International Journal of Advance Research in Science and Engineering
Volume No.06, Issue No. 12, December 2017
www.ijarse.com
IJARSE
ISSN: 2319-8354

FABRICATING THE MAGNETIC ABRASIVE FINISHING SETUP ON LATHE

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ABSTRACT

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. In MAF processes, surface and edge finishing is obtained by a flexible magnetic abrasive brush in the influence of magnetic field. Magnetic abrasives used in MAF mainly contain two components i.e. ferromagnetic component and abrasive component, these components should be bonded to each other. The experiments have confirmed that MAF is very effective machining process for sizing work-piece and for achieving out of roundness (OOR) error that cannot be realized using traditional machining processes. The MAF is capable of achieving the surface roughness of 0.04µm and OOR of 0.5µm. It is capable of producing work-piece, having closer tolerance than other machining processes. The MAF is a novel technique for the finishing of cylindrical specimens such as rollers for use in ceramic hybrid bearings. The material removal rate is generally high (~1µm/min) and the finish quality is also excellent (R_a~5nm).magnetic abrasives. In present study we tried to made a complete setup of MAF process on lathe machine by fixing some of the parameters related to process

***Keywords*: electromagnets, material removal rate, magnetic abrasive polishing, surface roughness**

I. INTRODUCTION

With the development of modern manufacturing trends various industrial applications require very high surface finish ranging from nanometers or even above. Presently, it has been found that very fine surface roughness is required in the manufacturing of semiconductors, atomic energy parts, medical instruments and aerospace applications. Due to the shapes of vacuum tubes, wave-guides and sanitary tubes it is difficult to polish them by conventional finishing methods like lapping.

1.1Working Principle

The Figure 1.1 depicts the internal polishing process for magnetic abrasive. The principle of magnetic abrasive machining utilizes the machining force generated by the magnetic field strength as well as the gradient of the magnetic field.

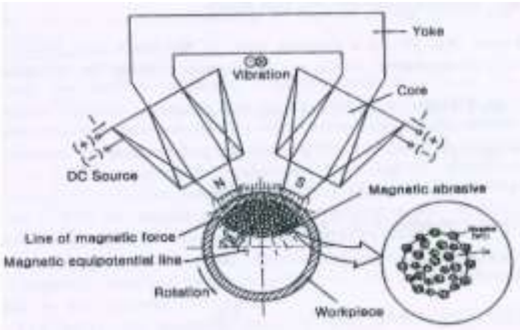

Fig. 1.1 Schematic view of the internal polishing system using magnetic abrasive machining

1.2 Types of Magnetic Abrasive Finishing

II.LITERATURE REVIEW

The literature, which was reviewed for this project selection, was based upon different aspects of abrasive mixtures that were prepared by various techniques. The non magnetic abrasives were required to be attached these with any ferro-magnetic material, so that the combination of ferro-magnetic material and abrasives can be attracted by magnetic field. Various researchers have prepared different mixing techniques for this purpose for testing surface finish, finishing time, wear of abrasives mixture. Only few researchers have focused upon the fabrication of the setup used for the same.

Sakulevich et. al. (1980) developed a rotor type machine for abrasive machining of parts with ferromagnetic abrasive powders in magnetic field and demonstrated that invention will render most efficient surface for finishing both soft ferromagnetic materials and alloys and such non magnetic metals as silver, aluminium, copper etc. and for finishing hard to work materials such as titanium alloys, silicon semiconductor alloys, optical glass etc.

Kurobe (1983) used magnetic field to finish silicon wafer, glass and copper. In this study the reasercher prepared magnetic fluid, which had the ability to move under magnetic field. The magnetic fluid was made up of suspension of fine magnetite into a solvent.

Bhagavat et. al. (1994) done a lot of research efforts to understand the effect of different process parameters such as slurry concentration, abrasive size distribution, applied loads on material removal rate, surface roughness of the workpiece.

Baron Y.M (1997) investigated about magnetic abrasive finishing method and its application to deburring and found the specific abrasive powders mixed by lubricating oil, that is suitable and appropriate for finishing and deburring drilled holes placed on a plane steel surface.

Yin et al. (2001) designed a set up for vibration-assisted magnetic abrasive finishing process. The effects of vibration on cylindrical finishing characteristics were studied. On the basis of these experiments, the finishing characteristics are represented summarily and the mechanisms on vibration-assisted finishing are discussed.

Tzong et al. (2003) in their study on Electrolytic magnetic abrasive finishing, Electrolytic magnetic abrasive finishing (EMAF) is a compound finishing process, involving traditional magnetic abrasive finishing (MAF) and an electrolytic process.

Dixit (2004) 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. An experimental set-up is designed and fabricated for the measurement of the magnetic field distribution in the working gap.

