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Weld Bead Analysis on TIG Welding on Room Temperature and 100°C on Aluminum 6351-T6

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1. INTRODUCTION

The research will be conducted to understand the interference of welding and find the best way of weld interaction in the aluminum alloy 6351-T6. Thus, it will address a review of the existing literature and present ways to avoid failures in the process that lead to material breakage and, consequently, attempt to reduce waste. The goal is to analyze and compare the weld interactions in aluminum 6351-T6 metal alloys, where one bar will undergo a heating process at a temperature of approximately 100°C, and the other bar will not be subjected to the heating process before welding.

This research also aims to analyze the weld interaction in the TIG welding process. Two samples of aluminum alloy 6351-T6 will be used, with one undergoing a heat treatment before welding, and the other will have welding applied at room temperature. The study will cover topics related to welding processes, including a brief historical overview, aluminum and its alloys, heat treatments, and heat treatments applied to the aluminum alloy. Material tests such as metallography, liquid penetrant testing, and visual inspection will be conducted. Finally, the research will conclude with an analysis of the obtained results.

2. METHODOLOGY

The material used for this work was a solid shaft made of an aluminum alloy 6351-T6. This material has the following dimensions, with a diameter of 50.8mm (2 inches) throughout its entire length. From this material, samples with a length of 140mm will be taken.

After the samples were cut to a length of 140mm, they underwent a split cut, dividing them into two equal parts, using a circular band saw machine, as shown in Figure 1, which is a drawing created using software, illustrating the split cut of the aluminum alloy 6351-T6. Following the ASTM E10-93 standard, a hardness test was conducted in the laboratory on the samples using a benchtop hardness tester.

The samples that underwent the welding process with preheating and without preheating were sliced into 8 equal parts, with each sample labeled from 1 to 8 in sequence. Figure 12 illustrates a drawing created by software depicting how the cutting will be performed on all samples N and J, as illustrated in figure 2.

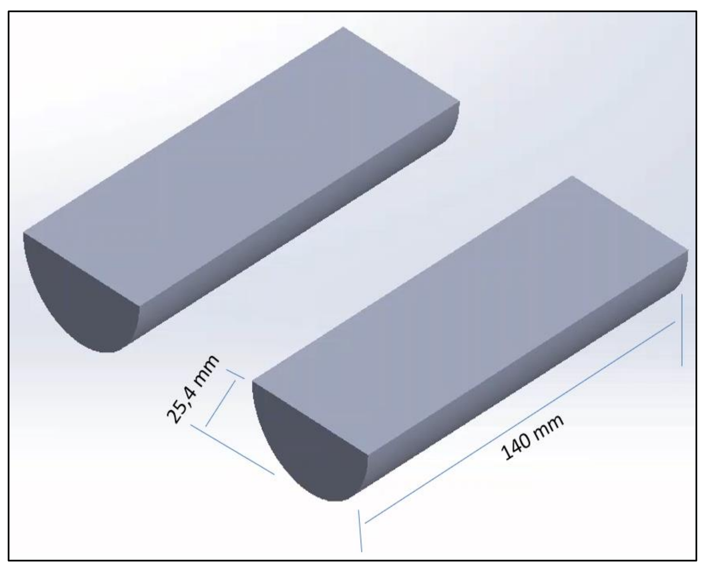

Figure 1. Bipartite 3D drawing of aluminum alloy 6351-T6 (Own elaboration).

