iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 Issue: V Month of publication: May 2020

DOI: http://doi.org/10.22214/ijraset.2020.5218

Effect of the Process Parameters on Surface Finish in Electromagnetic Abrasive Grinding Process

Prof. Tejas R Prajapati
Assistant Professor, Mechanical Engineering Department, ADIT

Abstract: Electromagnetic abrasive finishing (EMAF) processes under the non-conventional machining processes are the precision material removal processes that applied to a huge variety of materials from brittle to ductile. However, their parametric selection is more difficult as compared to other processes because of the involvement of large process parameters. Hence, the aim of this paper is to study the performance of MAF process and to find out the optimum parameters while machining mild steel. This paper summarized better understanding about the experimental work that had been performed on process and response parameters. The surface roughness and material removal highly depend on machining gap and magnetic flux density. As in permanent magnet, flux density is fixed so in this paper, electromagnet has been chosen for experiment on centre lathe for cylindrical mild steel component. Al_2o_3 abrasive particles were used in different mesh size with iron particle of fixed mesh size. Different experiments were carried out by varying process parameters like current, percentage concertation of abrasive particle and mesh size of abrasive particle. As a response, surface finish was measured using digital surface roughness tester. Result shows that the effect of process parameters on surface finish.

***Keywords:** Electromagnetic abrasive finishing, Surface finish, Surface roughness, current, mesh size*

I. INTRODUCTION

Surface finishing is a key factor in important functional properties, such as wear resistance and power losses due to friction, in many of the engineering components [1]. Magnetic abrasive finishing (MAF) is one of the non-conventional machining processes in which cutting force is primarily controlled by the magnetic field and the magnetic abrasives play the role of cutting tools. This technique has been developed for finishing surfaces that are hard to reach by conventional techniques. The process can produce good surface quality of the order of few nanometres finish on flat as well as internal and external surfaces of cylindrical type workpieces [2], [3]. Highly technology industries require ultraclean mirror polished surfaces for their critical applications. Liquid piping systems, vacuum tubes, sanitary tubes, high purity gas tubes and Pharmaceutical industries require smooth finished Inner pipe surface to prevent the Contamination of gas and liquid.

But polishing of such surfaces involves high cost and Controlled atmosphere during polishing. To meet the requirements of the industry new Methods are being developed continuously. Magnetic abrasive finishing is one of such Method which uses a controlled magnetic force to finish surfaces Magnetic abrasive finishing is one of the non-traditional machining processes that have been studied to improve the surface quality and deburr the workpiece. The magnetic particles influence the finishing efficiency and the final surface quality.

The ferromagnetic particles used in all studies of MAF is iron (Fe); the abrasives are mainly silicon carbide, aluminum oxide, boron nitride, etc. To minimize the surface damage, gentle/flexible finishing conditions are required, namely, a low level of controlled force. Magnetic field assisted manufacturing processes are becoming effective in finishing, cleaning, deburring and burnishing of metal and advanced engineering material parts. Magnetic Abrasive Finishing (MAF) is one of the non-conventional machining processes which came to the surface in 1938 in a patent by Harry P.Coats [4-7]. Magnetic Field Assisted is capable to give very good surface finish of intricate shape, reduce the possibilities of microcrackes as forces generated during the process are less & Process is relatively fast and inexpensive. In addition of MAF possesses many attractive advantages such as self-adaptability, self-Sharpening, controllability, and the finishing tool require neither compensation nor dressing.

MAF is successfully used for finishing of internal as well as external and complicated design of pipes and flat surfaces. In magnetic abrasive finishing process the magnetic force is affected by the composition of magnetic abrasives, material of the job, shape and size of work, gap between pole and work, shape and size of magnetic pole etc [10]. Dixit carried out experiments upon MAF having a slotted magnetic pole. This study deals with the effect of a slot made in the electromagnet on the forces and surface quality during MAF [11].

II. WORKING PRINCIPLE OF MAGNETIC ABRASIVE PROCESS

Figure 1 shows the schematic diagram of magnetic abrasive process. The gap between the workpiece and the magnet pole is filled with magnetic abrasive particles (MAPs), which are composed of ferromagnetic materials, such as iron particles, and non-magnetic abrasive powders. The MAPs are joined magnetically between magnetic poles (N and S) along the lines of magnetic force and form a flexible magnetic abrasive brush (FMAB). The cylindrical magnetic abrasive finishing process is achieved when the cylindrical workpiece starts to rotate at the same time as the cylindrical workpiece or magnetic pole is vibrating [9].

