TO STUDY THE EFFECT OF DIFFERENT PARAMETERS ON MAGNETIC ABRASIVE GRINDING

Er. Anmol Deep[1] | Er. Krishan Kumar[2]
[1](Research Scholar, Dept. of Mechanical, RIEIT, Roper Punjab, Punjab Technical University, anmolthakur59@gmail.com)
[2](Research Scholar, Dept. of Mechanical Engg, LRIET, Solan H.P., H.P. Technical University, ksaini007@ymail.com)

Abstract—*The fine quality of surface is an important factor to decide the performance of manufacture product. Magnetic abrasive finishing is a machining process in which work piece surface is machined by removing the material as micro-chips by abrasive particles in the presence of magnetic field in the finishing zone to create the force towards the metal piece with abrasive particles. To improve the machining efficiency of the electromagnetic abrasive finishing (MAF) technique there many other methods which we are using earlier for finishing will not produce much fine surface, to obtain a good of finished some new method has been proposed out of which one method is known as electromagnetic abrasive grinding or finishing, that is a surface grinding technique in which a magnetic field is used to force abrasive particles with iron particles against the target surface. Magnetic field-assisted finishing (MAF) processes have been developed for a wide variety of applications including the manufacturing of medical components, fluid systems, optics, dies and molds, electronic components, micro electro mechanical systems, and mechanical components. As we know magnetic flux density and voltage has significant effect on magnetic abrasive machining. But not much work is done on the mechanical parameters related with this machining process. Mixture of iron particles (Fe particles of mesh no. 300) and abrasive particles (SiC, Al2O3) having different mesh size. It has been observed that the increase in rotational speed, weight of abrasive in mixture and mesh number (iron particles and abrasive particles) improve the surface finish.*

Keywords— MAF; MAM; MFD; Material Removal Rate; Magneto-Rheological Flow Polishing

1. INTRODUCTION

A Magnetic abrasive finishing (MAF) process was first invented by Harry Coats in Japan. He did fundamental research related to external finishing and internal finishing of tubes as well as flat surfaces during 19's. Magnetic abrasive finishing (MAF) can be defined as a process by which surface is finish by removing the material in the form of fine chips by abrasive particles (al2o3) in the presence of magnetic field in the finishing zone.

Electromagnetic abrasive grinding (MAF) is one of the advanced surface finishing processes, which produces a fine level of surface quality and is controlled by a magnetic field including other parameters in the machining time, standoff distance from work zone. Magnetic abrasive finishing (MAF) set up has electromagnets which produce strong magnetic field which is used for finishing process. The work piece is kept between the two poles of an electromagnet. The method was originally introduced in the Soviet Union, with further fundamental research in various countries including Japan. Nowadays, the study of the mechanical parameters assisting finishing processes is being conducted at industrial levels around the world

2. LITERATURE REVIEW

Before discussing mechanical parameters oriented finishing process, it is beneficial to understand the material removal mechanism commonly adapted in conventional finishing process. Grinding, honing, micro honing are the examples of conventional abrasive finishing process. Multi point cutting tool in the form of abrasive cutting particles are used in these Method.

In all these finishing process the particle work piece interaction involves one or more of the basic material removal. i.e. cutting, ploughing, sliding/friction. Mostly cutting a material removal process, ploughing is a material displacement process and sliding is a material modification process. The intensity of material deformation and change in surface roughness depends upon the amplitude of forces and the number of active abrasive cutting edges in abrasive finishing process [5, 6, and 9].

In grinding process a grinding wheel made up of large abrasive cutting points is used. Grinding is more effective in removing material than finishing surfaces due to random distribution of abrasive particles. Finishing of complex parts is difficult and requires expensive shaped grinding wheel.

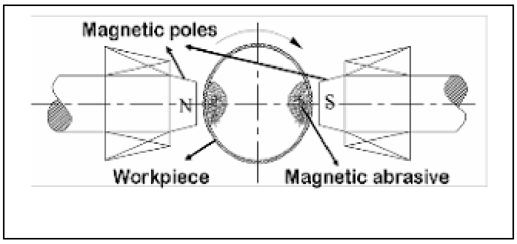

Figure 2.0: Magnetic abrasive flow machining

3. WORKING PRINCIPLE

The working gap between the work piece and the magnet is filled with magnetic abrasive particles (MAP), composed of ferromagnetic particles and abrasive powder. MAP is prepared by sintering of ferromagnetic particles and abrasive particles. The magnetic abrasive particles join each other along the lines of magnetic force and form a flexible magnetic abrasive brush (FMAB) between the work piece and the magnetic pole. This brush behaves like a multi-point cutting tool for finishing operation. When the magnetic N-pole is rotating, the Magnetic Abrasive Finishing Brush (MAFB) also rotates like a flexible grinding wheel and finishing is done according to the forces acting on the abrasive particles. In external finishing of cylindrical surface, the cylindrical work piece rotates between the magnetic poles, with the MAP filled in both the gaps on either side, whereas in internal finishing of cylindrical surface, the work piece rotates between the magnetic poles and the MAP as shown in (Figure1.5). The magnetic field generator can be either electromagnetic coils or permanent magnets. The relative motion between the induced abrasive particles of the FMAB and workpiece generates the necessary shearing action at the abrasive work-piece interface to remove material from the work-piece in the form of miniature chips

