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Magnetic Abrasive Flow Machining Process Review and its Experimental Investigation

Rajbir Singhl[1], Sachin Dhull[2]
[1,2]Assistant Professor,
Maharaja Surajmal Institute of Technology,
Delhi, India

***Abstract*:- The present paper explains different work done on conventional and non conventional abrasive flow machining process. This process employs the finishing of internal surfaces of work by extrusion pressure. In the paper different in-house developed polymer media is used having aluminium oxide abrasives embedded into it. The experimentation was performed on magnetic abrasive flow machine. The experimental results were optimized using Taguchi L9 technique and it was found that the experimental values were in close approximation with the desired values os material removal and surface roughness calculated before performance.**

Keywords: Abrasive, media, Taguchi

1. INTRODUCTION AND LITERATURE SURVEY:

In abrasive flow machining the fine finishing of workpiece is done and a lot of work has been done in this field It is a non conventional technique of material removal. In this paper, different polymer media were prepared and their practical usage was checked [1]. The effect of ECM voltage, number of extrusion cycles and magnetic supply voltage has been studied in detail and explained graphically. The internal surfaces of the workpiece are finished to nano-scale using the impact force provided by abrasive laden media [2]. The different input parameters taken were rotational speed, extrusion pressure, number of cycles, supply voltage, abrasive mesh size, whereas output response i.e. material removal and surface roughness were optimized using the minitab software. In the paper [3], the preparation steps of electromagnets is studied and different roughness graphs are plotted and studied in details. Abrasive flow machining (AFM) is a novel technique having potential to provide high precision and economical means of finishing in a inaccessible areas and complex internal passages on otherwise difficult to machine material and component [4].

With the use of magnetic field around the work piece in abrasive flow machining, we can increase the material removal rate as well as the surface finish [5]. The strength properties of hybrid fibre reinforced concrete was determined by using steel and polypropylene fibres with total volume of fibre fraction of 0.75% and the results were analyzed to determine the optimum combination of fibre which gives better performance in terms of strength [6]. In the paper, the different polymer media viz. styrene butadiene rubber, nitrile and natural rubber based media has been developed and subsequently the XRD and FTIR analysis has been done [7]. In this study, an attempt is made to develop a new abrasive, alumina with Carbon non tubes (CNTs) in viscoelastic medium. CNTs in house produced through chemical vapour deposition technique [9]. A cost effective electrochemomagneto rotational abrasive flow finishing (ECMRAFF) setup has been designed and developed indigenously [15] . The newly developed polymer media, i.e. natural rubber, silicone rubber, nitrile and styrene butadiene rubber based media have been used in the experimentation and it was found that styrene butadiene rubber media usage resulted in highest material removal. Mathematical modeling was done for the output in terms of flux composition. The study reveals that the slag produced is dependent upon the basicity index of the flux and CaF_2 used as a flux ingredients [16].

2. ABRASIVE FLOW MACHINING SETUP:

The setup is integrated to a hydraulic press. The flow rate and pressure acting on piston of the presswere made adjustable. The upward movement of the piston (i.e. stroke length) is controlled with the help of a limit switch. Two strokes make up one cycle. A digital counter is used to count the number of cycles. It was specially designed to accommodate electromagnet poles such that the maximum magnetic pull occurs near the inner surface of the work piece.

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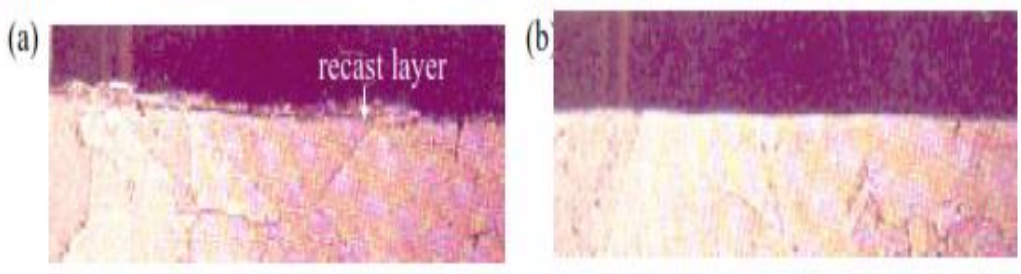

Figure 1: Removal of thermal recast layer (a) before AFM (b)after AFM

The original 2 µm R_aEDM finish is improved to 0.2µm with a stock removal of25 µm per surface. Fig. 1 shows the complete removal of EDM recast layer.

