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INVESTIGATION OF NICKEL ALUMINIUM ALLOY BY ELECTRIC DISCHARGE MACHINE, A REVIEW

Dinesh Kumar[1], Devendra Singh[2], Dr. Ajay Kumar Sharma[3]

[1]Student, Sachdeva institute of Technology, Mathura, Mechanical engineering, AKTU, Lucknow , U.P.-India
[2]Asst. Prof. Mechanical Engineering, Sachdeva institute of technology, Mathura, U.P.-India
[3]Asst. Prof., Mechanical Engineering, Institute of Engineering & Technology, Lucknow, U.P.-India

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Abstract - The objective of this research study is to investigate the optimal Process parameters of Electric Discharge Machining on Nickel aluminum composite work piece with copper as a tool electrode. The effect of various process parameters on machining performance is investigated in this study. The input parameters considered are impulse current, Pulse on time and pulse off time, voltage gap are used for experimental work and their effect on Material Removal Rate, Tool and Surface Roughness. our main objective of the present work has been decided to develop a composite material (Al_2O_3-p reinforced aluminum composite) and to characterize the composite material and find the hardness and tensile strength.

1. Manufacturing of Ni-Al composite:

The Ni-Al reinforced Al composite was produced by sand casting in foundry shop. The dimensions of final product were 45mm in diameter and 300mm length. In order to obtain matrix material at the beginning phase of the production, 99.9% pure aluminum was melted in the crucible at 700°C on muffle furnace. Then the nickel was added in the crucible and steered continuously. In order to increase wetting capability of reinforcement, 2% of Mg was added. In our experiment three types of nickel particles reinforced metal matrix composites were casted. In the first type 15% by weight nickel and remaining aluminum and could able to mix 4% by weight alumina in the final cast product.

In type second 20% by weight nickel and remaining aluminum and could able to mix 6% by weight nickel in the final cast product. In third type 25% by weight nickel and remaining aluminum and could able to mix 8% by weight nickel in the final cast product. The dimension of work piece was 30 mm x 30 mm x 10 mm.

2. Methodology:

EDM characteristics have been investigated over the last five decades. A broad look at the literature reveals that EDM of steels has received maximum attention. EDM machining tool manufacturers have also been providing machining data for steels based on their in house experimentation. Such data base is based on the quantitative and qualitative relationship between the technological parameters like erosion rate and surface integrity.

3. Selection of process parameters:

It is necessary to choose a reasonable set of factors to be varied in the experiment. The performance on EDM of nickel-Aluminum composites are governed by a large number of interactive variables. The variables can be classified as electrical parameters, non-electrical parameters, electrode based parameters and work piece material based parameters. Review of literature revealed that among all the factors, discharge parameters such as discharge current, pulse-on time, and duty cycle and gap voltage have most significant influence on the EDM performance. Therefore, it has been decided that these four factors be chosen for the present study.

4. Experimentation on EDM with EDM oil as Di-Electric fluid Medium -

Die sinking EDM experiments have been carried out on EDM machine (Model Spark nix, India). In all the experiment, Nickel reinforced aluminum composites of 8% composition of Nickel powder used because its tensile strength and hardness value was better than other two composites. In all the experiments, EDM oil has been used as dielectric medium. Total 18 experiments have been performed using CCRD with independent variables at 5 different levels. Machining time for each work piece in the experiments has been kept 60 minutes.

After EDM, Nickel reinforced aluminum composites (8%) samples have been cleaned with acetone. A high precision electronic weighing balance with least count 0.01 mg has been used to measure the weight loss of work piece and electrodes after each experiment. The surface finish after machining was measured using Talysurf 6 (Rank Taylor Hobson, England). A traverse length of 3 mm with a cut-off

evaluation length of 2 mm was used. The Centre line average value of the surface roughness (SR) is the most widely used surface roughness parameter in industry, was selected in this study. Each sample was measured three times and the average was taken as the response. Measurement of out of roundness of the electrode was performed before and after machining so as to determine the actual change in the shape of the electrode. This measurement was performed on Carl Zeiss Coordinate Measuring Machine and Calypso software. The change in roundness of the tool has been considered as the response in the study to represent the shape of the tool.

