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Analysis of Steel Cutting Results Using a Semi-Automatic Oxy-LPG Gas Steel Cutting Machine

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Abstract

The manufacturing industry, steel is one of the main materials in making every tool. Steel itself has different thicknesses according to its use, ranging from 1 mm-20 mm. The thicker the steel used, the more difficult the fabrication process, especially cutting the steel, will be. In general, the tool used to cut thick steel is Gas Cutting with the type of gas used being Oxygen and LPG (Liquified Petroleum Gas), or you can also use Oxygen and Acytelene gas, this is more effective when compared to cutting steel or steel using cutting grinder. However, the operator who operates the cutting gas greatly influences the neatness of the cut results. Given these problems, this research aims to analyze the results of cutting steel or steel using semiautomatic Oxy-LPG cutting gas, and then the results of this research are compared with the results of cutting steel or steel using conventional Oxy-LPG cutting gas.

Keywords: Gas Cutting, Oxy-LPG Welding, Oxygen, Steel Cutter

Abstrak

Industri manufaktur baja merupakan salah satu bahan utama disetiap pembuatan alat. Baja sendiri memiliki ketebalan yang berbeda-beda sesuai dengan kegunaannya, mulai dari 1 mm-20 mm. Semakin tebal baja yang digunakan, maka proses fabrikasi terutama pemotongan baja tersebut akan semakin sulit. Pada umumnya, alat yang digunakan untuk memotong baja yang tebal adalah Gas Cutting dengan jenis gas yang digunakan berupa Oksigen dan LPG (Liquified Petroleum Gas), atau bisa juga menggunakan gas Oksigen dan Acytelene, hal ini lebih efektif jika dibandingkan dengan memotong baja atau baja menggunakan gerinda potong. Tetapi operator yang mengoperasikan gas cutting ini sangat mempengaruhi kerapian hasil potongan. Dengan adanya masalah tersebut, penelitian ini bertujuan untuk menganalisis hasil potongan baja atau baja menggunakan gas cutting Oxy-LPG semiotomatis, dan kemudian hasil penelitian ini dibandingkan dengan hasil potongan baja atau baja menggunakan gas cutting Oxy-LPG konvensional.

***Kata-kata kunci**: Gas Cutting, Las Oxy-LPG, Oxygen, Pemotong Baja*

1. Introduction

Steel or steel cutting generally uses laser plasma cutting and gas cutting machines. Gas Cutting Machine is a tool used to cut steel or steel with the types of gas used are Oxygen and LPG, or Oxygen and Acytelene. The way gas cutting works is oxyfuel welding, this welding relies on burning a mixture of oxygen gas with LPG or oxygen and acetylene [1] [2]. In cutting steel or steel, there are several parameters that influence the cutting results, such as the distance of the arc from the workpiece, the size of the arc (occurring in the cutting gas), and the cutting speed [3] [4]. If these parameters are hampered, the resulting impact will affect the level of roughness of the cut surface. This surface roughness will affect the results of the manufacturing process, such as difficulties in joining plates because one or both sides of the surfaces to be joined have a high level of roughness, and this will result in poor joining results. If the connection results are not good, it will affect the manufacturing results of a material.

Semi-automatic gas cutting machine with constant cutting speed and can be adjusted according to needs. This constant cutting speed and straight arc movement can certainly improve the results of cutting done manually, because the cutting results using a semi-automatic gas cutting machine will be smoother and neater when compared to manual gas cutting [3]. Then, the thickness of the steel plate also influences the cutting speed, because the thicker the steel plate, the smaller the cutting speed given so that the cutting results can be categorized as good [5] [6] . This research uses carbon steel specimens with varying thicknesses of 3 mm, 5 mm and 8 mm. The aim is to determine a good cutting speed on carbon steel with a thickness of 3 mm, 5 mm and 8 mm. Given these problems, the author created an Oxy-LPG gas cutting machine.

2. Method

2.1 Place and Time

This research was conducted at the Construction and Welding Laboratory of the Yogyakarta LPP Polytechnic. Starting from the design and engineering stages of the semi-automatic gas cutting machine, fabrication and assembly, then the test specimens are cut using the semi-automatic gas cutting machine and the cutting time rate is recorded [7].

2.2 Research Flow

This research was carried out in the order shown in **Figure 1**.

