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التوثيق الالكتروني والميكروفيلم

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Effect of Nd:YAG Laser Parameters on Cutting Quality of Ultra Low Carbon Steel Sheets using sensors systems

Thesis

Submitted for partial fulfillment of master degree in Industrial Applications and Laser Materials Processing

By

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Summary of the thesis

Lasers are unique heat source with high energy density, and have been used in various industrial applications, especially laser materials cutting. Because of its accuracy and efficiency, and it does not require critical environment around the sample during the processing by using the laser.

There are many non – linear interaction factors responsible for laser cutting process performance due to high heating and cooling rates induced by the laser irradiation. The identification of the dominant factor for which variation could lead to large effects on the cut quality is important.

In this research, the gas pressure, laser power and scanning speed were selected as the cutting parameters involved studying the effects of these cutting parameters on the laser cut quality, such as narrow kerf width, narrow Heat Affected Zone (HAZ) area, low surface roughness and oxide layers width.

Materials and Experimental Techniques:-

Commercial low carbon steel sheets were used in the present work to investigate the effect of laser cutting parameters on the cut quality. Size of the specimens were 50mm x 50mm, with thickness of 1.25 mm all the specimens were cut by CW (continues wave) Nd:YAG laser at wavelength of 1064 nanometer.

The laser cut specimens generated were characterized to ascertain the various attributes important for determining the resulting cut surface quality, which are: minimum surface roughness, no dross formation, no burning defects, a narrow kerf width, a narrow HAZ width, and no oxide

layers approximately. Another cut with 30mm length, was made in the middle of the specimen to measure the kerf width, heat affected zone area (HAZ), microhardness, and oxide layers for studying the effect of the processing parameters on the cut quality.

A CCD camera was used with Laser Beam Analyzer to monitor the laser cutting process during changing the processing variables.

Some of the parameters that were selected from all the trials were chosen to be the phases of this work trying to obtain the optimum parameters for the good cut quality. Pre selected values of 337 watt, 700 mm/min, and 5 bars for power, scan speed and gas pressure respectively, were selected based on phase I at each optimum parameter variable. Various experiments were made which resulted to be the same for every series based on the fact that, all the other process parameters were kept constant, except one of the parameters had to be changed.

Results:-

Analytical results were made for every variable with respect to the value of the kerf width, microhardness value, HAZ area, oxide layers width and surface roughness value. SEM was made to observe the surface morphology of the cut edge. And some photographs were taken for the top and bottom of the cut edge. Also microstructure analysis was made to some of the specimens. According to the results of this work, window of the optimum values of the three parameters were obtained, including the best cutting quality.

The results were discussed and compared with previous researchers.

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