

Experimental Investigation and Analysis of Laser Cutting Process Parameters

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Abstract— Laser cutting is one of the popular unconventional processes in which complicated shapes of various types of materials were being cut. This paper investigates the effects of parameters associated with CO₂ laser cutting process of aluminium plate because aluminium is difficult to cut using laser due to back reflection and low penetrating power of laser. The experiment was carried out on the basis of L₉ Taguchi's orthogonal array. The laser cutting parameters viz. laser power, cutting speed, assist gas pressure, and stand-off distance were arranged at three levels. It has been found that the quality of the cut edges and kerf are affected by laser power, cutting speed, assist gas pressure, and the stand-off distance. From the investigation it is found that the parameters such as laser power, cutting speed, stand-off distance have major impact on surface roughness and kerf width. Whereas, the effect of assist gas pressure over surface roughness and kerf width is less significant.

Keywords— CO₂ Laser, Laser power, Cutting speed, Assist gas pressure, Stand-off distance, Surface finish, and Kerf width.

I. INTRODUCTION

LASER stands for Light Amplification by Stimulated Emission of Radiation. Laser has a wide range of applications, ranging from military weapons to medical instruments. In industries laser is used as an unconventional method for cutting and welding. The main advantage of laser cutting is that, it is a non-contact operative method from which a good precise cutting of complicated shapes can be achieved. Also laser can be used to cut variety of materials like wood, ceramic, rubber, plastic and certain metals.

The most commonly used types of laser for laser cutting are CO₂ laser and Nd: YAG laser. CO₂ laser dominate this application due to their good quality beam combined to high output power and compared with other conventional mechanical processes, laser cutting removes little material, involves highly localized heat input to the workpiece thereby minimizing distortion and offers no tool wear. CO₂ laser has a wavelength of about 10.6µm due to this CO₂ laser has high power output when compared to Nd: YAG laser. Thus for cutting aluminum and aluminum based alloys CO₂ laser can be used.

In this paper, experimental work has been done to explore the influence of process parameters on the cut quality, such as: surface roughness and kerf width.

II. WORKING PRINCIPLE

Miroslav Radovanovic and Milos Madic [1] stated that laser beam is a high intensity beam of light that can be tightly focused onto a spot of only 0.1 to 0.2 mm in diameter. The high power density of the focused laser beam in the spot melts or evaporates material in a fraction of a second and the molten material is removed with a coaxial current of the assist gas as shown in Figure 1.

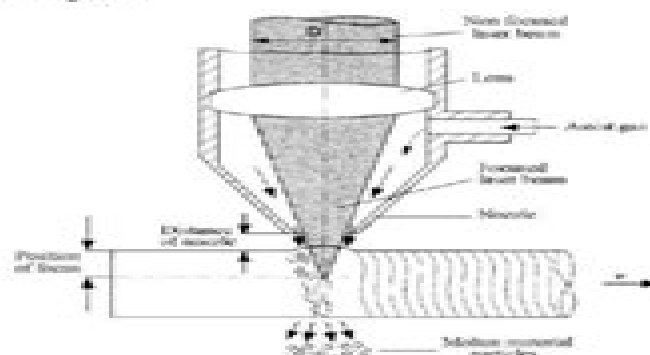


Figure 1. Laser beam cutting [1]

III. LITERATURE REVIEW

A. Surface roughness.

Surface roughness is an effective parameter representing quality of a machined surface. Thawari, G. et al. [2] observed that surface roughness value reduces with increase in cutting speed and frequency and decrease in laser power and gas pressure. Milos Madic et. al. [3] observed that the cutting speed should be kept at the highest level (7m/min), assist gas pressure at the lowest level (3 bar), while laser power should be kept at an intermediate level (0.9 kW) for obtaining minimal surface roughness. Sundar et al. [4] concluded the following: decrease in assist gas pressure shows a good decrease in surface roughness; higher cutting speed produces low surface roughness; there is a direct relation between the laser power and the surface roughness and the

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