Effect Of Surface Topography Of 8090 Al-li Alloy During Abrasive Waterjet Peening Process

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Abstract. Abrasive water jet (AWJ) peening strengthening test of aluminum-lithium alloy (8090Al–Li) was carried out with a variety of pressure process parameters. The research was done on the roughness as well as the morphology of the treated samples. A high dislocation density formed in the area of the workpiece that was subjected to the peening process. The result was a surface that was both rough and hardened. The abrasive effect took place in the area where the collapse took place. The fact that this method was the most effective option for treating the surface of the metal was very beneficial. According to the findings, the surface roughness, grain size, micro-strain, erosive effect, and micro-hardness of the alloy were all considerably affected by various peening settings. In this instance, the rise in pressure caused the surface roughness to increase as well. In addition, the microcrystalline structure was shown to have diminished in the treated area by the abrasive peening. The research demonstrated how the effect of varying the peening pressure can reduce the amount of surface roughness on materials. In comparison to the initial sample, the roughness reached its highest values of 62 μm to 92 μm and rose by 7.87 to 27.56 %. These results indicate a significant increase. In comparison, the average surface roughness of the equivalent area increased to 30.04 μm. According to the experimental observation, the AWJ peening collapse limits that were acquired by the proposed sample surface and metallographic images were extremely complete and accurate.

Keywords: Abrasive water jet peening, Surface layer, Roughness, crystallite size, Micro-strain;

13 March 2024 19:23:58

INTRODUCTION

Abrasive water jet (AWJ) peening is a physical phenomenon that involves the formation and breakdown of layers with liquid and air because of a high impact [1]. Presently, abrasive water jet cutting is one of the most rapidly evolving and intensively studied technologies for cutting materials [2]. It is a non-traditional way to make things that are often used to cut metals, fiberglass, rubber, stone, plastics, and other building materials [3]. It is expected that the technique will have advantages in terms of cutting pressures as well as cutting temperatures. AWJ peening used a high-pressure, high-speed jet injected into water, air, and abrasive-filled test room. The use of abrasive water jet peening on 8090Al–Li with abrasive aided manufacturing and material synthesis in recent years (Sekyi-Ansah et al. 2020), has been widely described in many publications [4].

They discovered that the aluminum-lithium 8090 alloy offers favorable features in the aviation industry, including high specific strength, lightweight, and good flexibility [5]. Due to their superior qualities, such as resistance to corrosion, lightweight, and tensile strength, among others, aluminum alloys are widely employed [6]. Diverse surface treatments, including shot peening, laser shock peening, and so on, have been executed with various techniques. Moreover, the utilization of the aforementioned techniques in the aviation business has disadvantages such as pollution, excessive expenses, etc [7]. Abrasive impacts, on the other hand, might be viewed as a useful or destructive process. AWJP is a resource-intensive approach for enhancing the qualities of a given material [8]. In general, the AWJP process is extremely challenging. More geometric, hydraulic, chemical, and material properties influence its properties and control values [9]. Damage and erosion test findings were highly variable because of this, and further data was still scattered about as a result [10]. It is possible to thoroughly explore the relationship between abrasive strength and material erosion rate, and essential parameters for forecasting damage and erosion rate can be determined [11].

In the research that has been done, the significance of these parameters for abrasive penetration and shedding frequency has been discussed [12]. On the other hand, pressures with abrasive are formed in the nozzle as a result of the partial pressure decrease of the flowing liquid. These pressures cause pits in the material, which can be seen as

The 5th International Conference on Automotive Innovation and Green Energy Vehicle
AIP Conf. Proc. 2998, 060005-1–060005-6; https://doi.org/10.1063/5.0188280
Published by AIP Publishing. 978-0-7354-4793-6/$30.00