Proceedings IRF2018: 6th International Conference Integrity-Reliability-Failure
Lisbon/Portugal 22-26 July 2018. Editors J.F. Silva Gomes and S.A. Meguid
Publ. INEGI/FEUP (2018); ISBN: 978-989-20-8313-1

PAPER REF: 7239

EXPERIMENTAL STUDY OF LASER BEAM MACHINING IN Ti6Al4V ALLOY

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ABSTRACT

This work aims to evaluate the performance of laser beam machining process, regarding manufactured components quality and the production efficiency. The machining tests were performed on Ti6Al4V by varying three input parameters, pulse frequency (A), laser speed (B) and laser intensity (C). The test plan was defined based on a Taguchi model, seeking to identify the influence of operating parameters on surface integrity, geometric and dimensional accuracy, as well as the material removal rate. The results show that the laser erosion process can be used with success in the manufacture of micro components and functionalities.

Keywords: laser beam machining, titanium alloy, surface integrity, material removal rate.

INTRODUCTION

Laser beam machining (LBM) is well known in manufacturing industry for general consumer goods applications. The machine available in the market differs essentially by the laser source they use, being of two types: gas or solid-state lasers. The power source choice depends on the application purpose. In case of metal processing it is necessary to use a concentrated light beam which allows adequate penetration of the radiation into the material. Crystal and fiber lasers are those that, due to a micrometric wavelength, allow faster and more efficient processing of metallic materials. They are examples of applications in the most diverse sectors of the industry, such as injection molds, automotive, aerospace and medicine, making use of various materials, including titanium alloys, stainless steel, aluminium and nickel superalloys [1]. LBM is an advanced machining technology that enables small material removal quantities with high precision and fabricates complex geometries in almost any material [2]. The material removal rate (MRR) is based on thermal processing due to the high heat flux generated by the laser beam that melts and vaporizes the workpiece at the focal point [3]. As energy transfer occurs through irradiation, mechanical stress, vibration, or mechanical degradation of the workpiece or tool is not impelled. In particular, the non-wear of the tool permits constant geometric and dimensional accuracy and eliminates the problems associated with tool replacement or breakage. In addition, the MRR is not limited by constraints such as maximum tool strength, burr formation, or deformation of delicate component functionalities.

RESULTS AND CONCLUSIONS

Figures 1 and 2 shows the main effect plots for roughness (Ra) and MRR, respectively. It can be noticed that the input factor with most influence on the surface roughness is the laser speed, meanwhile for MRR is the pulse frequency.

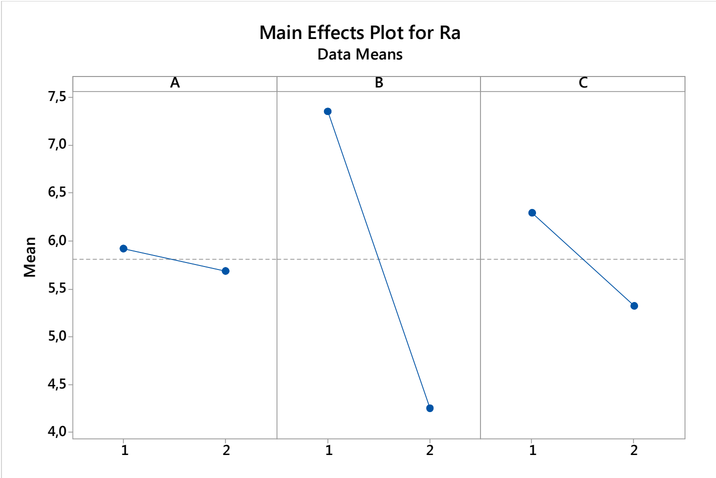

Fig. 1 - Main effect plots for Ra.

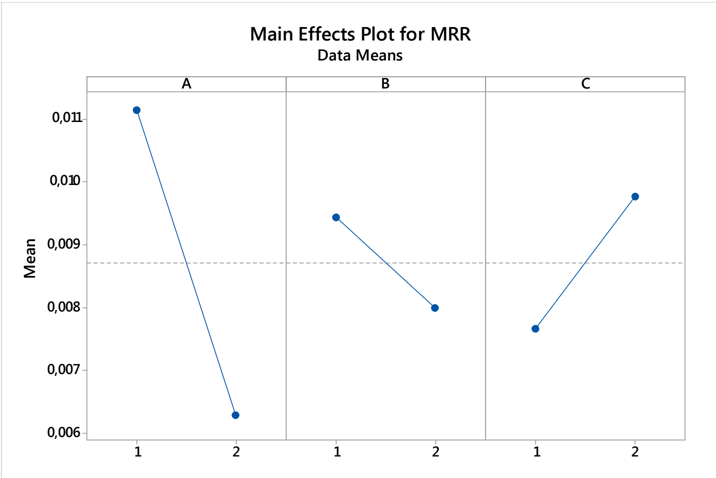

Fig. 2 - Main effect plots for MRR.

ACKNOWLEDGMENTS

The authors gratefully acknowledge the funding by IDMEC/UL, LAETA, CNPq and Erasmus Mundus.

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