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THE EFFECT OF HEAT TREATMENT ON AISI 8630 STELL CLADDED WHITH WELD METAL R80SD2

Fabrício José Nóbrega Cavalcante[1]
fabricio.nobrega@bol.com.br
José Gonçalves de Almeida[1]
Saulo Moretti Araújo Duarte[1]
Esdras Carvalho da Costa[1]
Ronelles de Santana Silva[1]
Severino Jackson Guedes de Lima[1]
José Hilton Ferreira da Silva[1]
[1]Universidade Federal da Paraíba, Cidade Universitária, João Pessoa – Paraíba

Abstract. *Structural steel is a good choice for use in welding components or Cladded materials. Among the materials used in steel AISI 8630 has application in structures related to the oil industry, such as tubing. As a contribution to the improvement of process conditions, the objective of the study is to evaluate the influence of the heat treatment of steel AISI 8630 cladded with R80S D2 filler metal. For the evaluation, we used an AISI 8630 steel plate with dimensions 200x40x25 mm. Welding was added to 25 mm in size and used for MIG welding deposition. The material was processed, and then for two hours at 677 ° C. The heat treatment experimental results evaluating the available heat treatment of the material. The results were analyzed by comparing the optical microscopy (OM), Metallographic characteristics and hardness of the test material. The results were consistent with the literature, the heat treatment for stress relief AISI 8630M buttery, resulted in a decrease in hardness and evaluated with regard to metallographic analysis, we conclude that heat treatment performed after buttering of steel plates AISI 8630M contributed to morphological changes of the microstructure. The region of the HAZ STTAT presented with coarse, and the presence of non-tempered martensite, while for CTTAT condition, martensiterevenida less grain was obtained, showing the influence and significance of tratramento used in the study.*

Keywords: *8630M, welding, heat treatment, GMAW*

1. INTRODUCTION

The use of welded components in the oil industry, can be checked in various ways, especially pipes which has the important function of transporting oil and its derivatives efficiently. New technology is being used to meet the expectations for the exploration and production of this product, applying increasingly complex processes and studies and research directed application. In this context, the components used employ new materials and fabrication conditions, such as better welding conditions. A technique for coating materials of the deposition material has improved the utilization of these new materials, as well as by joining of dissimilar material welding process. A material, widely used in oil pipes, is the low alloy steel AISI 8630, justified by their mechanical properties suitable for applications in the area. The AISI 8630, after receiving a coating by welding generally recomeda the use of a heat treatment for stress relief. This treatment, as appropriate, can provide improved uniformity and mechanical properties, which makes the evaluation of this heat treatment important application of AISI 8630 coating by a welding process. The welding process generally takes place with the application of heat, changes in microstructure can arise, are not always desirable and acceptable by causing many cases, change in properties of the welded material. The metallurgical changes suffered in the welded joint, occur during solidification and cooling of the material, being of importance, the evaluation of such phenomena, involving the welding thermal cycles. Thus, the development of a desirable set of mechanical properties or not, is a result of the phase transformations undergone by the material during the process, and the relevant study of such conditions and metallurgical phenomena that might help in better control and continuity of mechanical properties as is the case of the heat treatments after the welding process, so it is important to review some heat treatment conditions in a given material, to evaluate for example, the resulting microstructure and hardness corresponding to the condition imposed, where evaluating regions of higher brittleness or hardness of greater or condition to provide greater uniformity in this parameter.

