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Wire EDM Parameters for Surface Roughness in Straight Gear Manufacturing: An Experimental Study

Amit Hazari[1], Samsul Mondal[2], Rajibul Sekh[3], Aziz Md SK[4], Purnendu Singha[5] and Rajesh Biswas[6]
[1]Assistant Professor, Department of Mechanical Engineering, Ideal Institute of Engineering College, Kalyani, West Bengal, INDIA
[2]Student, Department of Mechanical Engineering, Ideal Institute of Engineering College, Kalyani, West Bengal INDIA
[3]Student, Department of Mechanical Engineering, Ideal Institute of Engineering College, Kalyani, West Bengal INDIA
[4]Student, Department of Mechanical Engineering, Ideal Institute of Engineering College, Kalyani, West Bengal INDIA
[5]Student, Department of Mechanical Engineering, Ideal Institute of Engineering College, Kalyani, West Bengal INDIA
[6]Student, Department of Mechanical Engineering, Ideal Institute of Engineering College, Kalyani, West Bengal INDIA

[1]Corresponding Author: hazariamit94@gmail.com

ABSTRACT

The gears are an essential component of any system. A gear is a spinning circular machine part with cut teeth, or inserted teeth (called cogs) in the case of a cogwheel or gearwheel, which mesh with another toothed part to convey torque. A gear is sometimes referred as a cog colloquially. Geared devices can adjust a power source's speed, torque, and direction. To eliminate backlash, high precision is required while making gears. Wire cut EDM is a high-precision machining technology that may manufacture high-precision straight gear. The goal of this research is to use the WEDM Process on an EMS 45 to determine the surface roughness of the workpiece and to optimise the influence of current and wire speed on the surface roughness of the straight gear. Wire cut machining parameters employed were 4, 6, and 8 amperes of current and 9, 11, and 13 mm/min of wire speed. Wire has a diameter of 0.25 mm, and the cutting material is brass. It has been demonstrated that as current and wire speed increase, surface roughness decreases, and vice versa. As a result, reduced machine settings can be used to generate a smoother and better workpiece surface.

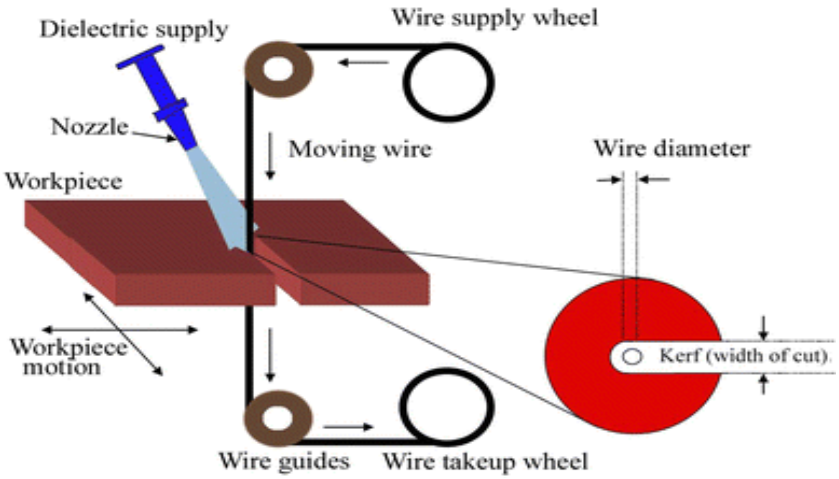
Keywords-- Wire EDM, EMS 45, Advanced Manufacturing, Surface Roughness Tester

I. INTRODUCTION

Wire EDM machines are frequently thought of as a last resort for machining. More well-known machining strategies include processing, turning, and crushing. The market for wire EDM is far less than the market for chip manufacturing. When a factory, machine, or processor is unable to machine a portion, a wire EDM is frequently used to fill the void.

Wire EDMs do not generate chips; instead, they devour metal with intense heat and a continuous supply of electrically charged metal wire that vaporises the conductive material regardless of its hardness. Because the cable never contacts the work item, there are no device constraints on it. The dissolved particles are flushed away from the start hole with deionized water.

Figure 1: Schematic figure of wire cut EDM



A dielectric, or deionized water, is used in the wire-cutting process. Deionization produces pure water that can be used as an insulator. Furthermore, because the fixed water contains minerals, the wire is extremely conductive. Meanwhile, the operation of water circulation on the wire cut system was carried out to set the conductivity of water. Figure 1 depicts a diagram of the wire-cutting process.

