

CHAPTER 1

INTRODUCTION

1.1 PROJECT BACKGROUND

The term "laser" is an acronym for Light Amplification Stimulation Emission of Radiation. A medium, either gaseous or solid, is excited to emit a monochromatic (single wavelength) coherent source of light. This light can be focused to a point source, called spot size, resulting in very high power densities, capable of vaporizing various materials. By controlling the power density, through the laser power and spot size, and with the assistance of gases, laser cutting and welding can be achieved.

Laser beam cutting (LBC) is achieved by the radiation emitted by a focused beam of coherent light with the assistance of a high pressure gas. An assist gas is used to remove the melted and volatilized materials from the beam path. Both metallic and non-metallic materials can be cut by the laser beam process. [T. Norikazu, Y. Shigenori and H. Masao, (1996)] The output beam is often pulsed to very high peak powers in the cutting process. Pulsing generally increases the travel speed of the cutting operation.

Advantages of using LBC are, materials with complex figures can easily be cut by incorporating CNC motion equipment, LBC has high cutting speed, Low distortion, very high edge quality and most important thing is LBC has a minimal heat affected zone (HAZ). [4]

Heat Affected Zone HAZ - Adjacent to the weld metal zone is the heat-affected zone that is composed of parent metal that did not melt but was heated to a high enough temperature for a sufficient period that grain growth occurred. Heat affected zone is that portion of the base metal whose mechanical properties and microstructure have been altered by the heat of welding.

The heat affected zone is subjected to a complex thermal cycle (sudden heating followed by rapid cooling) in which all temperatures from the melting range of the steel down to comparatively much lower temperatures are involved and HAZ therefore consists of a series of graded structures ringing the weld bead. HAZ usually contains a variety of microstructures. [I.A. Almeida, W. Rossi, M.S.F. Lima, J.R. Berretta, G.E.C. Nogueira and N.U. Wetter *et al.*, (2006)]

Surface roughness is the measure of the finer surface irregularities in the surface texture. These are the result of the manufacturing process employed to create the surface. Surface roughness Ra is rated as the arithmetic average deviation of the surface valleys and peaks expressed in micro inches or micrometers. ISO standards use the term CLA (Centre Line Average). Both are interpreted identical. [G. Thawari, J.K. Sarin Sundar, G. Sundararajan and S.V. Joshi, (2005)]

1.2 PROJECT OBJECTIVE

1.2.1 To investigate the width of Heat affected zone of the material cut with LBC machine. To analyze the Surface roughness of the material cut with LBC machine.

1.2.2 To obtain a relationship between cutting quality and machining parameters.

1.3 PROJECT SCOPES

1.3.1 Laser parameters considered are pulse duration, laser power, the nozzle gap, cutting angle and the air pressure.

1.3.2 Experimental plan will be designed with Response Surface Method.

1.3.3 Shape of experiment material will be designed in Art Cam or in SOLIDWORK and cut using Laser Beam Cutting machine.

1.3.4 Analysis of the width of Heat affected zone (HAZ) by using optical microscope with analyzer.

1.3.5 Surface roughness analyze with Perthometer.

1.4 PROBLEM STATEMENT

Laser beam has been commonly used for machining for various materials. One of the problems with laser machining is unwanted heat-affected zone HAZ, which downgrades the quality of the cut surface of the material. Heat-affected zone HAZ occurs very often due to lack of information on the characteristic of the laser beam.

1.5 PROJECT PURPOSE

Purpose of this project is to analyze experimentally the acrylic cut by laser, to see the mechanical properties, heat affected zone and surface roughness changes as the parameters of the laser vary.

1.6 PROJECT AIM

Great hope that, by complete the project, it could help to analyze the changes of mechanical properties as the parameters of the laser varies. Hence helps manufacturers to produce a quality cutting surface.

1.7 PROJECT QUESTION

Experimental Study of the Heat Affected Zone (HAZ) and Surface Roughness on Laser Beam Cutting (LBC) on Acrylic Sheet.