5. LITRATURE REVIEW:

The review presented in this section is based on current EDM research trends. Few researches have been investigated in areas discussed-

Pradhan et al. [1] have studied three different parameters namely pulse current, discharge time and pulse time and pause time for EDM process of AISI D2 steel using response surface method. It was found that all the three machining parameters and some of their interactions have significant effect on MRR.

Ryota Toshimitsu et al. [2] have studied a new EDM surface finishing method using chromium powder mixed fluid was proposed and the finished surface characteristics were experimentally discussed.

Syed, Palaniyandi et al [3] worked on addition of aluminium metal powered I distilled water resulted in high MRR, good surface finish and minimum white layer thickness when compared with pure distilled water.

Singh et al[4] investigated that negative polarity of tool electrode is desirable lowering of surface roughness and addition of powder particles I dielectric fluid decreases surface roughness of specimen in EDM process.

Rozeek et al. [5] was found that application of powder I the dielectric lead to reduce surface roughness. The investigation result showed that there were chances for replacing the conventional dielectric powder suspended deionized water and that would imply considerable economic and ecology advantages.

Biswas et al. [6] investigated that surface roughness is directly proportional to linear effect of pulse current and pulse on time.

Mohd. Abbas et al[7] reviewed the research trends in EDM on ultrasonic vibration, dry EDM machining, EDM with powder additives, EDM in water and modeling techniques in predicting EDM performances is presented.

Kansal et al. [8] developed a axis symmetric two dimensional thermal model to predict the several aspects of the PMEDM using FEM.

Kiyak.M. et al.[9] explained surface roughness increased with increasing pulse current and pulse time. Work piece surface roughness would be increase due to wear rate on electrode.

Afazov et al [10] determined stable cutting conditions for corresponding cutting tools with specific geometries was essential for achieving precision micro- milling with high surface quality.

Kansal et al[11] have studied that peak current concentration of the silicon powder pulse- on time and gain significantly affect the MRR in PMEDM.

Kendal.J. et al. [12]investigated the surface integrity induced by the AFM process on hardened tool steel AISI D2.

Liquing et al[13] proposed two new dry EDM techniques, namely oxygen- mixed dry EDM and dry EDM with cryogenically cooled work piece with the objective of increasing MRR and surface integrity.

Kolke et al[14] studied the possible productivities, tool wear and surface qualities in processing gamma titanium aluminides with the help of Sinking EDM.

Tomadi. S.H. et al[15] investigated the condition of parameters, main effect and the significance of individual parameter to surface roughness, material rate and electrode wear of material.

Choudhary Suraj et al[16] concluded that copper electrode showed the highest MRR while the brass electrode showed the least MRR. For lowest value of pulse-on time the MRR is low. At current 30 A the MRR is highest.

Bikramjit Singh et al[17] concluded that adding SiC and Aluminium powder into Kerosene oil increased the gap distance, resulting in higher MRR and depth.

Potdar.V.V et al[18] concluded that the material removal rate increased by mixing powder in the dielectric fluid as compared with conventional EDM process.

From the above literature survey, it can be concluded that our main objective of the present work has been decided to develop a composite material (Al_2O_3-p reinforced aluminum composite) and to characterize the composite material and find the hardness and tensile strength to study the effect of surface roughness, and material removal rate and using powder suspended working fluid instead pure dielectric such as kerosene and deionized water. The above literature survey shows that there are chances for replacing the conventional dielectric with powder suspended deionized water and silicon oil and that would imply considerable economic and ecology advantages.

6. conclusion-

After EDM, Nickel reinforced aluminum composites (8%) samples have been cleaned with acetone. A high precision electronic weighing balance with least count 0.01 mg has been used to measure the weight loss of work piece and electrodes after each experiment. The surface finish after machining was measured using Talysurf 6 (Rank Taylor Hobson, England). A traverse length of 3 mm with a cut-off evaluation length of 2 mm was used. The Centre line average value of the surface roughness (SR) is the most widely used surface roughness parameter in industry, was selected in this study. Each sample was measured three times and the average was taken as the response. Measurement of out of roundness of the electrode was performed before and after machining so as to determine the actual change in the shape of the electrode.

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