface modification of additive manufactured components

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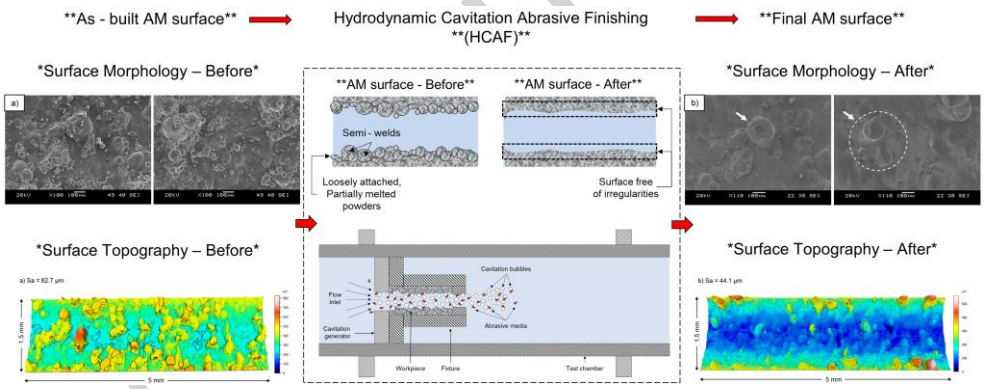
Abstract

The understanding and control of wear process can result in advances in manufacturing science. For example, Surface finishing the internal surfaces of a component built using Additive Manufacturing (AM) technique that consists of random roughness distribution throughout its surface is a key problem. This paper describes an innovative approach of using hydrodynamic flow at its cavitating conditions along with freely suspended abrasive particles for finishing the internal surfaces of additive manufactured components. Experiments are conducted on cylindrical as-built aluminium alloy AlSi10Mg parts manufactured using Direct Metal Laser Sintering (DMLS) technique. Application of controlled cavitation erosion by fluids containing entrained SiC particles resulted in a 40% reduction in the average surface roughness (Sa) on the internal surface of a cylindrical specimen. Scanning electron microscope (SEM) observations showed erosion due to hydrodynamic cavitation removed most of the surface irregularities such as loosely attached and/or partially melted powders. Furthermore, direct abrasion after the addition of micro-abrasive media into the cavitating flow deformed as well as partially removed the larger-sized irregularities and resulted in smoother surfaces.

Graphical abstract:



1. Introduction

Surface finishing is an important post-processing step in manufacturing. Surface finishing techniques are used to alter the surface parameters according to functional requirements. Each and every surface finishing technique is capable of producing a unique surface texture. Surface finishing techniques are optimised to achieve the desired surface waviness (long wavelengths) and roughness (short wavelengths) [1]. The surface texture of a component is a crucial factor that controls the friction and transfer layer formation during sliding and