Experimental Study of Wire EDM Parameters for Surface Roughness in the Manufacturing of Straight Gear

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Abstract

The gears are an important part of a mechanism. A gear is a rotating circular machine part having cut teeth or, in the case of a cogwheel or gearwheel, inserted teeth (called cogs), which mesh with another toothed part to transmit torque. A gear may also be known informally as a cog. Geared devices can change the speed, torque, and direction of a power source. Making gears requires high precision to avoid backlash. The advanced machining process that can produce high precision straight gear by the use of Wire cut EDM process. This study aims to determine the surface roughness of the workpiece and optimize the effect of current and wire speed on the surface roughness of the straight gear through WEDM Process on EMS 45. The wire cut machining parameters used are 4, 6, and 8 amperes for current, and wire speed of 9, 11, and 13 mm/min. While the diameter of Wire is 0.25 mm and Brass material is used for cutting. It is shown that the if the current and wire speed is increase the surface roughness will be low and Vice versa Therefore, it can be performed on low machine parameters to produce a smooth and better workpiece surface.

Keywords*: - Wire EDM, EMS 45, advanced manufacturing, Surface roughness tester*

INTRODUCTION

Wire EDM Machine is regularly viewed as a last machining strategy. Processing, turning and crushing are all more well known machining strategies. The wire EDM market is littler than chip making market. However by and large when a factory, machine or processor cannot machine a section, a wire EDM will regularly fill the void.

Wire EDMs don't make chips, they consume with extreme heat metal with a constant sustain of electrically charged metal wire that vaporizes the conductive material paying little heed to its hardness. There's no device constrain on the wire on the grounds that the wire never touches the work piece. Deionized water is utilized to flush the dissolved particles far from the start hole In the wire-cut process, there is deionized water called a dielectric. The deionization process will make pure water that serves as an insulator. in addition, the fixed water contains minerals, so it makes the wire very conductive. Meanwhile, to set the conductivity of water, then made the process of water circulation on the wire cut system. Schematic of the wire-cut process was shown in the Fig. 1.

Water will be deionized when the system is electrically powered. Furthermore, there is an electrical spark jump between the wire and the workpiece and erode a small part of the workpiece. Electric pulses occur repeatedly thousands of times per second. While pressurized dielectric fluid is flowed to assist the process of cooling the workpiece and cleaning up the scraping of wire and workpiece.

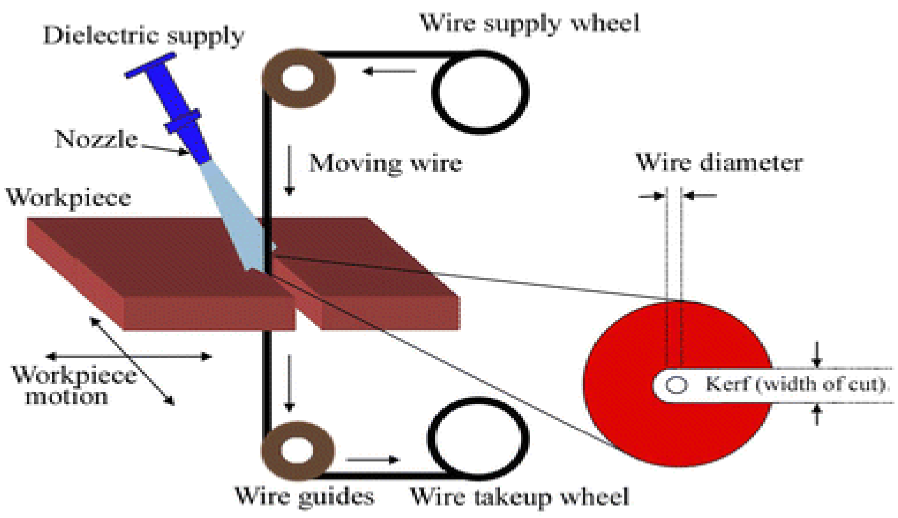

Figure 1 Schematic figure of wire cut EDM

EXPERIMENTAL SETUP

Materials

The material specification used in this experiment is EMS 45 steel. Meanwhile, the material used for wire cut electrode is wire with a thickness of 0.28 mm. EMS 45 steel is a common material for shaft parts. After quenching and tempering (or normalizing), it can obtain better cutting performance, and can obtain high mechanical strength such as high strength and toughness. The surface hardness after quenching can reach 45-52 HRC.

Cutting Parameters

In this Experiment, the experimental setup is using the cutting parameters as follow:

Table 1 Parameters for wire cut process

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

SURFTEST SJ-310

Surface roughness tester is used for Surface roughness testing was performed using. Data on Surface roughness was measured three times for each position. Surface metrology equipment is used to measure the surface finish and/or geometry of engineering components.

