ASEAN Journal of Science and Engineering 1 (3) (2021) 207-212

ASEAN Journal of Science and Engineering

Journal homepage: http://ejournal.upi.edu/index.php/AJSE/

Optimization of The Oxy-Acetyline Gas Cutting Process on Aisi 1045 Steel Material to Produce Minimum Width Kerf

Mohammad Egie Syahputra, Haipan Salam, Asep Hadian Sasmita

Universitas Pendidikan Indonesia, Bandung 40154, Indonesia
Correspondence: E-mail: egimohammad59@gmail.com

ABSTRACT

This research is intended to determine the optimum combination of parameters and how much the contribution of the parameters of cutting speed, oxygen gas pressure, and nozzle distance to the width of the cutting kerf. This research was conducted with a method, namely Taguchi Design of Experiments (DoEs) by varying the process factors used in the AISI 1045 steel material cutting process. The control factors in this study consisted of three factors, namely cutting speed, gas pressure, and tip distance. The cutting speed and cutting gas pressure are significant factors in the optimization of the AISI 1045 steel cutting process for minimum kerf width with a contribution of 95.6%, while the tip / nozzle height factor is not significant in the optimization of the AISI 1045 steel cutting process for the kerf width minimum. The optimum parameter values to obtain the minimum kerf width in AISI 1045 steel are cutting speed of 250 mm/min, gas pressure of 3 kgf/cm^2, and tip height of 4 mm. Furthermore, the results of the verification tests carried out indicated that the optimal process parameter formula obtained is feasible to use, indicated by the S / N ratio and confidence interval (CI) of prediction and verification that coincide with one another. The optimal process parameter formula can be used as a reference for industrial production activities with a 95% success rate.

ARTICLE INFO

Article History:
Submitted/Received 27 Mar 2021
First revised 29 Apr 2021
Accepted 16 Jul 2021
First available online 20 Jul 2021
Publication date 01 Des 2021

Keyword:
Oxy-fuel Gas Cutting,
AISI 1045,
Kerf,
Taguchi DoEs

1. INTRODUCTION

AISI 1045 steel is one of the most widely used raw materials in the manufacturing industry, cutting oxy-acetyline gas was chosen because it is a steel cutting technique with an economical value, but with an incorrect combination of parameters it can result in a large kerf width or gap resulting in the waste of material resulting in higher production costs.

The review of research studies related to the parameters used in cutting, namely (1) cutting gas pressure (2) cutting speed, and (3) tip / nozzle height (Harish *et al.*, 2017; Ghane *et al*., 2018), in addition there are also pre-heat parameters in several previous studies, namely (1) Preheat, (2) fuel gas pressure, (3) cut gas pressure, (4) material thickness (Munoz – Escalova 2006, Harnicarvora, 2010, Akurt, 2009) so that in previous studies the parameters used were cutting speed, cutting gas pressure, high tip / nozzle, preheat, fuel gas pressure and material thickness as well as based on the results of previous studies the optimal parameters for the Oxy-acetyline cutting process have not been found and formulated and the effect of each parameter used has not been fully analyzed.

This research is intended to determine the optimum combination of parameters and how much the contribution of the parameters of cutting speed, oxygen gas pressure and nozzle distance to the width of the cutting kerf, and the results of this study are to study the effect of each cutting parameter, how the cutting contributes and become reference cutting data steel AISI 1045 with a thickness of 14 mm.

2. METHODS

This research is intended to determine the optimum combination of parameters and how much the contribution of the parameters of cutting speed, oxygen gas pressure and nozzle distance to the width of the cutting kerf, and the results of this study are to study the effect of each cutting parameter, how the cutting contributes and become reference cutting data steel AISI 1045 with a thickness of 14 mm see **Figure 1**.

The scope of the study was limited to the parameter factors of cutting AISI 1045 steel with Oxy-acetylene gas and a material thickness of 14 mm, then measuring the kerf width of the cut using a digital microscope with a magnification of 20x.

