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Optimization of process parameters using Abrasive Flow Machining By Taguchi Method : A Review

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Abstract: Abrasive Flow Machining (AFM) is an effective way to polish unsymmetrical surfaces and interior structure of parts, which are difficult to reach by conventional machining. The material to be machined may be cylindrical or any complex shape. Various process parameters are Material Removal Rate, Machining Time, and Abrasive Mesh size that affects the performance of AFM. The objective of this paper is to study the effects of process parameter related to it such as material removal rate, surface finishing etc.

Keywords— Abrasive flow machining, Material Removal Rate, Surface finishing.

INTRODUCTION: ABRASIVE FLOW MACHINING

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 an 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

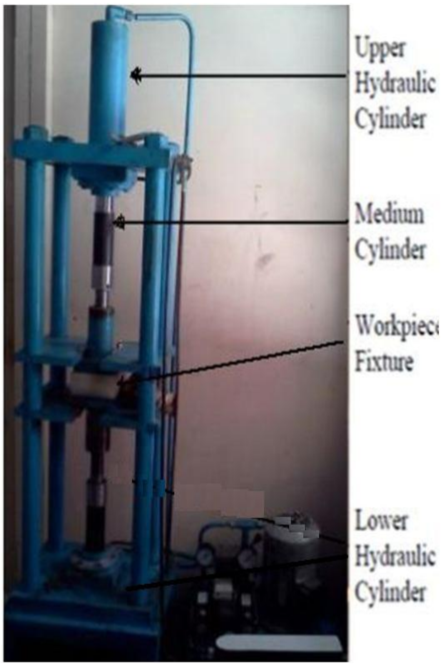

Figure- Two way abrasive flow machine

KEY COMPONENTS OF MACHINE

1. Lower Hydrulic Cylinder
2.Workpiece Fixture
3.Middle Cylinder
4.Upper Hydrulic Cylinder
5.Pressure Regulator

MAJOR AREAS OF EXPERIMENTAL RESEARCH IN ABRASIVE FLOW FINISHING

With the perspective of developing better insight of the subject and to explore the current status of the charismatic technique, which has opened up new vistas for finishing difficult to machine materials with complicated shapes which would have 15 been otherwise impossible. These processes are emerging as major technological infrastructure for precision, meso, micro, and nano scale engineering. This review provides an insight into the fundamental and applied research in the area and creates a better understanding of abrasive flow finishing process, with the objective of helping in the design stage of our study.

OBJECTIVE OF OPTIMIZATION

To see the effect of changing parameters (abrasive concentration, no. of cycles, extrusion pressure) on the workpiece metal removal rate and surface roughness.By use of taguchi as a optimization method we calculate the workpiece MRR and Surface Roughness and see the most important parameter that effects the workpiece.

WORKING MATERIAL

Brass is used as a working material to be machined on AFM. The diameter of Brass used in this process is (I.D.12 and O.D.19 mm).It is hollow cylindrical in shape having length 55 mm.

PROCESS PARAMETERS

S.NO.	PROCESS PARAMETER	RANGE	UNIT
1	ABRASIVE CONCENTRATION	1:1 TO 2:3	NO
2	EXTRUSION PRESSURE	15 TO 35	BAR
3	NUMBEROF CYCLES	20 TO 40	NO

Table-1

EXPERIMENTAL PROCEDURE

The experiments were performed by AFM technique conducted on cylindrical work-piece. The abrasives used in the media are silicon carbide. The mixture of media is mixed with the abrasive particles of particular mesh size in a definite proportion to achieve the desired percentage concentration of abrasive particles by weight. Before performing the real experiments, the intermediate was run for 20-25 cycles with the trial work piece, so as to get uniform mixing.

Based on the conclusions from the preliminary experiments, four significant variables are identified the number of cycles, extrusion pressure, abrasive mesh size, work piece material and are kept constant which is explained below.Values of variable parameters and of constant parameters are given in the table-1. All experiments were conducted on work piece surfaces comprising of cylindrical part. Material removal and surface roughness values were output responses calculated as performance indicators in each case.

WORKING METHODOLOGY

In first step we move the plates in order to set the plates in proper balance regard to each other With the help of hammer. Place the fixture between the two plates in the centre of plates. Generally a square type fixture is commonly used for the operation. But shape of hole in fixture depends upon the shape of your workpiece. Centering of fixture with regard to piston movement is very to easily allow abrasive to pass through the workpiece to remove the metal. Then tight these plates with key and hold these plates with the help clamp. Before starting the operation check all the components of the machine .pressure is varied according to the movement of piston with the help pressure valves which are used for both upper movement and lower movement of piston.Maximum limited pressure for this machine is restricted to 60bar.we move the piston in upward direction to set its pressure to zero that allow us to set preesure to pre determined level.
then pass the slurry through number of times according to the number of cycles used.

RESULTS

The results of this paper suggests that all the input parameters used in this work to optimize the response parameters i.e. MRR and Surface Roughness effect these output variables but the effect of abrasive concentration on MRR and Surface Roughness is comparatively more as compared to other parameters.

CONCLUSION AND FUTURE SCOPE

The effect of Extrusion Pressure, A; Abrasive Concentration, B; Number of Cycles, D; and Oil Concentration, E; on the material removal are found to be significant. It is further established that Extrusion Pressure, A; and Number of Cycles, D; are the most significant factors influencing the **material removal, Surface roughness** values. While Abrasive Concentration, B; and Oil Concentration, E; in the medium also have some contribution in influencing the material removal values. . Efforts should be made to investigate the effects of AFM process parameters on performance measures in a cryogenic environment. The weightages to be assigned to various characteristics in multi response optimization models should be based upon requirements of industries.

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