Surface texture and topology characteristics include surface roughness, contour, form, waviness, and defects. Mitutoyo 178-561-02A Surftest SJ-210 Surface Roughness Tester is used to measure surface roughness.

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

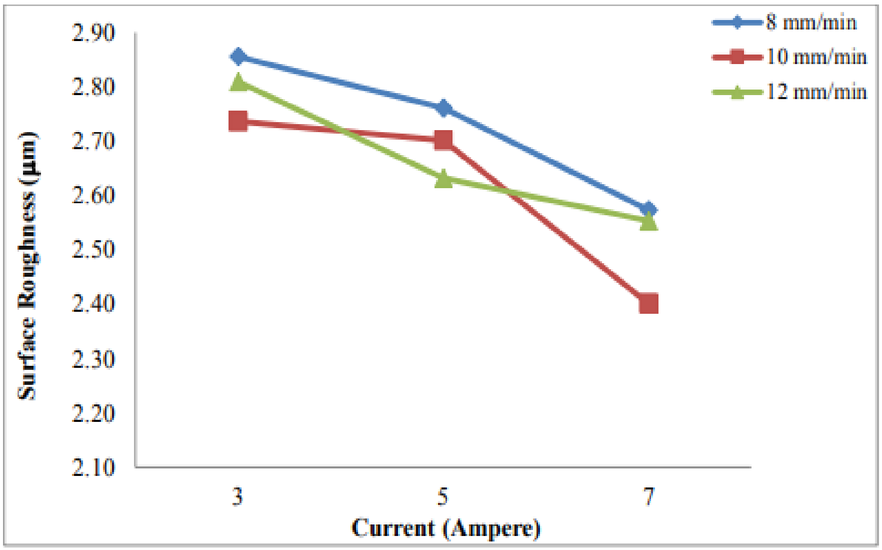

Figure 2 Data of surface roughness for different of current

Fig. 2 shows that surface roughness is strongly influenced by currents. It is very clear that the surface roughness tends to be smoother if the current value is greater. If the current is minimized then the surface roughness will be rougher.

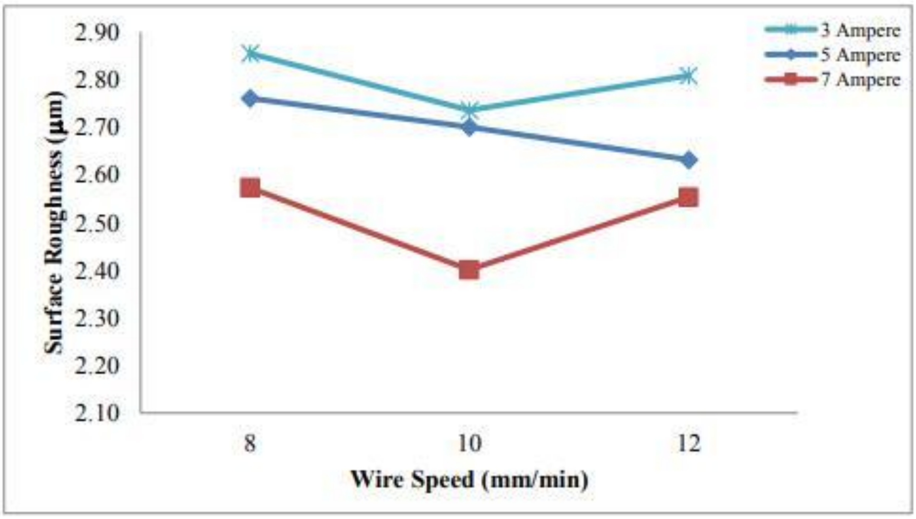

Figure 3 Data of surface roughness for different of wire speed

Fig. 3 presents that surface roughness is influenced by wire speed, where the lower wire speed the surface roughness value will be rougher. Likewise, if the wire speed is improved then the surface roughness value will be smoother, but if wire speed is added then it will make the workpiece surface rough again. it was found that an excellent machined finish can be obtained by setting the machine parameters at low pulsed current and small pulse-on duration. This can be attributed to the fact that as the pulsed current decreases, discharges strike the surface of the sample less intensely, and the resulting better erosion effect leads to smoother surface.

Furthermore, as the pulse-on duration decreases, the amount of heat energy transferred to the sample surface decreases, and so less material melts. The fact that the surface roughness decreases with decreasing discharge energy has been described in the literature Displaying the results of gear made with the wire cut process can be seen in Fig. 4.

Figure 4 Display the results of making gear straight

The wire cut process using two variables (i.e. current and wire speed) has been running well. The result of surface roughness and cutting time is significantly influenced by strong variables of current and wire cut.

CONCLUSION

Based on the investigation done in the process of wire cut on the straight gear making, it can be concluded that the current variable gives a significant influence on the roughness of the straight gear surface. The greater the current use, the roughness of the straight gear surface is lower, the smaller the current is used, the higher the roughness of the straight gear surface.

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