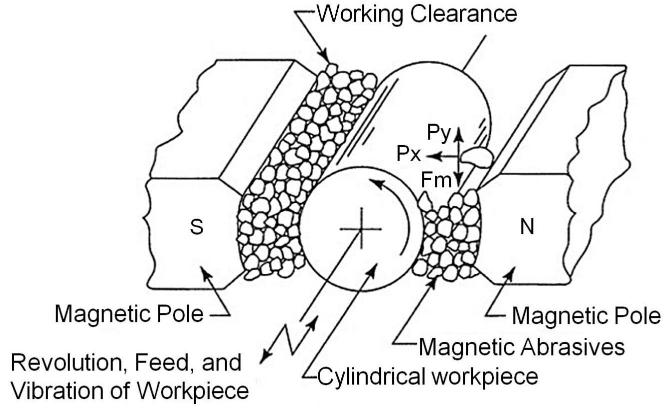


Figure 1 Cylindrical magnetic abrasive finishing process [8]

III. PROCESS PARAMETERS

The parameters of the MAF process are divided into two categories: (i) input process parameters like magnetic abrasive type, abrasive particles, magnetic device, workpiece material, working gap, grinding oil, rotational speed, and axial vibration) and (ii) output process parameters like surface roughness and removal weight). The magnetic abrasive type, abrasive particles, magnetic device, workpiece material, working gap, grinding oil, rotational speed, and axial vibration are known as the significant input parameters in the MAF process because they have significant influence on the MAF process. Surface roughness and removal weight are used to evaluate the performance of magnetic abrasive finishing for a cylindrical surface, an internal surface, and a plane surface.

IV. COMPOSITION OF ABRASIVE MATERIAL AND IRON PARTICLE

function of abrasive material is to finish the work piece while function of iron particle is to trap the abrasive material within FMAB by magnetic force. So, composition change of this parameter can considerably affect the output of experiment. Abrasive material available for finishing is aluminum oxide (Al2O3), silicon carbide (SiC), titanium carbide (TiC), diamond etc. Al_2O_3 is selected for current experiment because it is easily available and economic even though it can give better abrasive action. Composition selections for experiment are 60-40, 70-30, 80-20. Showing the percentage composition of iron to abrasive material. 60-40 showing 60% of iron particle and 40% of abrasive material. Selected mesh size for experiment are 100 nm,200 nm ,300 nm which are easily available for aluminium oxide (Al2O3) in the market. Also, selected values can give distinct results.

V. SELECTION OF PROCESS PARAMETERS

For any experimental study, selection of process parameters plays important role that which parameter affects the result. As there are many parameters like Work piece material, Abrasive material, Working gap, magnetic flux density, Composition of abrasive, Machining time, Speed in (R.P.M.), mesh size of iron particles, mesh size of abrasive particle etc. based on this parameters some of the parameters chosen as fixed and other as a variable parameters. Following are the parameters chosen for the current experiment.

A. Fixed Parameters

1) Gap between workpiece and magnet(mm)
2) Finishing time(sec)
3) Work piece rotational speed (rpm)
4) Mesh size of iron particle
5) Work-pieces material

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue V May 2020- Available at www.ijraset.com

B. Variable Parameters

1) Current (amp)
2) Mesh size of abrasive particle
3) Composition of abrasive and iron particle (%)

Some specifications of the process parameters are given below.

1	Machine	Engine Lathe
2	Speed	388 rpm
3	Workpiece material	MILD STEEL
4	Time	10 min
5	Workpiece size	25 mm Dia,125 mm long
6	Magnetic flux intensity	0.0185 Tesla
7	Magnetic abrasive particle	Fe(80%) +Al_2O_3(20%) Fe(70%)+Al_2O_3(30%) Fe(60%)+Al_2O_3(40%)

Table 1 specification of process

VI. DESIGN & EXPERIMENTATION

The whole experiment was carried out on lathe machine. Carriage of lathe machine is replaced with the MAF attachment. It consists the parts as side plate, jaw plate, lead screw and magnetic core. For the MAF process DC electromagnet is used because in AC electromagnet fluctuation occurs due to change in polarity of AC current. Due to this change in polarity electromagnetic intensity also fluctuates and vibrates. When in DC current due to constant polarity it gives smooth intensity of electromagnet.