2. WELDING PROCESS

The welding process is a process of coupling forces is based on microscopic and can be described as the union of two materials, using a heat source with or without application of pressure. It is an operation that seeks the union of two or more parts or used for surface coatings, and is considered one of the main processes used in the permanent union of metal parts with various applications. During the process the application of heat is inevitable and may be alterations in the microstructure of the material which is not always desirable and acceptable, often, causing changes in material properties. The metallurgical changes suffered in the welded joint, occurs during solidification and cooling of the material, having importance in the evaluation of such phenomena involving phase transformations in the material (Marques et al. 2009). The welding coating is generally used in carbon steel or low alloy consisting of depositing a filler metal on a surface of the base metal. One advantage of this method is to improve the corrosion resistance of these materials used in various applications, providing a longer life for the use of components and mechanical structures. In the application of welding coating on AISI 8630 modified with carbon steel alloys, one advantage is the good semelhancia chemical composition between the two materials, providing better dilution between the interfaces of the materials involved. Studies on the use of nickel alloys show the difficulties encountered in using this material as the filler metal such as carbon steel jacket, failures may occur in the interface region of the material and result in non-uniform properties throughout the parent metal and metal addition (Bernasovsky, 2006; Lundin, 1982). This coating application is also widely used when secessita is a welding with different materials, or welding between dissimilar steels, widely used in joints of carbon steel, stainless steel and nickel alloys in petrochemical industries. Studies such as Smith (2009), the main applications of welding dissimilar materials are in unions and coating metals having different structures and properties. Bridges (2012), reports on his work in which welding dissimilar generally uses one layer deposition welding of the materials involved before final welding. This deposition is considered a technique used to accommodate the stresses generated at the interface of base metal and weld metal, expanding the application of this technique to better results in the process.

3. HEAT TREATMENT IN WELDED JOINTS

The heat treatment can be considered as a set of operations that are submitted materials in controlled conditions of temperature and cooling rate. This operation aims to change to the microstructure and consequently the properties the material. Evaluating the literature Chiaverini (2002), report that the main objectives of the heat treatment in the application the welds are stress removal, homogenization the hardness, increase resistance mechanic, improved ductility and improved corrosion resistance. In applying the heat treatment in the welding process, generally classified as processing of pre-heating and post-heating, improves the solderability the material. For heat treatment after the welding process, the main objectives are: reduction of residual stress: reduction and homogenization of hardness, improved toughness of the weld metal and the HAZ and reduced sensitivity to stress corrosion failure. Generally, in a welded joint, applies normalization, and tempering treatments, such as stress relief in the material. Studies related to the effects of heat treatment on steel 8630 are reported in Catarin (2011) and Bridges (2012). With use of a coating deposited on the AISI 8630 may occur at the interface between the coating and the base metal regions with a large change microstructure and high chemical gradient, resulting in regions with varying mechanical properties such as hardness increase with decrease the presence toughness martensitic phase. The connection zone between the base material and the filler material, may show in neighboring regions, fragile areas, and may fail when the component is subjected to tensions arising from the use. An alternative to increasing the hardness of the welded interface generated by the presence of the martensitic phase is conducting heat treatment of stress relieving. The treatment should be evaluated and considered a temperature that provides fewer problems in the material. Therefore, taking into consideration the application should be evaluated the mechanical behavior and microstructure of welded samples and subjected to heat treatment cycle.

4 – METHODOLOGY

The methodology is illustrated in Figure 4.1, in achieving the expected results in the research.

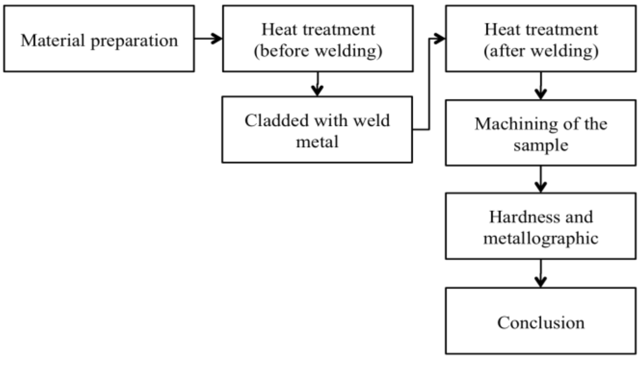

Figure 4.1 - Metodologia

4.1 - Materials used

The base material used was AISI 8630 steel as the chemical composition of Table 3.1. This steel is medium carbon low alloy being originated from forged bars, resulting in plates measuring: 210 x 50 x 28 (mm). Before the coating process by welding, the metal was heated at 872 ° C remained for 1 hour followed by cooling in water, and then the material was annealed at a temperature of 677 ° C for 2 hours, resulting in base metal ready for coated. The filler material was used to coat the solid wire in carbon steel, regulated by AWS A5.28, ER80S-D2 with classification and Table 3.2, as presented in Table 3.1. We used the gas active CO2, with a flow of 25 l / min. thus characterizing a process Metal Active Gas Welding (GMAW).