Vahdati et.al. (2008) carried out experiments upon micromachining of aluminum pipes using magnetic abrasive finishing. In this research, some effective parameters on surface roughness such as magnetic flow density, process time, amount of magnetic abrasive powder, and rotational speed of work piece have been tested and roughness sensation against these parameters has been studied

III.PROBLEM FORMULATION

Earlier research on Magnetic Abrasive Machining was carried out only to utilize this machining process in different operations. Only different types of material work-parts are processed upon this machine by various research personnel and organizations. But the cost can be reduced by making the setup on lathe machine Therefore, the present study aims to develop a suitable setup for magnetic abrasive finishing using lathe machine.

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www.ijarse.com
IJARSE
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3.1 Objective of study

To make a setup on lathe machine, for internal finishing of pipes with the help of abrasives, by using the working principle of magnetic abrasive machining.

IV.EXPERIMENTAL SETUP

An electromagnet consists of two coils of copper wire , which are adjusted at mutually perpendicular to each other. The work piece is clamped in between the electromagnetic poles with the help of a chuck.. An AC to DC convertor is used to supply DC current to the motor. The electromagnet is attached at a slide. The electromagnet is attached at the slide by aluminum nuts and bolts so that the magnetic flux could not leak to the slide. A magnetic abrasive powder is put inside the workpiece pipe and closed by a plastic cover, so that magnetic powder can not come outside from the pipe while rotating. When workpiece is rotated and current is supplied to the electromagnet a magnetic field is generated in the electromagnetic poles. The magnetic field attracts the magnetic abrasive powder placed in the workpiece pipe. Due to this relative motion, finishing is performed by the magnetic abrasive powder on the inner surface of pipe.

V.RESULTS AND DISCUSSION

After the fabrication process SiC abrasives were simply mixed with ferromagnetic powder and thus the magnetic abrasives were used to analyse the internal surface finish of brass hollow pipes. After the machining of those pipes the surface roughness was checked and it was found that there is a percentage improvement in surface finish. The whole process was analused under two different conditions i.e dry & wet conditions.

Table. 5.1. Simple Mixed Abrasive

S. No.	Initial surface finish in µm	Final surface finish in µm (Dry condition	%age improvement (Dry condition)	Final surface finish in µm (wet condition)	%age improvement(Wet condition)
1.	4.05	3.70	8.64	3.53	12.83
2.	4.08	3.68	9.80	3.49	14.46
3.	4.10	3.50	14.63	3.44	16.09
4.	4.11	3.46	15.81	3.40	17.27
5.	4.19	3.66	12.64	3.58	14.55

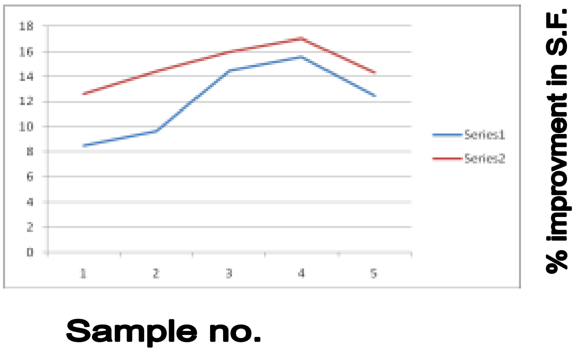

Fig. 5.1 percentage improvement in surface finish under dry and wet conditions

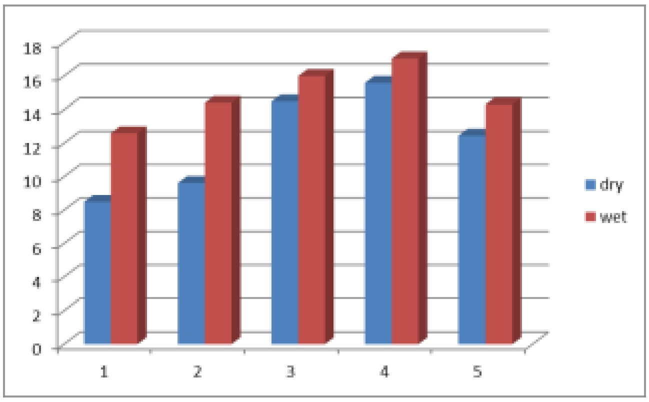

Fig 5.2. percentage improvement in surface finish

VI.CONCLUSIONS

1. The process is highly efficient and the removal rate and finishing rate depends on the work piece circumferential speed, magnetic flux density, working clearance, work piece materials, and size, type and volume fraction of abrasives.

2. The exciting current of the magnetic coil precisely controls the machining force transferred through magnetic abrasives on the work piece.

3. The maximum percentage improvement in surface roughness for simply mixed magnetic abrasives and Silicon Carbide was approximately 18%.

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