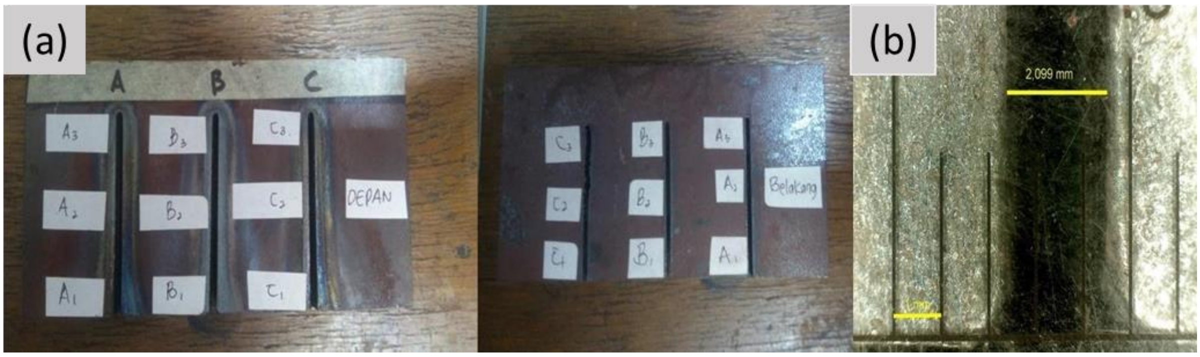

Figure 1. (a). Kerf width measurement point in the test specimen and (b). Kerf width measurement at 20x magnification (personal documentation)

DOI: http://dx.doi.org/10. 17509/xxxxt.vxix
p- ISSN e- ISSN

3. RESULTS AND DISCUSSION

Based on **Figure 2 & 3** it can be seen that the cutting speed and cutting gas pressure are significant factors in the optimization of the Aisi 1045 steel cutting process for the minimum kerf width with a contribution of 95.6%, while the tip / nozzle height factor is not significant for the optimization of the process cutting AISI 1045 steel for minimum kerf width (Patel *et al.,* 2015; Selvam *et al*., 2019; Alduroobi *et al*., 2020; Rzeźnikiewicz, 2014).