Figure 2 Centre lathe with MAF setup

Whole MAF processes with electromagnet is shown in figure 3 which consist of ac supply (240V), DC to AC rectifier, voltage transformer, ammeter MAF attachment. AC supply with 240 V is applied to rectifier which convert AC to DC , then DC transformer can change voltage according to our required current as resistance of winding remain constant. Working gap can be set by lead screw rotation. After applying current to circuit, mixture is sprayed in between the electromagnet.

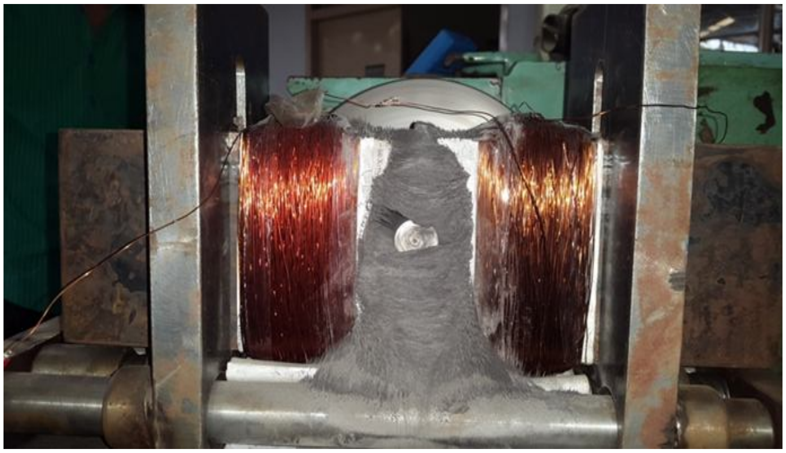


Figure 3 Magnetic abrasive brush

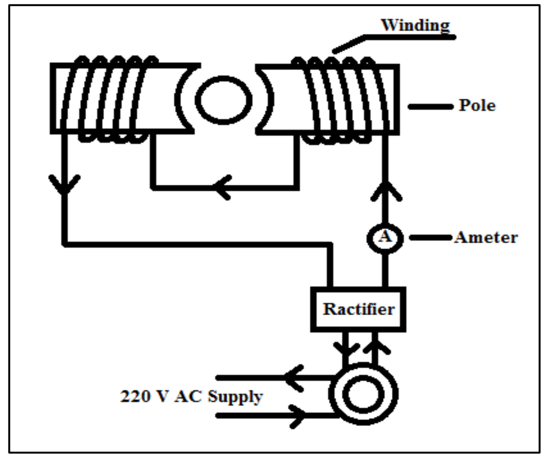


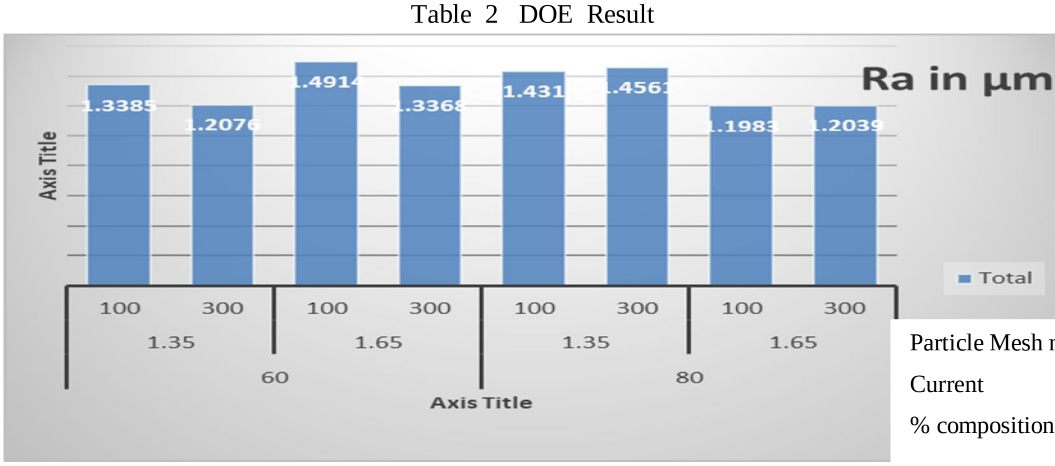
Figure 4 Electric circuit for MAF

VII. RESULT & DISCUSSION

Design for experiment is carried out of 2^3 Full Factorial Method for finding the best combination of process parameters which gives the optimum result of surface finish. No of experiments are carried out by varying the mesh size of the abrasive material as 100 nm, 200 nm & 300 nm, Current density 1.35 amp, 1.50 amp & 1.65 amp and 60, 70, 80 percentage change in composition of iron particles.

