www.ijiarec.com

ISSN:2348-2079

Volume-5 Issue-2

International Journal of Intellectual Advancements and Research in Engineering Computations

An Experimental Investigation of Aluminium Alloy 8011 using Abrasive Water-Jet Machining

M.Easwaramoorthi[1] ,C.E.Mohankumar[2],K.Mohanraj[2],M.Munusamy[2],S.P.Ramachandran[2]
[1] Professor, [2] UG Students

Department of Mechanical Engineering, Nandha Engineering College, Erode, Tamilnadu, India
eswaramoorthi65@gmail.com, sprams1996@gmail.com

Abstract:

Abrasive water jet machining process is one among the non- conventional machining processes and extensively used to manufacture aerospace components. An attempt is made in this project to measure the material removal rate (MRR) and surface roughness of aluminum alloy 8011keeping work piece at different angles by abrasive water jet machining. The effect of the process parameters like water pressure, abrasive flow rate and standoff distance on material removal rate is investigated for different jet pressures.

Index words – MRR, Surface Roughness, Abrasive water jet machining, Garnet abrasive.

I. INTRODUCTION

Nowadays abrasive water jet machining is widely used in manufacturing area. In this AWJM a small stream of fine grained abrasive particle is mixed in suitable condition, which is forced on a workpiece through nozzle. MRR occurs due to erosion caused by the impact of abrasive particle on the material surface. This process is many suitable for machining of brittle materials, composite materials and ductile materials. In this the technique based on major factor like Jet pressure ,Stand off distance of nozzle from the target. Abrasive flow rate, Traverse rate, work materials. In this process , there is no affected zone, low machining force on the work surface and ability to machining wide range of materials has increase the use of abrasive water jet machining over machining process. In this process there is no thermal distortion takes place on the work material.

II. LITERATURE SURVEY

Hashish (1998) investigated the isogrid patterns in aluminium and titanium using AWJPM to increase the strength of the materials. In this, the Applications of isogrid structures were extremely used in the field of aerodynamics. He observed that factors like degree of overlap, cross feed increment and mixing tube diameter are significant for the formation of the required patterns[1].

Krishnaiah chetty&Kanthababu (2006) has investigated single mesh and double mesh size abrasives using parameters like pressure, traverse rate and abrasive flow rate. Research result revealed that Single mesh size abrasives are found to yield decreased surface roughness than multi mesh size abrasives [2].

Fowler et al (2009) have carried out AWJPM in titanium alloy (Ti6Al4V) to study the effects of different abrasive particle (white and brownaluminium oxide, garnet, glass beads and steel shots) shape andhardness. They have observed that the ratio between the hardness of the workpiece and the abrasive particle is more significant than that of abrasive particle shape. They have also observed that increase in the material removal rate and surface roughness with the increase in the abrasive particle hardness. They have observed that among the different input process parameter, traverse rate is found to be more significant for material removal rate for different abrasives. They have also found thatshape factor and particle hardness have no significant effect on the surface waviness[3].

Selvan et al.(2009)studied the influence of process parameters on depth of cut and surface roughness in abrasive water jet cutting of stainless steel. Experiments were conducted in varying water pressure, nozzle traverse speed, standoff distance and abrasive flow rate for cutting stainless steel plates using abrasive water jet cutting process.

Increase of WP resulted in increase in depth of cut when mass flow rate, TS and S.O.D were kept constant, When WP is increased, the jet K.E increased that lead to more depth of cut. Higher AFR achieve higher cutting ability of the jet. But for higher AFR, abrasives collide among themselves and lose their K.E. It was evident that the surface was smoother near the jet entrance and gradually the SR increases towards the jet exit [4].

III. EXPERIMENTAL WORK

3.1 Material

In the present study, Aluminium alloy 8011 was used as a material. This material is a ductile material and has used for various applications widely as an aircraft material.

3.2 Equipment

The used for machining the work piece was Omax 2626 abrasive water jet machining centre equipped with a abrasive feeder system, a pneumatically controlled valve and a work piece table.

3.3 Experiment setup

In this present study, three machining parameters were selected as constant namely transverse speed, stand-off distance and abrasive flow rate. Constant pressure and various angles are considered. The garnet abrasive with size 80 mesh was selected. The experiment setup is shown in Fig.1.