When the system is powered by electricity, water will be deionized. In addition, an electrical spark jumps from the wire to the workpiece, eroding a small portion of the workpiece. Thousands of times each second, electrical pulses occur. While pressurised dielectric fluid is pumped through the system to aid in the cooling of the workpiece and the cleanup of scraped wire and workpiece.

II. EXPERIMENTAL SETUP

2.1 Materials

In this experiment, EMS 45 steel was employed as the material specification. Meanwhile, wire with a thickness of 0.28 mm is used for wire cut electrodes. For shaft parts, EMS 45 steel is a popular choice. It can achieve improved cutting performance and high mechanical strength, such as high strength and toughness, after quenching and tempering (or normalising). After quenching, the surface hardness can reach 45-52 HRC.

Cutting Parameters (3.2)

The experimental setup in this experiment uses the following cutting parameters:

Table 1: Parameters for wire cut process

Parameter	**Range**		
Current (Ampere)	4	6	8
Wire Speed (mm/m)	9	11	12

Surf Test SJ-310

A surface roughness tester is used to measure the roughness of a surface. Surface roughness testing was carried out with the help of. For each point, surface roughness was measured three times. Surface metrology equipment is used to assess the quality of a component's surface finish and/or geometry. Surface roughness, contour, shape, waviness, and flaws are all features of surface texture and topology. 178-561-02A Mitutoyo Surface roughness is measured with the Surftest SJ-210 Surface Roughness Tester.

III. RESULTS AND DISCUSSION

The results of surface roughness on the straight gear making are shown in Table 2.

Table 2: The result of surface roughness

EXP no	**Current (Amp)**	**Wire Speed (mm/min)**	**Surface Roughness (µm)**			
			Ra1	Ra2	Ra3	Average
1	4	9	2.828	2.929	2.871	2.876
2	4	11	2.695	2.720	2.640	2.685
3	4	13	2.656	2.751	2.954	2.809
4	6	9	2.656	2.700	2.755	2.761
5	6	11	2.296	2.823	2.709	2.801
6	6	13	2.767	2.649	2.553	2.632
7	8	9	2.866	2.567	2.497	2.573
8	8	11	2.829	2.457	2.450	2.401
9	8	13	2.793	2.577	2.615	2.653

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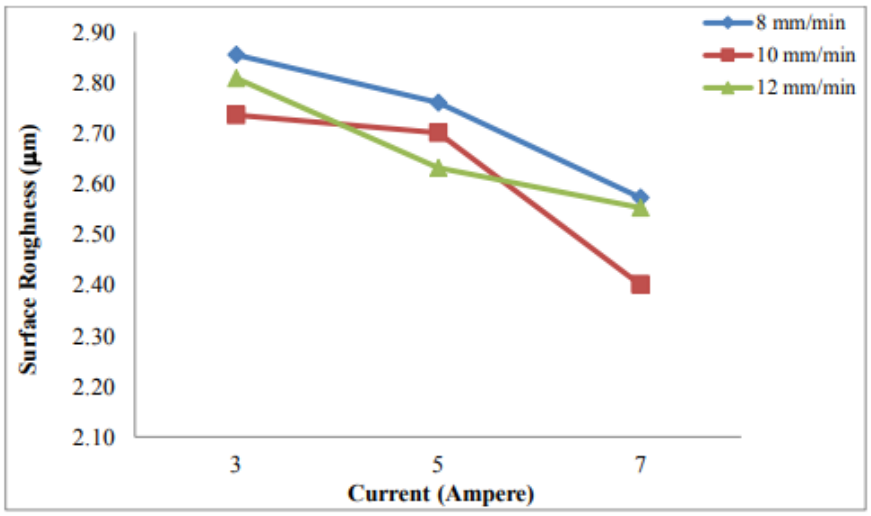
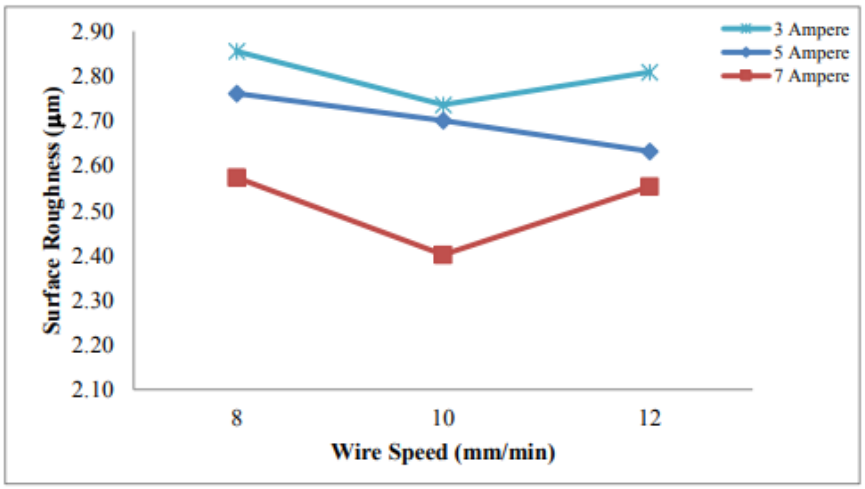
Figure 2: Data of surface roughness for different of current.