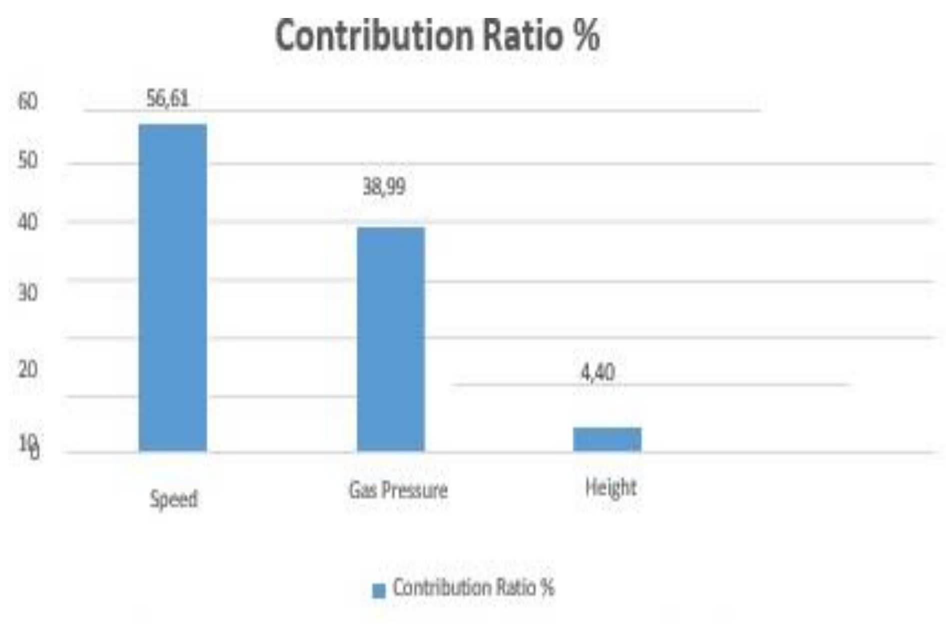

Figure 2. Large Contribution Factor for kerf width response

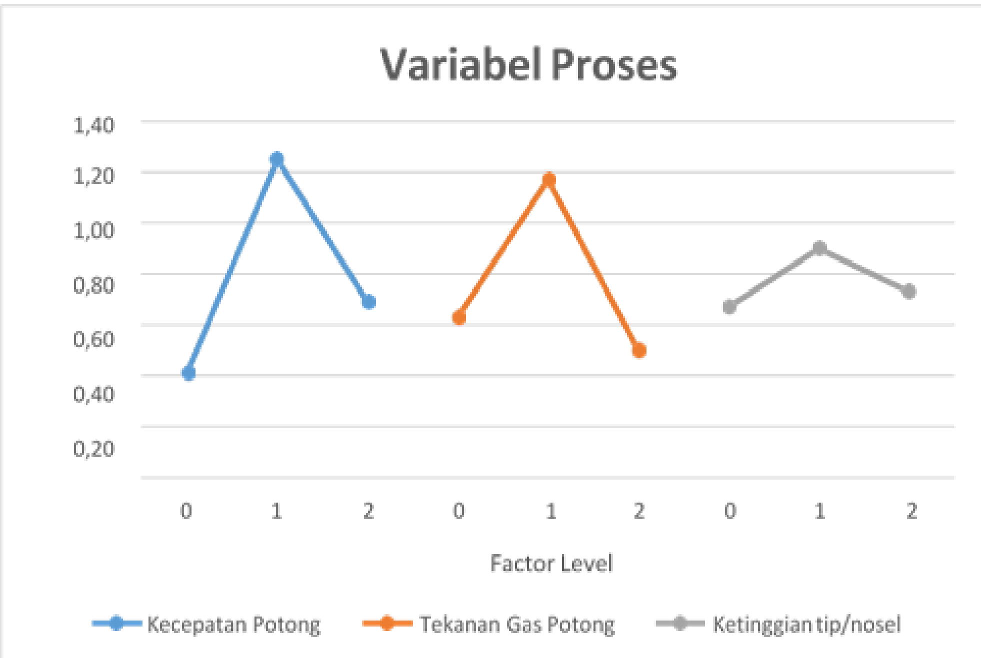

Figure 3. Variable process cutting

DOI: http://dx.doi.org/10.17509/xxxx.vxix
p- ISSN e- ISSN

The minimum results in the cutting process are influenced by the parameters in Figure (3), the combination of factors and levels can be seen in Figure (3), so the variation of factors and levels for optimization of the Aisi 1045 steel cutting process for minimum kerf width can be obtained write down (Majanasastra, 2013; Parnianifard, *et al*., 2018; Santoso *et al*., 2018):

- Cutting speed (A) at level (1): 250 mm/min
- Gas pressure (B) at level (1): 3 kgf/cm^2
- Tip / nozzle height (C) at level (1): 4 mm

So that the factor and level used to optimize the process of cutting Oxy-acetyline gas in 1045 AISI steel material to produce the minimum kerf width is A1B1C1.

After obtaining the optimal process variables based on the "Taguchi Method", then verifying the results in the product against the product variables obtained, the verification process is carried out by conducting 5 experiments using the optimal process variables obtained, and as a comparison of the results of the prediction and verification tests can be seen in **Table 1** and **Figure 4**.

Furthermore, the S / N value of the verification ratio obtained is compared with the S / N value of the prediction ratio, the result of the S / N ratio of the prediction is 2.16 and the result of the S / N ratio of verification is 0.84, then to determine the feasibility of the optimal variable formula used , the confidence interval (CI) value and the S / N value of the prediction and verification ratio must coincide with each other, and it can be seen in Figure (4) that this means that the optimal variable formula is suitable for use in the optimization of the AISI 1045 steel cutting process for resulting in the minimum kerf width.

4. CONCLUSION

The optimum parameter values to obtain the minimum kerf width on AISI 1045 steel are cutting speed of 250 mm / min, gas pressure of 3 Kgf / cm2 and tip height of 4 mm and the dominant factors that affect the quality of cutting results with Oxygen-acetylene gas in AISI 1045 materials kerf width is the cutting speed with a percentage of 56.61%, cut gas pressure with a percentage of 38.99%, while for the height of the tip / nozzle it is categorized as insignificant in the optimization of the cutting process with a percentage of 4.40%.

