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Modeling on surface cut quality of CO_2 laser cutting for Austenitic Stainless steel sheet

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Abstract

CO_2 Laser cutting is the widely used in the cutting process in which quality of finished product mainly depends on the input parameters are Laser beam power, Cutting speed and Assist gas pressure. By considering responses are Heat affected zone of the AISI 304 Stainless Steel material. These work we are using response surface methodology are used, in this techniques are very helpful to identified to develop the different mathematical modeling of this processes finally best mathematical model are developed.

Introduction

Laser cutting is one of thermal based cutting technology. The cutting of sheet metal in CO_2 laser to achieve high speed cut. But cutting edges are damages are occur and HAZ. Although, Heat affected zone is usually affected with laser beam power and gas pressure, Gas pressure and laser beam power are utilized to evacuate the molten material and melting of material respectively [1]. The HAZ of the material depends mainly on different gas types and pressures [2]. Further the process of CO_2 laser cutting with continuous and pulsed modes was examined with some researcher and their results revealed that pulsed mode generated good surface quality with moderate power. And continuous mode encourages the high cutting speed [3].

The lower cutting speed improves the cutting edge quality and surface roughness during CO_2 laser cutting. In that view many researchers were employed to develop mathematical models for predicting accurate experimental values [4], [5]. Laser cutting process consumes very high cost for carrying out the production. In response the DOE concepts was utilized by some of the researchers to reduce the experimental run. [6], [7]. So this work tries the Box Behnken design for conducting the experiments.

In this work the Heat affected Zone are considered as dependent variables and the independent variables are Laser Beam Power, cutting speed and Assist gas pressure. The influences of cutting parameters on dependent variables are identified with the aid of ANOVA table [8]. The dependent and independent variables interaction and their relations are formulated with the help of regression analysis to develop mathematical model linear, 2FI, quadratic, Cubic and Modified Model are generated [9].

Section snippets

Experimental procedure

The experiments are carried by AMADA make CO_2 Laser cutting machine as shown in Fig. 1 and the specification of machine as shown in Table 1. The work piece considered for this work is AISI 304 Stainless steel 2.5 mm thickness sheet are used. The input parameters considered are Laser beam power, cutting speed and gas pressure. Three levels of each factor are considered. For reducing the experimental trial runs and cost associated for conducting the experiments the Box-Behnken Design was used and …

Result and discussion

Response surface methodology is a collection of mathematical and statistical techniques for the modeling and analysis of problems in which a response [11]. In order to model the interactions between these variables, the response surface methodology was assumed Eq. (1).

$$R = b_0 + \sum_{i=1}^{2} b_i X_i + \sum_{i=1}^{2} b_{ii} X_{ii}^2 + \sum_{i=1}^{2} \sum_{j=1,\,(i<j)}^{2} b_{ij} X_i X_j + \varepsilon \ldots$$

Conclusion

The main objective for this work to develop the Mathematical model for Heat affected Zone in AISI 304 Stainless steel sheets. The following conclusion are made

- Response surface methodology is used in this work it has very effective method.…
- The mathematical model was developed with considering parameters are laser power, cutting speed, gas pressure and surface Heat affected Zone is response.…
- The developed mathematical models can be found out to predict response values within the limits of…

…

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but not limit to laser-removal (e.g., cleaning, cutting, drilling, etc.) [1–4], laser-deposition (e.g., welding, cladding, 3D printing, etc.) [5–8], and laser-enhancement (e.g., shock peening, hardening, texturing, etc.) [9–12]. It has been recognized that lasers, when compared with traditional manufacturing technologies [13,14], can offer clean, high speed, and easily automated processes with increased functions, accuracy, and efficiency.…

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