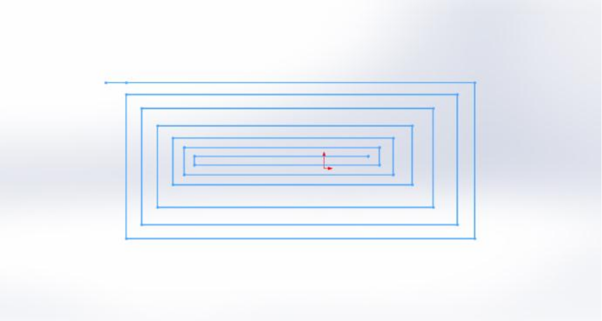


Fig.1. Spiral cutting path

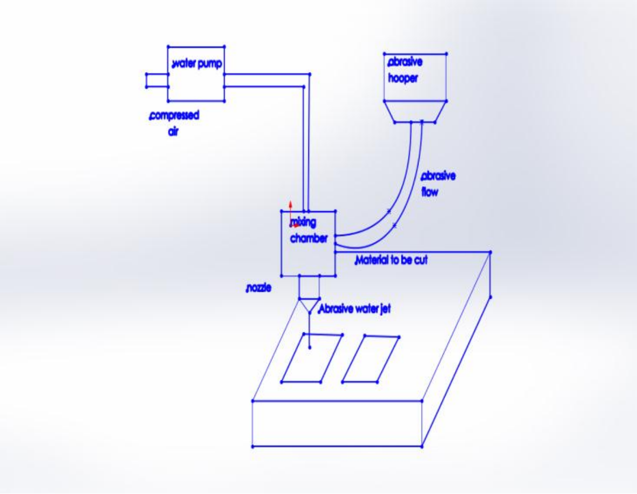


Fig.2. Schematic of an abrasive water-jet cutting process

The above schematic diagram indicates abrasive Hopper, Cutting Head, Abrasive Water jet, Catcher in the Abrasive water jet machining setup. In which, the work material is placed perpendicular to the water jet in order to cut the material in rectangular pocket using Spiral Pattern.

3.4 Machine Detail

Type of machine, power, Min and Max Water pressure level, Work Table size, Nozzle and Orifice diameters are tabulated in Table 1.

TABLE 1. Machine Specification

Machine Used	OMAX 2626 Precision jet machining Centre
Power	22kW, 50 Hz
Min water pressure	138 MPa
Max water pressure	413 MPa
CNC work table size	1168 x 787 mm
Nozzle diameter	0.76 mm
Orifice diameter	0.35 mm

3.5 Chemical composition

.

Material aluminium alloy 8011 is shown in Table 2

TABLE 2.chemical composition of Aluminium Alloy 8011

Aluminium (Al)	97.5 to 99.1 %
Iron (Fe)	0.5 to 1.0 %
Silicon (Si)	0.4 to 0.8 %
Residuals	0 to 0.15 %
Chromium (Cr)	0 to 0.1 %
Copper (Cu)	0 to 0.1 %
Magnesium (Mg)	0 to 0.1 %
Manganese (Mn)	0 to 0.1 %
Zinc (Zn)	0 to 0.1 %
Titanium (Ti)	0 to 0.050 %

IV DISCUSSION

In this mathematical method the values are calculated based upon the length, width, depth and time. Pressure is kept constant at 140 Mpa. The material removal rate (MRR) is calculated by using the following formulae

$$\text{MRR} = \frac{\text{Length x width x depth}}{\text{Time}}$$

Where,

Length - mm

Width - mm

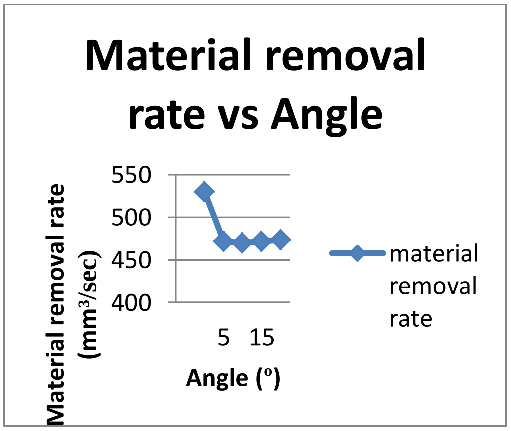
Depth – mm

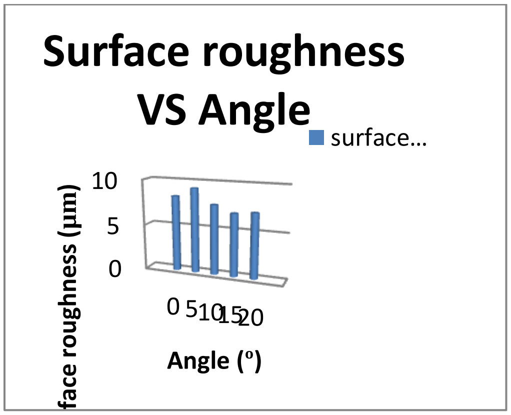
Time – min

The material removal rate and surface roughness of the taken material is calculated and the values are tabulated in the above tabular column on Table 3.

TABLE 3Experimental results

S.No	Water pressure (Mpa)	Angle (degree)	Material removal rate (mm^3/min)	Surface Roughness (µm)
1	140	0	529.65	8.28
2	140	5	471.73	9.25
3	140	10	469.80	7.63
4	140	15	471.73	6.88
5	140	20	473.67	7.10





V CONCLUSION

This work aims to determine the material removal rate (MRR) and Surface Roughness (Ra) of Aluminium Alloy 8011 by applying constant pressure and various angles. Mathematical calculation is carried out to find out the process parameters and the results were tabulated. It shows that MRR occurs higher at an angle 0^o when compared to other angles.

VI REFRENCES

[1] M. Hashish, "Controlled Depth Milling of Isogrid Structures with AWJs", Journal of Manufacturing science and Engineering Vol 120,
pp. 21–27,1998

[2] Kanthababu& M. Chetty Krishnaiah O.V.(2006)," A study on the use of single mesh size abrasives in abrasive water jet machining", ManufTechnol, 29, 532-540

[3] G. Fowler, I.R. Pashby, P.H. Shipway, "The effect of particle hardness and shape when abrasive water jet milling titanium alloy Ti6Al4V", Wear Vol 266 613–620,2009

[4]SelvanM.ChithiraiPon&Dr.Raju.N.MohanaSundara (2012),"A machinability study of stainless steel using abrasive water jet cutting technology", I International Conference on Mechanical Automobile & Robotics Engineering,208-212.