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Experimental of Abrasive Flow Machining on P20 Surface Mold Polishing

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***Abstract*- The paper presents the effect of the clearance of specimens and tools for surface roughness (Ra) of P20 mold steel that is related to abrasive flow machining (AFM). This study experimented with flat specimens. AFM experiments are performed to identify the improved surface roughness when applied to the polishing specimens. Specimens were prepared by turned, hardened, and polished with sandpaper from number P40 and measured an original value of Ra compared with the final value of Ra at the end of the process. The process parameters are as follows: an abrasive particle size (Al2O3) of 5.0 µm in water (50 % concentration by weight), the pressure of 7 bar, hardness of specimens 30±2 HRC, etc. The experimental results show that under these conditions, the average surface roughness of specimens is differenced from an original value of Ra 0.551 to 0.356 µm.**

I. INTRODUCTION

Abrasive flow machining: AFM was polishing contemporary and small removal surfaces with the flow of the slurry medium. AFM was the high-end cutting process with deburring, radius, polish, removing recast layer, and made compressive residual stresses. This process wildly used in the 1960s and was interesting in consistent production and predict to results output. AMS process was developed by Extrude Hone co., ltd. in 1996.

II. LITERATURE REVIEW IN AFM

Process Parameters (Jun Wang, et all, 1999) mention the orbital amplitude to find the material removal rate in higher amplitudes yielding, higher material removal rates but orbital amplitude must not be bigger than the minimum internal feature of the workpiece. To find the material removal rate must focus on both the oscillation speed and the orbital amplitude as not got the effect from the geometrical dimension of the workpiece between 400 to 1200 RPM

High precision abrasive flow machining has two sub-systems were; a high-viscosity media; the range of between 150-1,000,000 centipoise a viscous-elastic plastic media (a semisolid polymer composition) and a low-viscosity media; 1-50 centipoise was a liquid abrasive slurry involve to abrasive suspended or slurried in fluid media by cutting fluids of honing fluids consisted of a thixotropic slurry plus a rheological additive and finely divided abrasive particles incorporate therein with mixed pressure and flow between 4,000 psi.

V.K. Jain, S.G. Adsul, 2000 in this research study the effects of parameters of the different processes of AFM such as the number of cycles, the concentration of abrasive, abrasive mesh size, and media flow speed. Study in material removal and surface finish. To find the dominant parameter such as percentage concentration of the medium, mesh size of abrasive media, cycle time or machining time, and speed of media flow. Test with Brass and Aluminum by compared experimental and theoretical of workpiece surface with Scanning electron microscopy: SEM, experiment on Lath by setup on turret steady rests so that Parameter planning show in Table 1.

V.K. Gorana, V.K. Jain, G.K. Lal, 2004. Study about force in cutting and density of grain in the process to show components of force and density of grain that affect surface roughness between the process of AFM. The paper focuses on two parameters that mention the developed real theoretical model more.

To compare between two papers that N.K. Jain, V.K. Jain, S. Jha, 2006, "Parametric optimization of advanced fine-finishing processes" AFM about 4 issues (1998 to 2000) and about 3 issues in MAF (1994 to 1996)

Neelesh K. Jain, V.K. Jain, Kalyanmoy Deb, 2007, "Optimization of process parameters of the mechanical type advanced machining processes using genetic algorithms" to study between 4 processes; USM, AJM, WJM, AWJM

TABLE 1. AFM PARAMETERS

1. Pressure *****	2. Mesh size ****	3. % Concentration *****	4. Viscosity
5. 1 Type of Particle	5.2 Carrier (medium)	5.3 Abrasive weight	5.4 Number of active grains
6. 1 Number of cycles (n)	6.2 Extrusion frequency (n/min)	6.3 Machining time (min)	6.4 Stroke length (mm)
7.1 Media flow speed or Velocity	7.2 Media flow rate	7.3 Media flow volume	7.4 Angle of media flow
	7.5 Shape of Nozzle	7.6 Reduction ratio	
8.1 Workpiece of material	8.2 Hardness of workpiece	8.3 Shape of the workpiece	9. Temperature
10.1 Normal stress	10.2 Cutting force	11. Specific energy	12. Magnetic flux density
13. Surface initial *****			