Table 3.1 – Chemical composition of base metal

Material	C	Si	Mn	P	Cr	Mo	Ni	Al	Cu	V
AISI 8630	0,33	0,26	0,84	0,007	0,92	0,38	0,81	0,006	0,09	0,015

Tabela 3.2 – Chemical composition of adition metal – 80S-D2 (%)

Material	C	Si	Mn	P	Mo	Ni	S	Cu
80S-D2	0,08	0,60	1,95	0,012	0,50	0,02	0,012	0,10

4.2 – METHODS

4.2.1 – Process parameters

For the coating MAG welding to the AISI 8630 was considered: welding speed: 20 cm / min; wire speed: 7m/min; Voltage: 26 V; stickout: 14 mm and welding energy of 1.4 kJ / mm . With the parameters defined, the material was coated with the metal 80S-D2 to yield a thickness of 4 mm and a total of 8 cords and two layers. The coating process was carried out by welding along the thickness of 28 mm. After the completion of the process, the material was subjected to heat treatment, according to item 4.2.2.

4.2.2 - Thermal treatment of coated material

The plates were conditioned in a metal box and covered with iron filings then set the parameters of the oven using a heating rate of 20 °C per minute, two temperature ranges for each condition studied. A maximum temperature to be reached 620 °C and 720 °C both with a time duration at the maximum temperature set 2 hour followed by cooling in air.

4.2.3 - Determination of microhardness

The determination of the microhardness, is justified by the need to evaluate the microhardness of the individual constituents of a microstructure, analyzing the existence of brittle phases in the material, and to evaluate the fusion line or connection zone between the weld metal and base metal . Sample preparation for the analysis was carried out with the metallographic preparation of the material and inlay bakelite. After preparation, the test was performed on (Micro Hardness Tester), with a test load of 980.7 mN (HV 0.1), a time of 15 seconds and with the aid of a lens with 40X magnification. Conforms to ASTM E92-82, the minimum distance between an impression and another should be at least twice the value of the diagonal of the previous print. The indentations were performed along the weld bead as well as the interfaces between HAZ and MB, evaluating the distribution of microhardness in these interface regions, according to ASTM E92-82.

4.2.4 - optical microscopy

The study and characterization of the microstructure will be performed by optical microscopy and image acquisition will be accomplished electronically with the program image analysis. Sample preparation should follow the ASTM E3-01, involving the steps of embedding, grinding, polishing and attack suitable reagent required for development of the microstructure. As a requirement analysis for a better understanding of the results, micrographic analyzes were performed to determine the influence of the heat treatment process, especially in the region of greatest weakness, HAZ, identifying the microstructure representation in the region.

5 – RESULTS

5.1 – Microhardness test

The results of microhardness conditions evaluated showed up as shown in Figure 5.1. In the evaluation, the data were plotted on each condition evaluated and compared. Figure 5.1 shows the variation of Vickers hardness (HV 0.1) along the longitudinal sections of the regions of the HAZ and MB, which were performed with a confidence interval of 95% for all conditions: without PWHT with PWHT to 620 °C and PWHT to 720 °C). At the temperature of 620 °C realizes a better performance micro-structural level of hardness since there was softness in linking regions of the MB and HAZ, with the gradual evolution of the hardness. One can also minimizing the toughness in these same regions (MB, HAZ), which implies a reduced risk of embrittlement. At the temperature of 720 °C has been reduced although the toughness of the HAZ compared with the temperature of 620 °C, the uniformity of results was not observed, compared to the temperature of 620 °C, which is measured in the microstructure of the material. The NACE MR0175 is recommended that the values of Vickers hardness in the HAZ must be less than or equal to 250 HV. According to Figure 5.1, the values are seen to use the standard temperature of 720 °C, presenting the results of the Vickers hardness at a temperature of 620 °C above the recommended amount.

