ANALYSIS OF THE EFFECT OF PLASMA CUTTING ON DEFORMATION OF THIN STEEL PLATES IN HULL CONSTRUCTION

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ABSTRACT

The deformation occurring in steel plates (thickness < 10 mm) under hot conditions in hull construction was analyzed. Plasma cutting and MAG welding were considered as the primary heat sources. Their effect was analyzed experimentally by first analyzing the effect of plasma cutting and then the effect of welding. Plate thickness used for this purpose was 6mm and fillet type welding was used. The effect of plasma cutting was studied by performing a micro-structural analysis as there weren’t any visible deformation. The results obtained from this analysis is presented with the respective micrographs of the samples and supported by the micro hardness graphs.

1. INTRODUCTION

A perennial problem faced by the ship building industry is the deformation of the thin steel plates which are used in hull construction. This deformation can be caused by many of the assembly procedures used in ship fabrication. But the principle cause is the intense heat conditions that the panels undergo. Prime among the heat sources is plasma cutting and welding.

One of the main reasons for the distortion being caused is that at a given moment, simultaneously a panel would undergo multiple processes which generates considerable amount of heat. Although plasma cutting is widely accepted as a precise cutting method with very little heat generated, our objective during this research was to establish whether there are any structural changes being caused as by virtue of plasma cutting in addition to the contribution of welding on the deformation of the steel plates [6].

The sample plates which were got down from the dockyard which were cut by plasma cutting and were subjected to a micro-structural analysis and after analyzing the effect of plasma cutting

2. METHODOLOGY

First the effect of plasma cutting was analyzed by the following steps;

2.1. Sample preparation

Samples of 10mm*50mm*7mm dimensions were cut from the plates by using the power saw. The locations where the samples were cut was decided so as it represents the effect of plasma cutting directly.
Subsequently the samples were grind and polished before etched by nital.

2.2. Micro-structural analysis

The prepared samples were analyzed by using the light microscope to identify areas where there is a structural change is present.

2.3. Micro hardness testing

The micro hardness of the samples were measured by using the Micro hardness tester to arrive at a variation of hardness values and further establish the change of hardness with the structural change.

3. RESULTS AND DISCUSSION

There was no visible deformation apparent in the fabricated plate. Samples from the plate were subjected to a microstructural analysis to identify any structural change at the micro-level and correlate them with the deformation or the absence of deformation. And then subsequently the micro-hardness of the samples were was obtained, with hardness being used as a supporting evidence to further confirm observations about structural change and the deformation caused by it.

Three samples were chosen from different locations and were named as $B_{1,2}$ and $N_{1,2}$ with N representing the narrow end being subjected to 2 plasma cuts from both the ends, and B representing the broad ending where only one end is significantly affected by the plasma cut.

According to the micrographs the effect of plasma cut is only up to 80µm from the cutting edge as only within that region there are fine grains visible. Similarly the hardness profile exhibits similar variation within the 80µm region.

The micrographs and the hardness profiles for the respective samples are shown below;

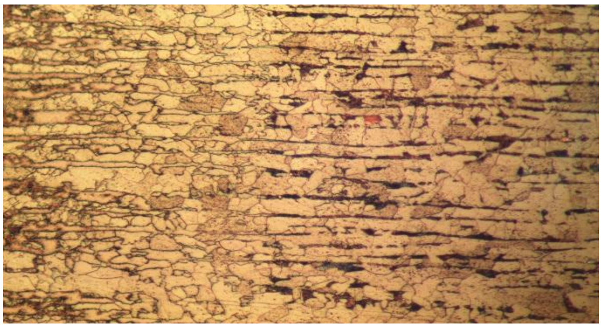

Figure 1 MICROGRAPH FOR N1

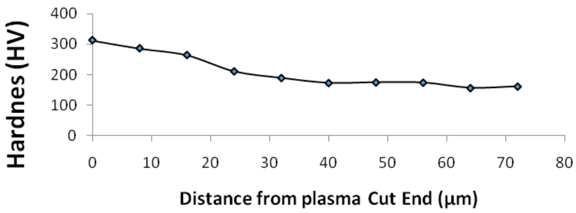

Figure 1.1 HARDNESS PROFILE FOR N1

Figure 2 MICROGRAPH FOR N2

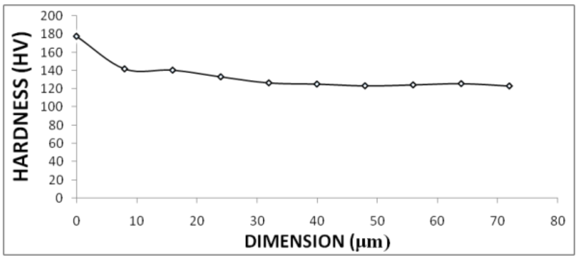

Figure 2.1 HARDNESS PROFILE FOR N2

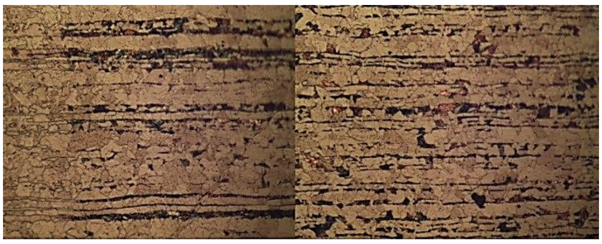

Figure 3 MICROGRAPH FOR B1

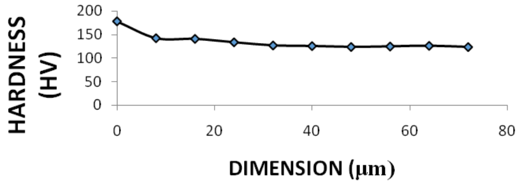

Figure 3.1 HARDNESS PROFILE FOR B1

4. CONCLUSIONS

Out of the two heat sources the effect of plasma cutting is miniscule and it only causes structural change at a microstructural level and that too in a very tiny range of 80 µm from the plasma cut edge. Therefore the major cause for the deformation is welding.

5. REFERENCES

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