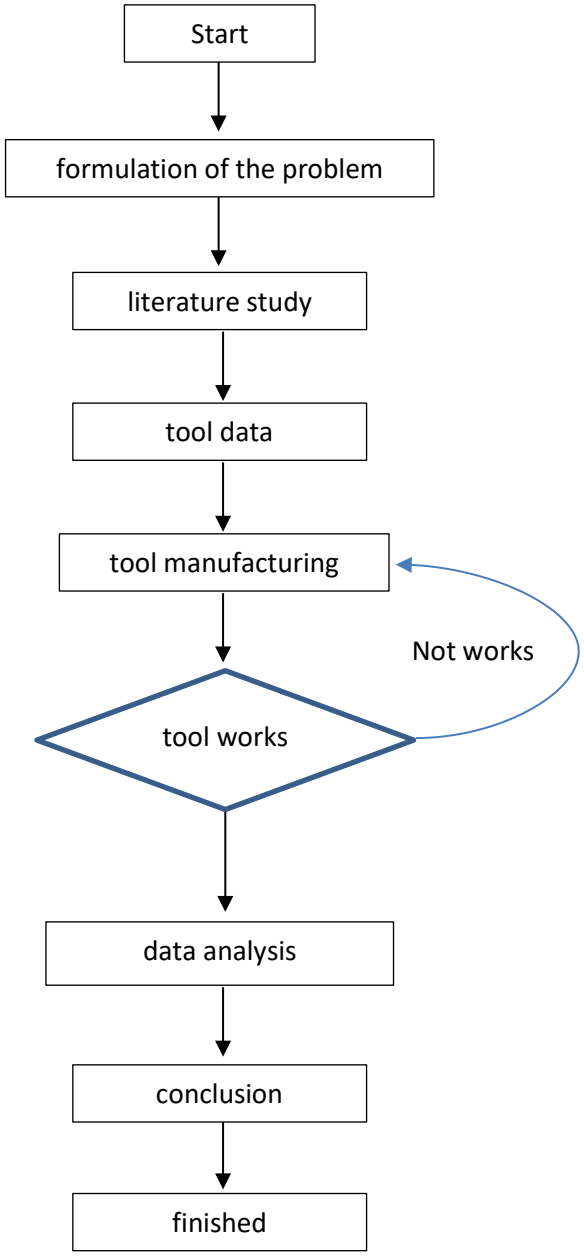


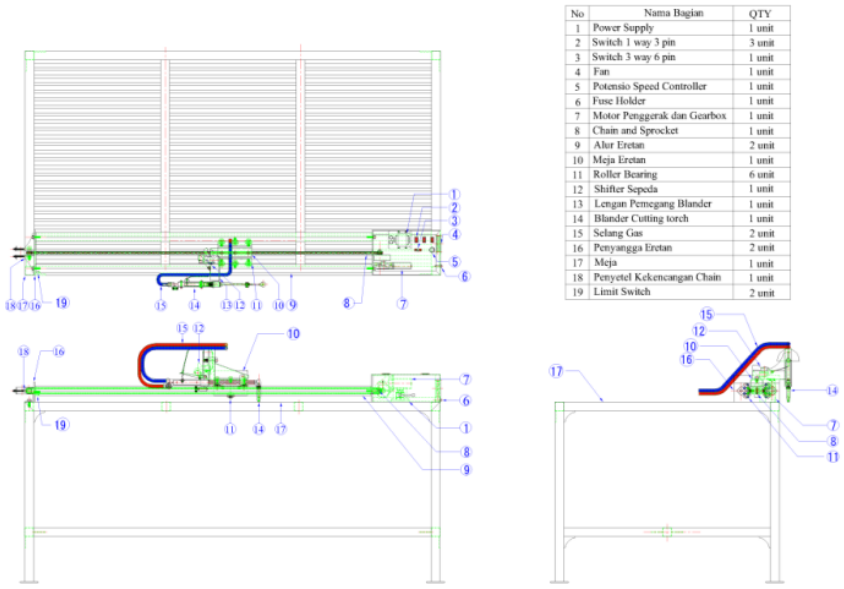
Figure 1. Research Flow.

This research uses an experimental method by conducting direct trials on test materials or test specimens. The test specimen used in this research was a carbon steel plate 100 mm long with varying thicknesses of 3 mm, 5 mm and 8 mm. The type of gas used in this semi-automatic gas cutting is oxygen gas with a pressure of 2 kg/cm^2, and LPG (Liquified Petroleum Gas) gas with a pressure of 0.2 kg/cm^2. Then the type of cutting torch used is the strong 8 model and nozzle no. 1. The use of nozzle no. 1 is because the thickness of the steel used is 3-8 mm, and nozzle no. 1 is intended for steel that has a thickness of 3-10 mm.