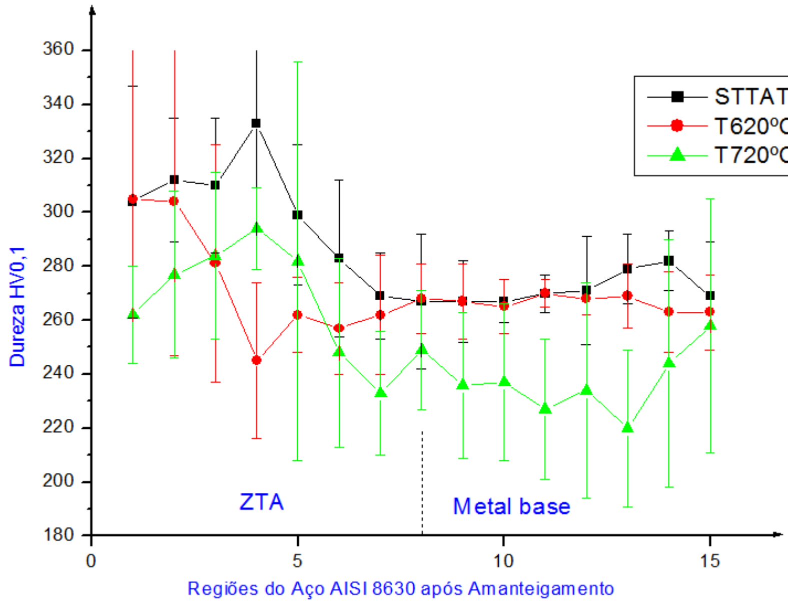

Figure 5.1 – result of Microhardness

5.2 – Evaluation of Microstructure

To evaluate the microstructure remained the same scale to evaluate the HAZ performed for each condition. The non-heat treated 8630 steel stress, there is shown that the microstructure is predominantly martensite resulting from a welding process, as shown in Figure 5.3. In Figure 5.4 and 5.5, respectively relating to the conditions of the heat treatment of 620 to 720 °C, occurs for the condition of 620 °C, the presence of the evaluation of tempered martensite microstructure, the microstructure presenting form more uniform in the sample. In the evaluation of heat treatment of 720 °C, there is greater diffusion of carbon in the material regions providing more concentrated area ferrite, which may be assumed that the microstructure is tempered martensite and ferrite as the own variations microhardness commented in the region.

