

# Advancement in surface finishing by abrasive flow machining:Review

Prof. Nagnath Kakde<sup>1</sup>, Tejas Deshmukh<sup>2</sup>, Prof.Akshaykumar Puttewar<sup>3</sup>, Prof.S.V.Lutade<sup>4</sup>

1. Asst.Professor, Mechanical Engineering Department, DBACER, Nagpur, [nagnath.kakde@gmail.com](mailto:nagnath.kakde@gmail.com), [9881204717](tel:9881204717)
2. M.tech Scholar, Mechanical Engineering Department, DBACER, Nagpur
3. Asst.Professor, Mechanical Engineering Department, DBACER, Nagpur
4. Asst.Professor, Mechanical Engineering Department, DBACER, Nagpur

## ABSTRACT-

Abrasive flow machining (AFM) is a manufacturing technique that uses the flow of a pressurized abrasive media to remove work piece material. In comparison with other polishing technique, AFM is very efficient, suitable for the finishing of complex inner surfaces. In recent years, hybrid-machining processes have been developed to improve the efficiency of a process by clubbing the advantages of different machining processes and avoiding limitations. It is experimentally confirmed that abrasive flow machining can significantly improve surface quality of nonlinear runner, and experimental results can provide technical reference to optimizing study of abrasive flow machining theory. This project is a genuine effort to optimize all the available modifications and permutation of abrasive flow machining in order to get the best available surface finish with minimum changes in the pre existing setups at no or very little cost.

**Keywords:-** Abrasive flow machining, Material removal rate; Surface roughness, Surface Finish

## INTRODUCTION

In the fields of military and civil uses, some special passages exist in many major parts, such as non-linear tubes. The overall performance is usually decided by the surface quality. Abrasive flow machining (AFM) technology can effectively improve the surface quality of the parts. Abrasive flow machining (AFM) is a nontraditional machining process that was developed in the USA in the 1960s.

Abrasive flow machining (AFM), also known as extrude honing, is an industrial process used in metal working. This process is used to finish the interior surfaces of cast metals and produce controlled radii in the finished product. The process of abrasive flow machining produces a smooth, polished finish using a

pressurized media. The medium used in abrasive flow machining is made from a specialized polymer. Abrasives are added to the polymer, giving it the ability to smooth and polish metal while retaining its liquid properties. The liquid properties of the polymer allow it to flow around and through the metal object, conforming to the size and shape of the passages and the details of the cast metal. Abrasive flow machining equipment is made in single and dual flow systems. In a single flow system, the abrasive media is forced through the project at an entry point and then exits on the other side, leaving a polished interior to mark its passage. For more aggressive polishing, the dual flow abrasive flow machining system might be employed. In dual flow system, the abrasive media flow is controlled by two hydraulic cylinders. These cylinders alternate motions push and pull the media through the project. This delivers a smoother, highly polished end result in much less time than a single-flow system. The process of abrasive flow machining is used in

the finishing of parts that require smooth interior finishes and controlled radii. Examples of these parts include automotive engine blocks and other precision finished parts. This process is also used in the metal fabrication and casting industry to deburr the dies and remove recast layers from molds used during production. Abrasive flow machining makes it possible to polish and smooth areas that otherwise would be unreachable, because of the ability of the media to flow through the part.

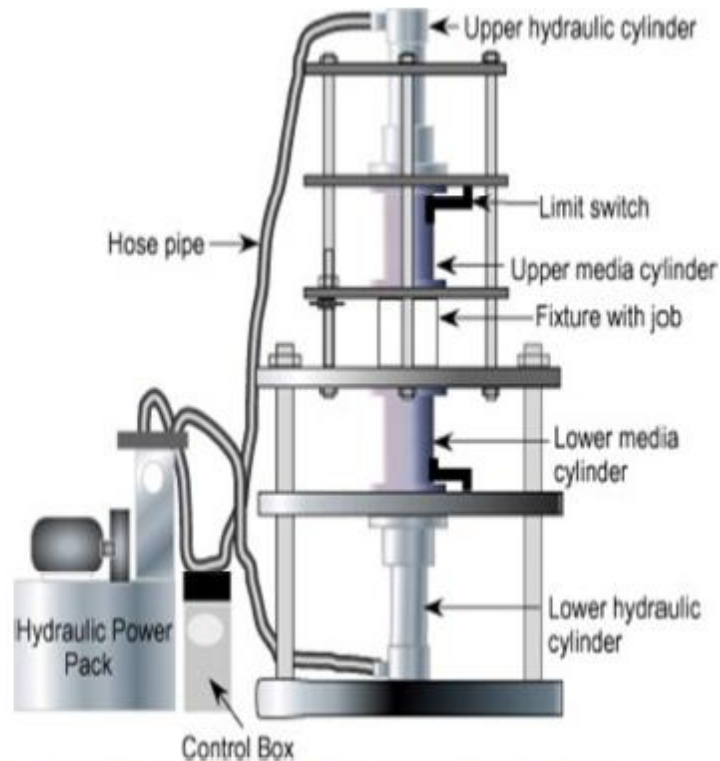


Fig. 1. Schematic diagram of abrasive flow finishing set-up

The AFM process has a limitation too, with regard to achieving required surface finish. With the aim to overcome the difficulty of longer cycle time, the project is trying to find a hybrid process, which permits AFM to be carried out. Harder materials require no. of cycles due to its low material removal rate [1].

Hybrid version of the abrasive flow machining may include use of magneto assistance during the finishing process, use of centrifugal force for abrasive particle or simply changing the abrasive putty which is grease, polymers or natural based. Thus in this project we are trying to prove the best available technique or even try to combine two or more technique for the raising the bar for the surface finish in the growing field of industrial up gradation.