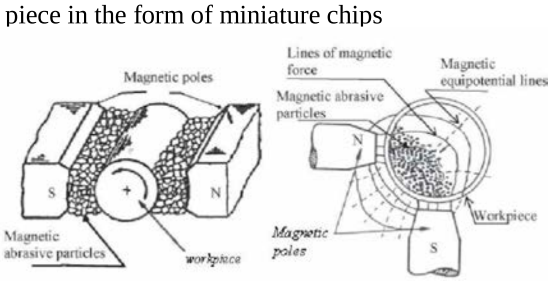

Figure 3.0: Magnetic abrasive machining

4. OBJECTIVES

1. To determine the suitable parameters for surface finishing with respect to mechanical parameters i.e. voltage, current and no. of turns in coil.
2. To predict the material removal rate due to magnetic abrasive finishing on above said materials using lathe chalk.
3. To determine optimum value of standoff distance of electromagnetic coil from work piece at which optimum value of maximum flux density is obtained to finish the desired work piece.
4. To study the effect of magnetic flux density w.r.t. to time of machining.
5. To determine the optimum revolution per minute where machining will be optimum.

5. DESCRIPTION AND WORKING OF MAGNETIC ABRASIVE TESTING APPARATUS

Figure 5.0: Working model of electromagnetic abrasive finishing

In Magnetic Abrasive finishing process the abrasive particles are introduced into the work piece along with ferrite particles. Then the machine is started to give the rotary motion to the work piece. The magnetic force on the abrasive powder is exerted by the two electromagnets connected in series, due to which electro abrasive particles attracted towards the internal side of the cylindrical tube. A high speed of about 780-920 rpm is used during the process.

6. OBSERVATIONS

The data is obtained by using the Surface Roughness Tester. By putting the different range values of magnetic flux density and voltage w.r.t. other parameters like standoff distance, concentration of mixture, speed, finishing time, we obtained the data.

6.1 Surface Roughness w.r.t. Magnetic Flux Density

TABLE 6.1: SURFACE ROUGHNESS W.R.T. STANDOFF DISTANCE

Sr. No	**Materials**	**MFD (Gauss)**	**Roughness before Testing**	**Standoff distance(in mm)**		
				30	***15***	***5***
1	SS-306	5130	1.01	0.87	0.65	0.38
2	BRASS	5130	1.51	1.46	1.39	0.99

TABLE 6.2: SURFACE ROUGHNESS W.R.T. MACHINING TIME

Sr. No	**Materials**	**MFD (Gauss)**	**Roughness before Testing**	**Machining time (in minutes)**		
				15	***30***	***45***
1	SS-306	5130	1.50	1.20	1.00	0.90
2	BRASS	5130	2.08	1.74	1.24	1.00

6.2 Surface Roughness w.r.t. R.P.M

TABLE 6.3: SURFACE ROUGHNESS W.R.T. STANDOFF DISTANCE

Sr. No	**Materials**	**RPM**	**Roughness before Testing**	**Standoff distance(in mm)**		
				30	***15***	***5***
1	SS-306	720	1.90	1.77	1.49	1.35
2	BRASS	720	2.85	2.00	1.65	1.00

TABLE 6.4: SURFACE ROUGHNESS W.R.T. MACHINING TIME

Sr. No	**Materials**	**RPM**	**Roughness before Testing**	**Machining time (in minutes)**		
				15	***30***	***45***
1	SS-306	720	0.99	0.79	0.40	0.29
2	BRASS	720	2.21	2.01	0.95	0.69

7. RESULTS AND ANALYSIS

It is not necessary all the times that all the mechanical as well as mechanical parameters have significant contribution in surface response. Some of the mechanical parameters may be very much significant than other parameters like MFD and current and voltage.

These experiments were conducted by selecting the mechanical parameters based on the findings of some of the mechanical parameters influence the surface roughness which is discussed below. With respect to these MFD study was work out to find the effect of work piece speed in rpm, distance from work and marching time, on surface finish of work piece. In this study, the rpm of 780, 810 and 920 rpm are taken with duration of machining as 0, 15, 30 and 45 minutes were taken for work carried out. It was discovered that the improvement in surface finish is more with the medium range of magnetic flux density

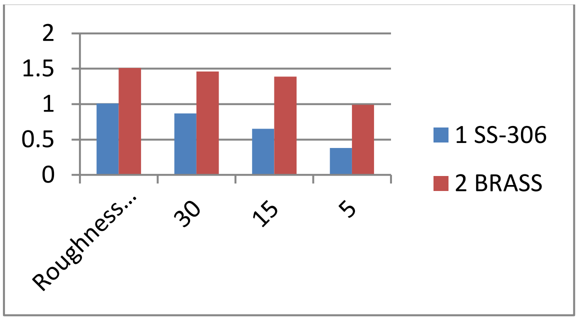

Figure Shows improvement in surface finish w.r.t standoff distance of coil from work piece.