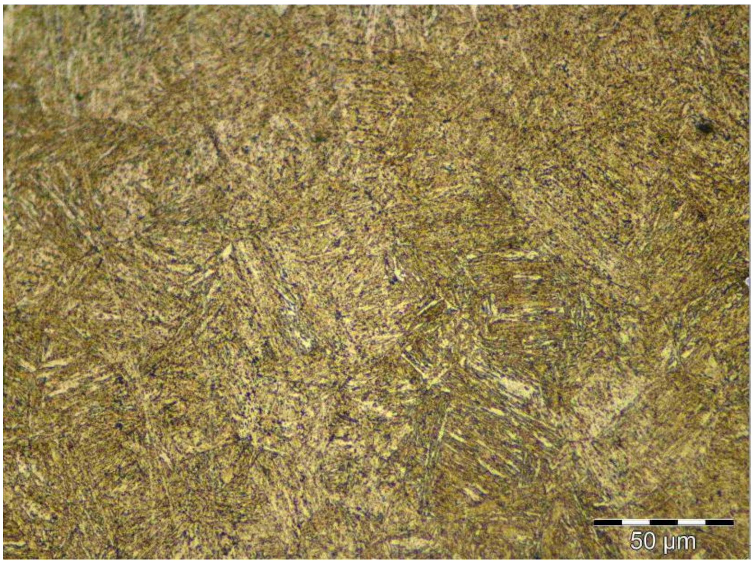

Figure 5.2 – Metallographic the HAZ

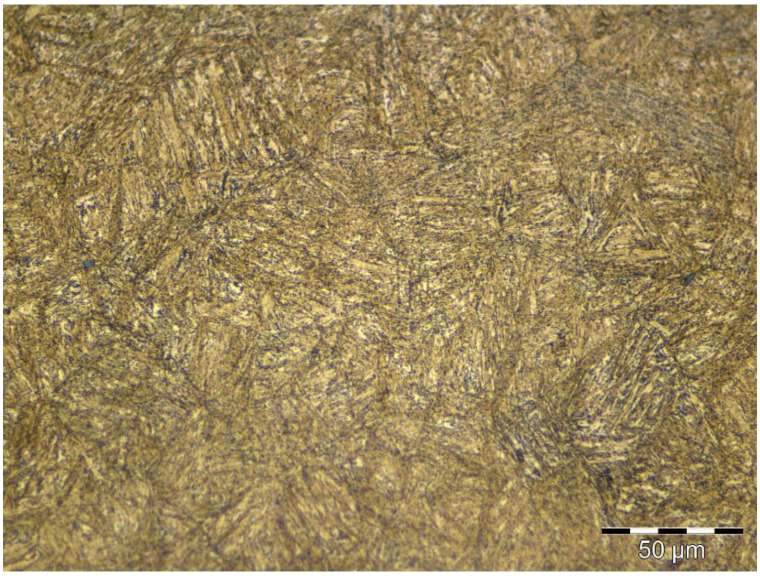

Figure 5.3 – Metallographic the HAZ 620 °C

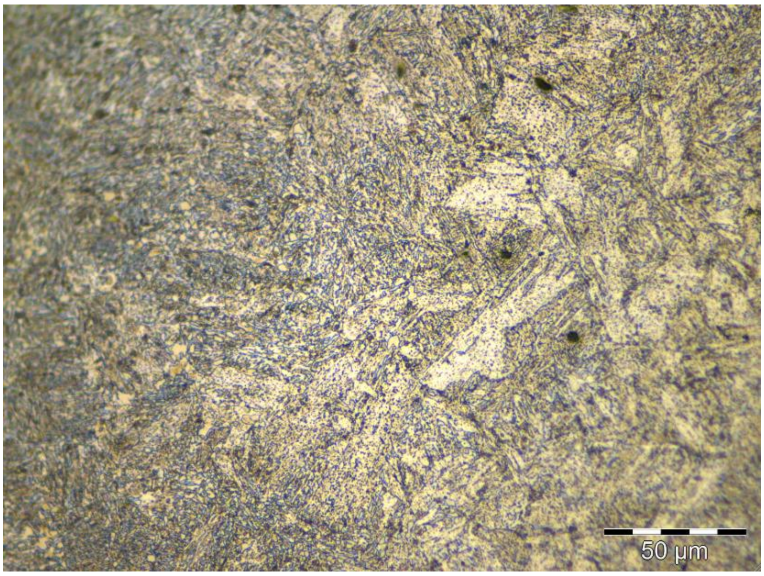

Figure 5.3 – Metallographic the HAZ 720 °C

6 – CONCLUSIONS

Based on the results, we can conclude that the temperature of 620 °C satisfactorily meets the need to reduce the hardness and consequently the minimization of fragile regions. The study compared to the temperature of 720 °C, show that with increasing treatment temperature hardness results presented below, which is justified by austenitizing the material, providing a greater change of microstructure, probably due to the greater diffusion of carbon in materials. Thus, the heat treatment for stress relief is highly recommended to use a temperature of 720 °C for a period of two hours and cooled in air, meeting the requirements of NACE MR0175.

7 – RESPONSIBILITY NOTICE

The authors are the only responsible for the printed material included in this paper.

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