3. Results and Discussion

3.1 Design and Design Results of the Semi-Automatic Gas Cutting Machine

The following are the results of the design and design of a semi-automatic gas cutting machine, which can be seen in **Figure 2** and **Figure 3.**



No	Nama Bagian	QTY
1	Power Supply	1 unit
2	Switch 1 way 3 pin	3 unit
3	Switch 3 way 6 pin	1 unit
4	Fan	1 unit
5	Potensio Speed Controller	1 unit
6	Fuse Holder	1 unit
7	Motor Penggerak dan Gearbox	1 unit
8	Chain and Sprocket	1 unit
9	Alur Eretan	2 unit
10	Meja Eretan	1 unit
11	Roller Bearing	6 unit
12	Shifter Sepeda	1 unit
13	Lengan Pemegang Blander	1 unit
14	Blander Cutting torch	1 unit
15	Selang Gas	2 unit
16	Penyangga Eretan	2 unit
17	Meja	1 unit
18	Penyetel Kekencangan Chain	1 unit
19	Limit Switch	2 unit

Figure 2. Gas Cutting Machine Design Results

Figure 3. Gas Cutting Machine Planning Results

3.2 Semi-Automatic Gas Cutting Cutting Results

At the start of cutting, the steel is preheated with a semi-automatic Oxygen-LPG gas cutting machine to a temperature of between 800°-900°C. Then highpressure oxygen gas (O_2) is sprayed into the heated part and a combustion process occurs which forms steel oxide. Because the melting point of steel oxide is lower than steel, the oxide melts and is blown away by cutting gas or oxygen (O_2), then the semi-automatic gas cutting machine is operated, with this cutting taking place. The category of good cutting results is that the cutting groove is small enough, the

cutting surface is smooth, the slag must be easily peeled off and the top of the cutting edge is not rounded. This has been regulated in standard No.WS-2801 **[6]**.

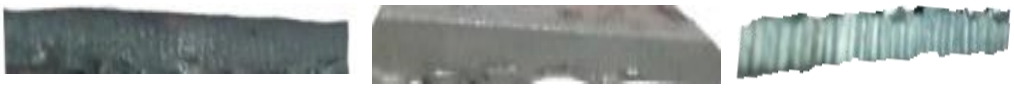
Then the operation of the semi-automatic gas cutting machine is carried out on three types of steel variables, namely steel with a thickness of 3 mm, 5 mm and 8 mm, with the length of each steel variable or test specimen being 100 mm. For cutting results and cutting speed measurements can be seen in **Table 1**.

Table 1. Semi-automatic Gas Cutting Results

Test Variable	Testing To -	Cutting Speed (mm/s)	Cutting Speed (mm/m)	Average Cutting Speed (mm/m)
Thick steel 3 mm	1	5,8	350	118,93
	2	7,61	461	
	3	6,25	375	
Thick steel 5 mm	1	3,44	207	70,48
	2	4,16	250	
	3	3,7	222	
Thick steel 8 mm	1	2,6	158	53,87
	2	2,5	150	
	3	2,7	160	

Based **Table 1**, it can be seen that the thicker the steel being cut, the slower the cutting speed will be. To get good cutting results, what must be considered is the thickness of the steel to be cut, oxygen pressure and LPG gas pressure, cutting speed [5]. The smaller the cutting speed value, the smaller the resulting surface roughness value, the smaller the surface roughness value, the cutting results can be categorized as good. This is because cutting speed greatly influences the surface roughness of the cutting result, the surface roughness value is directly proportional to the cutting speed value **[3] [7]**.

Visually, the cutting results in this study are in accordance with previous studies which concluded that the greater the cutting speed value, the greater the level of surface roughness of the cutting results. The visual cutting results can be seen in **Figure 4**, **Figure 5** and **Figure 6**.



350 mm/m *375 mm/m* *461 mm/m*

Figure 4. Visual results of cutting 3 mm steel

207 mm/m ***222 mm/m*** ***250 mm/m***

Figure 5. Visual results of cutting 5 mm steel

150 mm/m *158 mm/m* *160 mm/m*

Figure 6. Visual results of cutting 8 mm steel

Figures 4, **Figure 5** and **Figure 6**, we can see the differences in cutting results based on cutting speed, the greater the cutting speed value, the rougher the cutting surface will be [3]. A rough cutting surface is the presence of vertical lags (draw lines) that are rough or not smooth.

4. Conclusion

The results of cutting steel using a semi-automatic gas cutting machine are influenced by three things, namely steel thickness, oxygen and LPG gas pressure, and cutting speed. The thicker the steel to be cut to get good cutting results, the smaller the cutting speed value. In this study, the cutting speed that produces good cuts is 350 mm/m for a steel thickness of 3 mm, 207 mm/m for a steel thickness of 5 mm, and 150 mm/m for a steel thickness of 8 mm. Then, the cutting speed also affects the roughness of the cutting surface. The lower the cutting speed, the better the cutting surface or the smoother the vertical lag (draw lines).

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