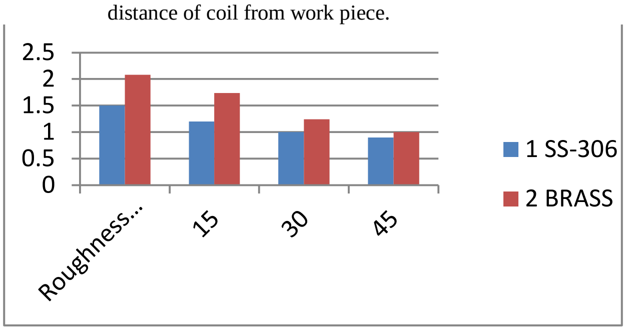

Figure: Shows improvements in surface finish w.r.t. time of machining.

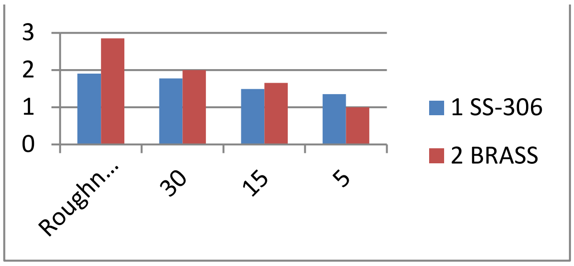

Figure: Shows improvement in surface finish w.r.t standoff distance of coil from work piece

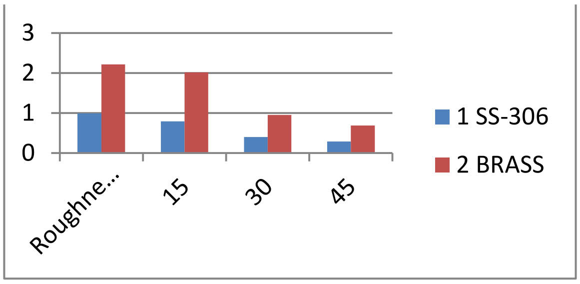

Figure Shows improvements in surface finish w.r.t. time of machining.

8. CONCLUSIONS

The present work is done set up to check the effect of mechanical parameters (speed of workpiece, machining time and standoff distance) on magnetic abrasive machining process on cylindrical work pieces by taking different input parameters and then the results are observed. It is found that all the mechanical parameters have a great effect on outputs considered in the present study. Finally, an attempt has been made to estimate the optimum values of rmp, standoff distance and magnetic flux density on different machining conditions to produce the best possible output within the experimental constraints.

- From these studies it was found that magnetic flux density around 0.6-0.10 Tesla give a significant fine improvement in surface finish with magnetic abrasive machining.
- It was also found that at 810 rpm in machining give a significant improvement in surface finish.
- This study shows that on various mechanical parameters improvement in surface finish is more in case of brass as compared to other materials like SS-306.
- It has been found that with the increase in number of turns in an electromagnetic coil magnetic flux density also increases as a result of which maximum material removal rate will be occurring.

- An effort has been made out to find out the best electrical as well as mechanical parameters for electromagnetic abrasive machining with respect to various machining parameters so that maximum surface finishing can be achieved.

REFERENCES

[1] Baron, Y.M., 2005, "Characterization of the Magnetic Abrasive Finishing Method and Its Application to Deburring", Key Engineering Materials Trans Tech Publications, Switzerland, vols. 291-292, pp. 291-296.

[2] Baron, Y.M., Manchenko, M. and Chubais, A.V., 1976, "Magnetic-abrasive finishing of parts made from non-magnetic steel", Proc. Technology of mechanical engineering for light and food industry and household device. – Moscow: TSIITAI light and food industry, issue 10, pp.9-19.

[3] Cherian, J., Jeoju, Issac, M., 2013, "Effect of Process Variables in Abrasive Flow Machining", International Journal of Emerging Technology and Advanced Engineering, vol. 3, issue 2, pp.554-557.

[4] Deepak, B., Walia, R.S., and Suri, N.M., 2012, "Effect of Rotational Motion on the Flat Work Piece Magnetic Abrasive Finishing", International Journal of Surface Engineering & Materials Technology, vol. 2, no. 1, pp. 50-54.

[5] Gorana, V.K., Jain, V.K., Lal, G.K., 2004, "Experimental investigation into cutting forces and active grain density during abrasive flow machining", International Journal of Machine Tool & Manufacture, vol. 44, issue 1-2, pp. 201-211.

[6] Gorana V. K, Jain V. K. and Lal G. K., 2006, "Prediction of surface roughness during abrasive flow machining", The International Journal of Advanced Manufacturing Technology, vol. 31, issue 3-4, pp. 258-267.

[7] Guixiang, Z., Yugang, Z., Dongbiao, Z., Fengshi, Y. and Zengdian, Z., 2013, "New Iron based SiC Spherical Composite Magnetic Abrasive for Magnetic Abrasive Finishing"