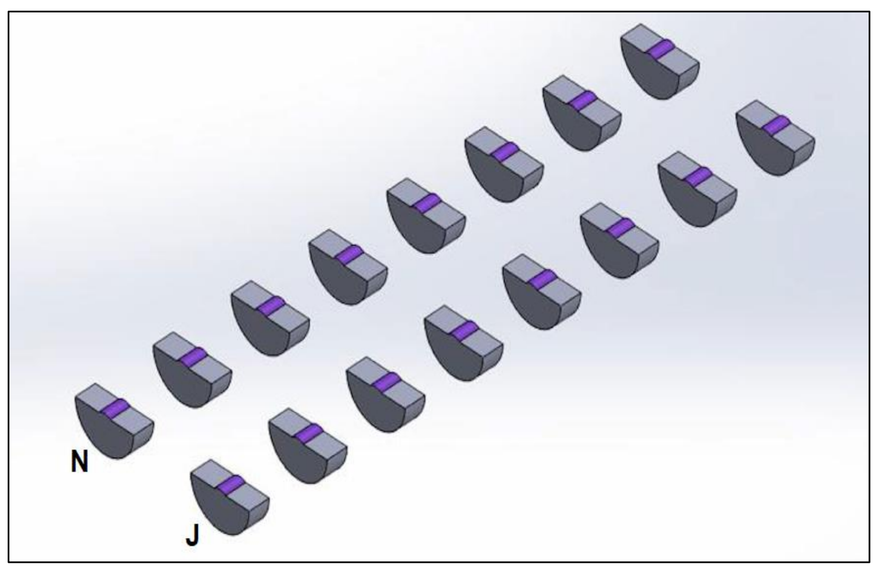

Figure 2. 3D drawing of samples N and J cut into 8 parts (Own elaboration).

3. RESULTS AND DISCUSSION

The practical research conducted aimed to evaluate the results of welding on an aluminum alloy 6351-T6, using two test specimens: one with preheating at 100°C, aided by a blowtorch, and another without preheating.

The test specimen that underwent preheating at 100°C showed the best results in the research. Through the analysis of weld penetration and its uniformity, it was possible to observe that the preheated sample showed better quality compared to the non-preheated sample.

Additionally, a hardness measurement was performed on both samples to verify if the variation remained within acceptable limits. The preheated sample exhibited a hardness variation within the acceptable standards, indicating a successful welding.

On the other hand, the specimen that did not undergo preheating showed more difficulty in welding. The weld did not show much penetration into the material, indicating a lower adhesion between the surfaces. This can be attributed to the stresses existing in the unheated part, which impede the fusion of the metal.

Furthermore, in the hardness test, the sample without preheating showed a non-homogeneous hardness ratio. This means that the hardness of the material was not uniformly distributed, which can compromise the strength and durability of the weld. These results reinforce the importance of preheating in the welding of aluminum alloy 6351-T6, ensuring good weld quality and homogeneous hardness throughout the specimen.

Thus, four Brinell hardness indentations were performed on both samples, with point 1 as the region of the filler metal, point 2 in the heat-affected zone, and points 3 and 4 in the base metal (Figure 2). In the conducted experiment, a vertical hardness test was carried out on a sample of 6351-T6 aluminum alloy. The sample was fixed on the hardness tester using a support, with an approximate distance of 2mm from the filler metal (Figure 3).

Figure 3. Hardness test (Own elaboration).

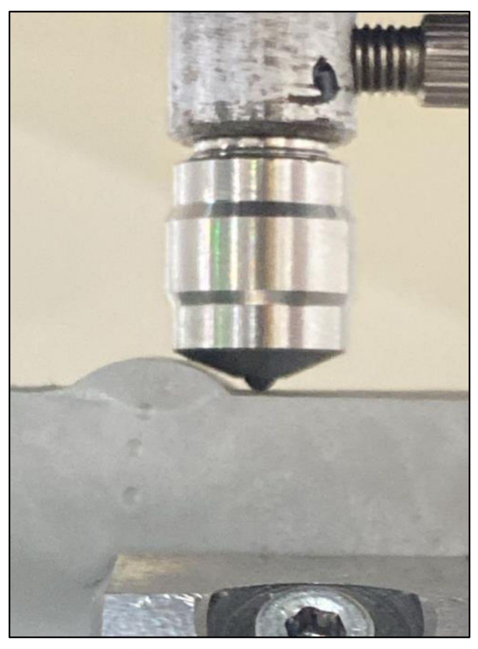

Figure 4. Vertical hardness test (Own elaboration).

The objective of this test was to determine the hardness of the sample at three points near the location where the filler metal was applied. A slight variation in hardness was observed in the analyzed points.

At the first point, where the test was conducted near the filler metal, the obtained hardness value was 61 HB (Brinell hardness scale). In the second point, the hardness was 60 HB, and in the third point, the hardness was 59 HB.

The variation in hardness found in the points near the filler metal can be attributed to different factors, such as the homogeneity of the alloy, the distribution of metallic alloys in the sample, among others.

It is important to emphasize that hardness is a mechanical property used to evaluate the resistance of a material to plastic deformation or wear. Through this test, it is possible to obtain information about the quality and resistance of the 6351-T6 aluminum alloy sample.

4. CONCLUSIONS

The results of the practical research demonstrated that the 100°C preheating is an important procedure in the welding of aluminum alloy 6351-T6. It contributes to better weld penetration, uniformity in results, and maintenance of acceptable hardness. Therefore, it is recommended to use preheating in future welding procedures involving this aluminum alloy.

5. REFERENCES

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