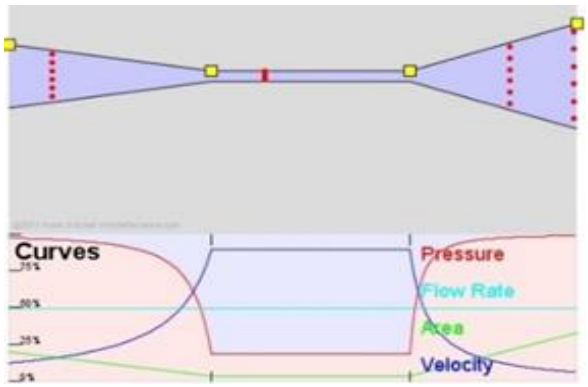

Fig. 1. Pipe Demo; Flow Rate, Pressure, Velocity, and Area

Fig. 2. Aluminum Oxide

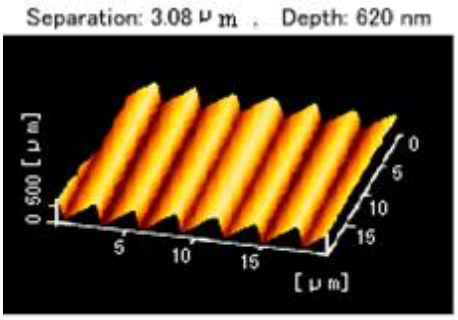

Fig. 3. Measured with an atomic force microscope, specimen

III. EXPERIMENTATION

Steps followed:

1. To prepare the workpiece surface with sandpaper from P40.
2. To measure initial surface roughness (SR); Ra micron before AFM process.

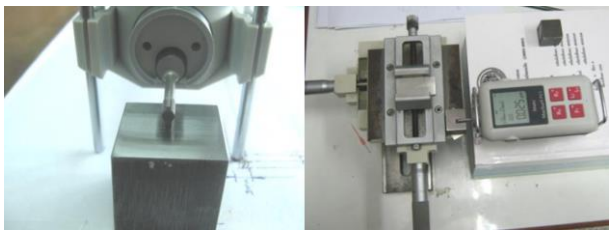

Fig. 4. Displays surface measurement

3. To polishing by AFM prototype within cycle time range 50, 100, 150, 200, 250, 300 cycle consequently.
4. To measure surface roughness after being polished by AFM (Final SR).
5. To measure the Raw Profile and Modified Profile of the workpiece.
6. To see the difference before and after polished to build a graph.

IV. RESULTS AND DISCUSSION

The results of the experiment followed:

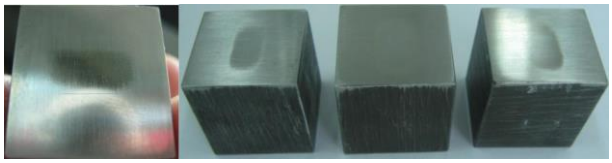

Fig. 5. workpiece was polished with AFM prototype

TABLE 2 THE POLISHING 0 TO 300 CYCLE

	Ra	average
	0.519	
Original	0.592	
	0.541	0.551
	0.426	
50 cycle	0.420	
	0.454	0.433
	0.395	
100 cycle	0.386	
	0.369	0.383
	0.362	
150 cycle	0.376	
	0.392	0.377
	0.355	
200 cycle	0.378	
	0.350	0.361
	0.361	
250 cycle	0.347	
	0.360	0.356
	0.333	
300 cycle	0.352	
	0.308	0.331

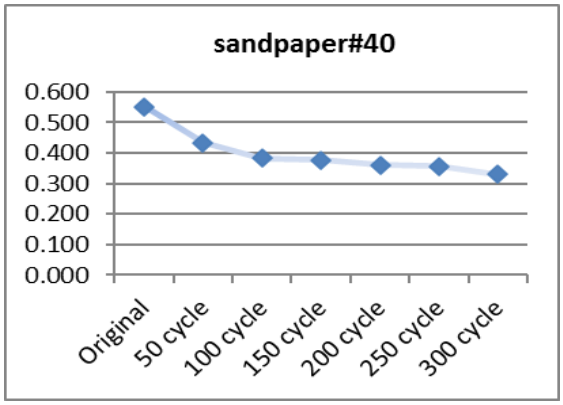

Fig. 6. Displays the relationship between surface roughness; (micron) and polishing with AFM prototype at 7 bar and interval time at 50 cycles from 0 to 300 cycles. step by step consequently.

V. CONCLUSION

The experiment of workpiece polishing P20 Mould Steel. Result that pressure 6, 7, 8 bar consequently and time range 20, 40, 60, 80, 100, 120-minute following Pressure 8 bar; the difference between before and after of average surface roughness maximum and trend to decrease surface roughness value (Ra). The difference; delta -0.012 to 0.010 µm

Pressure 6 bar; the difference between before and after of average surface roughness middle and trend to increase surface roughness value (Ra) the second. The difference; delta -0.015 to 0.018 µm

And Pressure 7 bar; the difference between before and after of average surface roughness middle and trend to increase surface roughness value (Ra) the third. The difference; delta -0.005 to 0.009 µm

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