Surface roughness is highly impacted by currents, as shown in Fig. 2. It is obvious that when the current value is higher, the surface roughness tends to be smoother. The surface roughness will be rougher if the current is reduced.

Figure 3: Surface roughness data for various wire speeds



Surface roughness is impacted by wire speed, as shown in Fig. 3, where the lower the wire speed, the rougher the surface roughness value. Similarly, increasing wire speed will make the surface roughness value smoother, but increasing wire speed will make the workpiece surface rough again. It was discovered that by adjusting the machine parameters to a low pulsed current and a short pulse-on period, an outstanding machined finish may be achieved. This is due to the fact that as the pulsed current is reduced, discharges strike the sample's surface less intensively, resulting in a better erosion effect and a smoother surface. Additionally, as the duration of the pulse-on reduces, the quantity of heat energy transmitted to the sample surface decreases, resulting in less material melting. The fact that surface roughness diminishes as discharge energy decreases has been documented in the literature.

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Figure 4: Outcomes of gear created with the wire cut procedure.

The two-variable wire cutting procedure (current and wire speed) has been working nicely. Strong variables such as current and wire cut have a substantial impact on surface roughness and cutting time.

IV. CONCLUSION

Based on research conducted during the wire cutting process for straight gear production, it can be inferred that the current variable has a considerable impact on the roughness of the straight gear surface. The roughness of the straight gear surface decreases when the current is increased, while the roughness of the straight gear surface increases as the current is decreased.

REFERENCES

[1] Guu, Y.H., Hocheng, H., Chou, C.Y., & Deng, C.S. (2003). Effect of electrical discharge machining on surface characteristics and machining damage of AISI D2 tool steel. *Materials Science and Engineering: A, 358*(1-2), 37-43.

[2] Selvam, M.P. & Kumar, P.R. (2017). Optimization Kerf width and surface roughness in wire cut electrical discharge machining using brass wire. *Mechanics and Mechanical Engineering, 21*(1), 37-55.

[3] M.P. Garg, A. Jain, & G. Bhushan. (2014). Multi-objective optimization of process parameters in wire electric discharge machining of Ti-6-2-4-2 alloy. *Arabian Journal for Science and Engineering, 39*, 1465-1476.

[4] G. Rajyalakshmi & P. Venkata Ramaiah. (2013). Multiple process parameter optimization of wire electrical discharge machining on Inconel 825 using Taguchi grey relational analysis. *The International Journal of Advanced Manufacturing Technology, 69*, 1249-1262.

[5] A. Ikram, N. Mufti, M. Saleem, & A. Khan. (2013). Parametric optimization for surface roughness, kerf and MRR in wire electrical discharge machining (WEDM) using Taguchi design of experiment. *Journal of Mechanical Science and Technology, 27*, 2133-2141.

[6] Kanlayasiri, S. (2007). Boonmung effects of wire-EDM machining variables on surface roughness of newly developed DC 53 die steel: Design of experiments and regression model. *Journal of Material Processing Technology, 192*, 459-464.

[7] Lauren Tiu Mihail. (2007). Robust optimization of the cylindricity deviation for the deep hole drilling process on flexible manufacturing systems. *International Conference on Economic Engineering and Manufacturing Systems Brasov, 8*, 528-531.

[8] K. Palanikumar. (2011). Experimental investigation and optimisation in drilling of GFRP composites. *Measurement, 44*(10), 2138-2148.

[9] Amit Hazari, Debabrata Das & Pritam Pain. (2018). Optimization of control parameter in abrasive water jet machining (AWJM) by using taguchi methodology on aluminum 6351. *International Research Journal of Engineering and Technology, 05*(04).