### Major areas of experimental research in abrasive flow finishing

"Ramandeep Singh" et al.[1] Abrasive flow machining (AFM) is a relatively new non-traditional micro-machining process developed as a method to debur, radius, polish and remove recast layer of components in a wide range of applications. Material is removed from the work-piece by flowing a semi-solid viscoelastic plastic abrasive laden medium through or past the work surface to be finished. Components made up of complex passages having surface/areas inaccessible to traditional methods can be finished to high quality and precision by this process. The present work is an attempt to experimentally investigate the effect of different vent/passage considerations for outflow of abrasive laden viscoelastic medium on the performance measures in abrasive flow machining. Cylindrical work-piece surfaces of varying cross-sections & lengths having different vent/passage considerations for outflow of abrasive laden

viscoelastic medium have been micro-machined by AFM technique and the process output responses have been measured. Material removal, MR and surface roughness, Ra value are taken as performance measures indicating the output responses. Experiments are performed with significant process parameters, such as concentration of abrasive particles, abrasive mesh size, number of cycles and media flow speed kept as constant on brass as work material. The results suggest that the work-piece surfaces having single vent/passage for media outflow have higher material removal and more improvement in surface roughness in comparison with work-piece surfaces having multiple vents/passages and the performance measures decrease with increase in the number of vents for media outflow.

"**R.S. Walia**" et al. [2] Limited efforts have been done towards enhancing the productivity of Abrasive Flow Machining (AFM) process with regard to better quality of work piece surface. In recent years, hybrid-machining processes have been developed to improve the efficiency of a process by clubbing the advantages of different machining processes and avoiding limitations. In the present study, the abrasive flow machining was hybridized with the magnetic force for productivity enhancement in terms of material removal (MR). The magnetic force is generate around the full length of the cylindrical work piece by applying DC current to the solenoid, which provides the magnetic force to the abrasive particles normal to the axis of work piece. The various parameters affecting the process are described here and the effect of the key parameters on the performance of process has been studied.

"**Junye Li**" et al. [3] Due to the high thickness of abrasives and fine particle size, the abrasives will show excellent viscosity. The mixture of interaction of processing conditions, such as extrusion of high pressure, causes the removal effect of abrasive to nonlinear material even more apparent on the surface of tube channels, so as to obtain better surface roughness. Due to the abrasive's continuous removal effect on nonlinear tube channel surfaces, after the abrasive flow machining, the surface profile becomes more smooth and fine than the ups and downs before processing.

"**Jose Cherian**" [4] The average percent reduction in surface roughness can be increased by keeping the extrusion pressure, grain mesh number and Abrasive concentration at high levels, while the average force ratio can be increases by keeping extrusion pressure and abrasive concentration at high level and grain mesh number at low level. Also when the force ratio is maximum the percentage reduction in surface roughness is also maximum. The correlation coefficient between average percent reduction in surface roughness and average force ratio is higher as compared to correlations of average percentage reduction in surface roughness with average axial and radial forces.

"**P.D. Kamble**" [5] A magnetic field has been applied around a component being processed by abrasive flow machining and an enhanced rate of material removal has been achieved. Magnetic field significantly affects both MRR and surface roughness. The slope of the curve indicates that MRR increases with magnetic field more than does surface roughness. Therefore, more improvement in MRR is expected at still higher values of magnetic field. For a given number of cycles, there is a discernible improvement in MRR and surface roughness. Fewer cycles are required for removing the same amount of material from the component, if processed in the magnetic field. Magnetic field and medium flow rate interact with each other .The combination of low flow rates and high magnetic flux density yields more MRR and smaller surface roughness. Medium flow rates do not have a significant effect on MRR and surface roughness in the presence of a magnetic field. MRR and surface roughness both level off after a certain number of cycles.

## Objectives

The recent increase in the use of hard, high strength and temperature resistant materials in engineering necessitated the development of newer machining techniques. Conventional machining or finishing methods are not readily applicable to the materials

like carbides; ceramics .Conventional machining processes when applied to these newer materials are uneconomical, Produce poor degree of surface finish and accuracy, Produce some stress, highly insufficient. Newer machining processes may be classified on the basis of nature of energy employed. Low material removal rate happens to be one serious limitation of almost all processes.

The main objective of this project is to increase the metal removal rate from the abrasive flow machining and decrease the no. of cycle for the MRR required. Just by simple modification of changing the medium, magneto system, and introduction of centrifugal force we can actually increase quality of output at less cost of modification. It also focus on bringing the AFM & surface finishing to a new level to attain an unreached standards, which not only will increase the product quality but also increase the use of standardize spares, ultimately increasing life expectancy of the product without any raise at any kind of expenditure on the spares.

## Methodology

Though the project is not that simple as it seems to be, as it requires a no. of operations, it can be done into steps for its successful implementation. The whole project is basically divided into three parts:

- Data collection from different companies for basic operation of the machine.
- Analysis on the data collected
- Optimized the permutations to select the best modification and best abrasive material for surface finish.

The first portion of the project requires some times to collect all necessary parameters. There are certain local companies which are using this type of surface finishing machines for their products. The data related to the parameters of AFM will be collected from such industries. Few parameters are required to be assumed as all the data cannot be obtained from the companies. so by selecting appropriate parameter we can fill in the gaps for the step one to be carried out.

The second step includes training of an appropriate process for surface measurement and comparison of the data collected. Few specimens would be passed though a no. of cycles at different conditions. These specimens would be the observed under the electron microscope for the comparison. Third step is to combined and analyzed this data on any of the analysis software to select the most optimum method.

It will focus to combine different methods for a better and hybrid surface finishing technique. This will also helps us to suggest the best available medium for the AFM. Option of selecting a cheap, easily available and environmental friendly medium is also one of the prime focuses of this project.

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