2.1. Experimental Design and Analysis:

Taguchi parametric design methodology was adopted. The experiments were conducted using appropriate orthogonal array (OA). An L9 (a standard 3-level OA) having 8= (9-1) degree of freedom was selected for the present analysis. The selected number of process parameters and their levels are given in the table:

Table 1:Process Parameters and their values at different levels

Process Parameters	Unit	Level 1	Level 2	Level 3
Pressure	Bar	8	18	28
No. of Cycles	Number	1	1	3
Magnetic field intensity	Intensity	Low	medium	High

A properly planned and executed experiment is of the utmost importance for deriving clear and accurate conclusions Taguchi defines quality loss via his 'loss-function'. He unites the financial loss with the functional specification through a quadratic relationship that comes from Taylor series expansion.

$L(y) = K(y-m)^2$

Where, L =loss in monetary unit

M =value at which the characteristic should be set

The further the product's characteristic varies from the target value, the greater is the loss. The loss is zero when the quality characteristic of the product meets its target value.

In a mass production process the average loss per unit is expressed as:

$L(y) = \{K(y_1-m)^2 + K(y_2-m)^2 + K(y_3-m)^2 + \ldots\ldots\ldots + K(y_n - m)^2\}$

3. RESULTS AND ANALYSIS:

From the bar diagram (figure 2) it is observed that MRR increases with increasing pressure and the increase is more in transition from level-1 to level-2 than in level-2 to level -3 i.e. MRR increases with decreasing slope.

(a) (b)

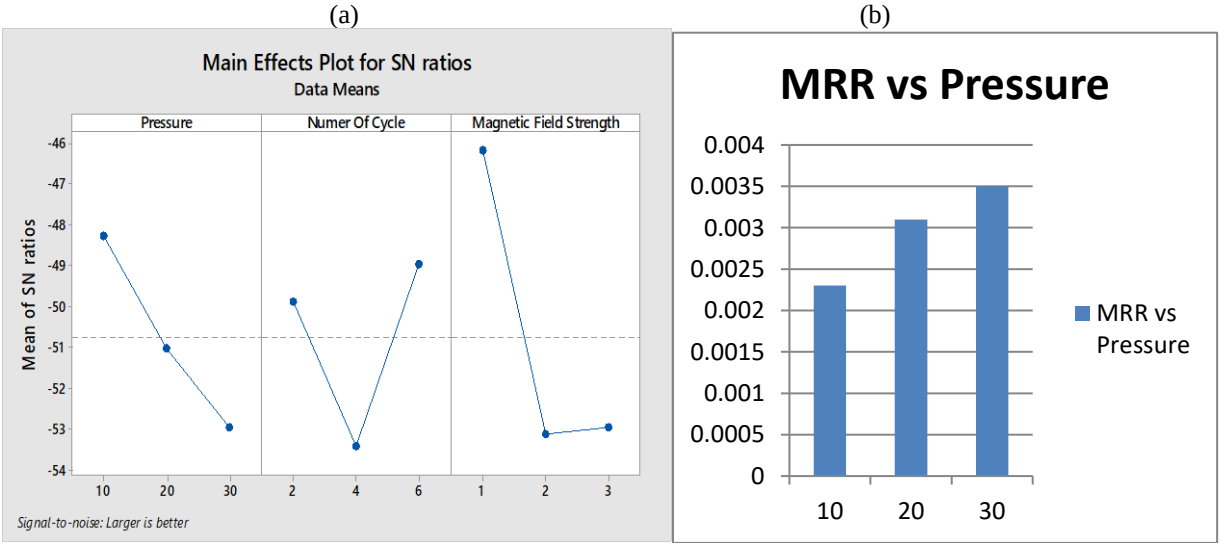

Figure 2: (a) Output graphs of mean of SN ratio for pressure, cycle and magnetic strength, (b) Effect of pressure on MRR In the table 2, it is clear that all the levels pressure field and cycles are shown with their delta or deviation values.

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Table 2: Response Table for Signal to Noise Ratios

LEVEL	PRESSURE	NO. OF CYCLES	MAGNETIC FIELD INTENSITY
1.	-48.24	-49.87	-46.16
2.	-51.03	-53.41	-53.11
3.	-52.95	-48.94	-52.95
DELTA	4.71	4.47	6.95
RANK	2	3	1

4. CONCLUSION:

In abrasive flow machining workpiece surface of internal areas is done and high removal is attained and the process efficiency is increased by making it hybrid. In the present paper different researchers' work has been explained in detail. Then the experimentation was performed so that different parameters like pressure, magnetic field and number of cycles is set such that output result is optimized. For this purpose Taguchi and SN ratio technique is used.

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