Table 1. Comparison of prediacated value intervals and kerf width verification results

	Sum of S/N Ratio	CI
Prediction	2.16	2.07
Verification	0.84	2.33

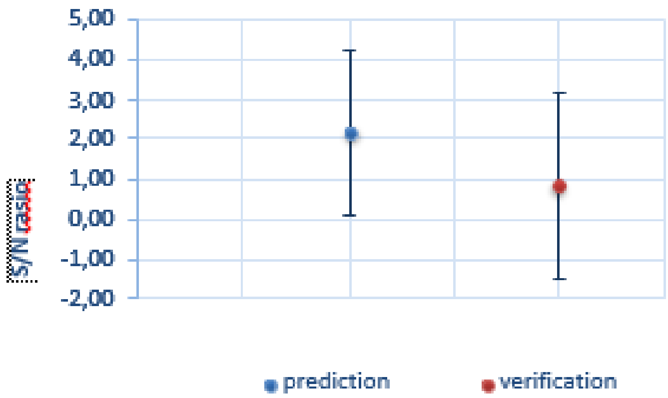

Figure 4. Prediction and verification results for kerf width

DOI: http://dx.doi.org/10. 17509/xxxxt.vxix
p- ISSN e- ISSN

5. ACKNOWLEDGEMENTS

This study is supported by the provision of research funding from the Indonesian University of Education for 2019.

6. AUTHORS' NOTE

The author states that there is no conflict of interest regarding the publication of this article. The author confirms that the paper is free from plagiarism. There are still many shortcomings and need further research from this article so that the resulting battery is used like a conventional battery.

7. REFERENCES

Akkurt, A. (2009). Surface properties of the cut face obtained by different cutting methods form AISI 304 Stainless Steel Material. *Indian Journal of Engineering & Material Sciences*, 16(*2009*), 373-38.

Alduroobi, A. A., Ubaid, A. M., Tawfiq, M. A., & Elias, R. R. (2020). Wire EDM process optimization for machining AISI 1045 steel by use of Taguchi method, artificial neural network and analysis of variances. *International Journal of System Assurance Engineering and Management*, 11(*2020*), 1-25.

Ghane, D. B., Abhang, L. B., Makasare, P. A., & Kharad, B. N. (2018). Optimization on Operating Parameters of CNC Plasma Machine by Experimentation. *i-Manager's Journal on Instrumentation & Control Engineering*, *7*(*1*), 26.

Harish, M. O. O. L. I., & Babu, P. K. (2017). Analysis of Oxy-Fuel cutting process parameters using Grey-Taguchi technique for mild steel HRE350. *International Journal of Innovative Technology and Research*, *5*(*2*), 5777-5783.

Harnicarova, M., Zajac, J., & Stoic, A. (2010). Comparison of different material cutting technologies in terms of their impact on the cutting quality of structural steel. *Tehnicki vjesnik*, *17*(*3*), 371-376.

Majanasastra, R. B. S. (2013). Analisis Simulasi Uji Impak Baja Karbon Sedang (AISI 1045) dan Baja Karbon Tinggi (AISI D2) Hasil Perlakuan Panas. *Jurnal Ilmiah Teknik Mesin Unisma" 45" Bekasi*, *1*(2), 97996.

Muñoz-Escalona, P., Payares, M. C., Dorta, M., & Diaz, R. (2006). Analysis and influence of acetylene and propane gas during oxyfuel gas cutting of 1045 carbon steel. *Journal of Materials Engineering and Performance*, *15*(*6*), 684-692.

Parnianifard, A., Azfanizam, A., Ariffin, M. K. A. M., & Ismail, M. I. S. (2018). An overview on robust design hybrid metamodeling: Advanced methodology in process optimization under uncertainty. *International Journal of Industrial Engineering Computations*, 9(2018), 1-32.

Patel, A. M., Shah, D., & Kothari, M. (2015). Design and Manufacturing of Automated Gas Profile Cutting Machine using PLC. *International Journal for Scientific Research & Development,* 3(2015), 2321.

DOI: http://dx.doi.org/10.17509/xxxx.vxix
p- ISSN e- ISSN

Rzeźnikiewicz, A. (2014). Cost comparison between oxyfuel and plasma cutting low alloy steel. *Journal of Achievements in Materials and Manufacturing Engineering*, *63*(2), 81-85.

Santoso, E. B., Hidayat, R., & Herraprastanti, E. H. (2018). Material hilang dan kekerasan daerah plastized zone pada pemotongan material SS400 dengan Oxyfuel Welding. DINAMIKA Jurnal Ilmiah Teknik Mesin, 10(*1*), 14–22.

Selvam, M. D., & Sivaram, N. (2017). The effectiveness of various cutting fluids on the surface roughness of AISI 1045 steel during turning operation using minimum quantity lubrication system. *Journal on Future Engineering & Technology*, *13*(1), 36-43.

DOI: http://dx.doi.org/10. 17509/xxxxt.vxix
p- ISSN e- ISSN