Std	Run	Block	Factor 1 A:size mesh	Factor 2 B:current Amp	Factor 3 C:%iron %age	Response 1 Ra Um
1	7	Block 1	100.00	1.35	60.00	1.3385
2	12	Block 1	300.00	1.35	60.00	1.2076
3	4	Block 1	100.00	1.65	60.00	1.4914
4	11	Block 1	300.00	1.65	60.00	1.3368
5	6	Block 1	100.00	1.35	80.00	1.431
6	9	Block 1	300.00	1.35	80.00	1.4561
7	8	Block 1	100.00	1.65	80.00	1.1983
8	5	Block 1	300.00	1.65	80.00	1.2039
9	2	Block 1	200.00	1.50	70.00	1.56
10	1	Block 1	200.00	1.50	70.00	1.53
11	10	Block 1	200.00	1.50	70.00	1.58
12	3	Block 1	200.00	1.50	70.00	1.56

Table 2 DOE Result



Particle Mesh no.

Current

% composition

Figure 5 Graphical representation

After carried out no of experiments, it was observed that as increasing in current, increasing percentage composition of iron particles and increasing mesh size of abrasive particles better surface finish is achieved.

VIII.CONCLUSIONS

From this experimental study following result can be concluded.

A. As increase in current, significant improvement can be seen in surface finish.
B. Surface finish is improved as there is increase in percentage concentration of abrasive particles.
C. Increase in particle mesh size of abrasive particle, up to certain limit surface finish is improved.

REFERENCES

[1] P.Jayakumar, "Semi Magnetic Abrasive Machining", 4th International Conference on Mechanical Engineering, December 26-28, 2001, Dhaka, Bangladesh, Section V, pp. 81-85.
[2] Shinmura.T, Takazava.K and Hatano.T, "Study on Magnetic Abrasive Process-Application to Plane Finishing," Bulletin of Japan Society of Precision Engineering, Vol 19(4),1985, pp. 289-291.
[3] Yamaguchi.H and Shinmuira.T, "Study of the Surface Modification Resulting from an Internal Magnetic Abrasive Finishing Process," Wear.225-229, 1999, pp. 246-255.
[4] Khairy A.B.,"Aspects of surface and edge finish by magnetoabrasive particles", Journal of Materials Processing Technology, Vol. 116, pp. 77–83, 2001.
[5] Kim J-D.,"Polishing of ultra-clean inner surfaces using magnetic force", International Journal of Advanced Manufacturing Technology, Vol. 21, pp. 91–97, 2003.
[6] Lin, C-T., Yang, L-D., Chow, H-M.,"Study of magnetic abrasive finishing in free-form surface operations using the Taguchi method", International Journal of Advance Manufacturing Technology, Vol. 34, pp. 122–130, 2007.
[7] Mori, T., Hirota, K., Kawashima, Y.,"Clarification of Magnetic Abrasive Finishing Mechanism", Journal of Materials Possessing Technology, pp. 143–144, 2003.
[8] Laroux, K. G.: Using magnetic abrasive finishing for deburring produces parts that perform well and look great. Alluring and Deburring. 2008, 60.
[9] Im, I. T.;Mun, S. D.; Oh, S. M.: Micromachining of an STS 304 bar by magnetic abrasive finishing.: Journal of Mechanical Science and Technology. 2009, 23(7), 1982–1988
[10] Harish Kumar, Sehijpal Singh and Pardeep Kumar, Magnetic Abrasive Finishing- A Review, International Journal of Engineering Research & Technology (IJERT) ,Vol. 2 Issue 3, ISSN: 2278-0181, 2013.
[11] Dixit. (2004), "Analysis of Magnetic Abrasive Finishing with Slotted Magnetic Pole", International Conference on Numerical Methods in industrial Forming Processes. Vol. 712, pp 1435-1440