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An Experimental investigation of sea sand as an Abrasive material in vibrating chamber by using Tungsten Carbide Nozzle in Abrasive Jet machining Process.

N. S. Pawar, R.R. Lakhe, R. L. Shrivastava,

**Department of Mechanical Engg, Government Polytechnic , Nagpur, Maharastra state, India*
*** Director, shreyas Quality Management system, Training and consultancy (9001:2000),11, Tulsivihar Abhayakar Nager Road TF-III, Nagpur-10, Maharastra State, India*
**** Professor in Mech Engg Dept.,Yashwanrao chavan college of Engg. Nagpur Maharastra State, India*

Abstract: - A large number of investigation carried out in Abrasive jet machining and water jet machining process with different parameter but no detailed work have been found or carried out by using sea sand as an abrasive in AJM process by using different types of nozzles and variable parameters. The present work gives performance of sand having grain structure of 100-150 micron in the tungsten carbide nozzle. The experimentation in this study give characteristic of sea sand as abrasive material. The parameter like pressure, standoff distance of nozzle from work piece keeping constant and variable. It give the result of material removal rate , powder flow rate, similar to actually abrasive used like Aluminum oxide, silicon oxide etc. The R square value o.97 to 0.996 degree of polynomial equation. It is also notice that width of cut slightly increase with increase of feed rate .The taper cut slot was found to be a higher at greater stand of distance and work feed rate .Tungsten carbide is very hard. It maintain high cutting ability as abrasive strike on work piece.

Keywords: - *sea sand, Vibrating chamber, Abrasive jet machine , abrasives, Nozzles, glass,*

I. INTRODUCTION

Sand Abrasive compressed air is used for surface cutting, holing of surface on the brittle material like glass, this also used for surface cleaning and surface texturing etc. In AJM process fine particles of sea sand having grain size 100-150 micron accelerate in mixing chamber. The sea sand particle directed toward working surface. The Tungsten carbide Nozzle is one of the most useful nozzle in modern AJM engineering process because of its high hardness, high wear resistance, high chemical inertness, high young's module and thermal conductivity. In earlier studies of Deng Jianxin used ceramic based composite have been developed and used in various application.

Nevertheless considering its working condition the AJM process can generate penetration. The acceleration of the sand abrasive in vibrating chamber generate the proper turbulence of particles along with compressed air of pressure varying from 5 kg per cm sq. to 12 kg per cm sq. The cam and follower at lower base side of the gives vibrating motion to chamber. The studies by Dong sam park (1) machining profile of grooves shows U type shape. He also elaborate masking for good result independent of the heating temperature with water abrasive jet machining . By Deng Jianxin (3) he focus on reducing stresses on entrance of ceramic nozzle with apparent increasing in erosion wear resistance. The effect of hardness of nozzle was reported by Jianais Deng (5). The experimental work carried out by Balasubramaniam (7) the effect of particles size on its normalized erosion profile and effect of normalized erosion profile as velocity assumed to be constant. For all stand of distance he conclude that the peripheral velocity of jet is increases it also increases the rate of material removal rate.

The present study set a target of sea sand as abrasive material in vibrating chamber of tungsten carbide nozzle with varying parameter of pressure, standoff distance. The morphology of impacted surface is compared conventional abrasive which used in AJM as well as water abrasive Jet machine process. In fact the quadratic polynomial and cubic polynomial model fit curve gives the R-square vary near to 1 i.e. 0.98 to 0.9918 which result good fitting of curve.

II. EXPERIMENTAL PROCESS AND SET UP

Experimentation were conducted to proposed sea sand as abrasive material with grain size vary from 100-150 micron. The microscopic structure can observed by sedimentation and decontation, sedimentation balance, BET, illustration method. For 1.5 to 2 mm diameter of nozzle 50-150 micron grain size is preferably used. The sieving size range start from 37 micron below this not possible to used for grain size measurement if the size is above 37 micron electronic microscope is used.
The pressure varying from 5 to 12 kg per cm. sq. and standoff distance keeping variable and constant for different powder flow rate throughout the machining process.

Table No.1:Experimental condition
Abrasive--------------sea sand
Grain size-----------100-150 micron
Pressure-------------5 to 12 kg/cm^2
Standoff distance ----------------constant
Tungsten carbide Nozzle--------2mm dia
Time consider for penetration----variable
Work piece----Glass & Thickness = 4 mm

Fig No:1 Experimental set up

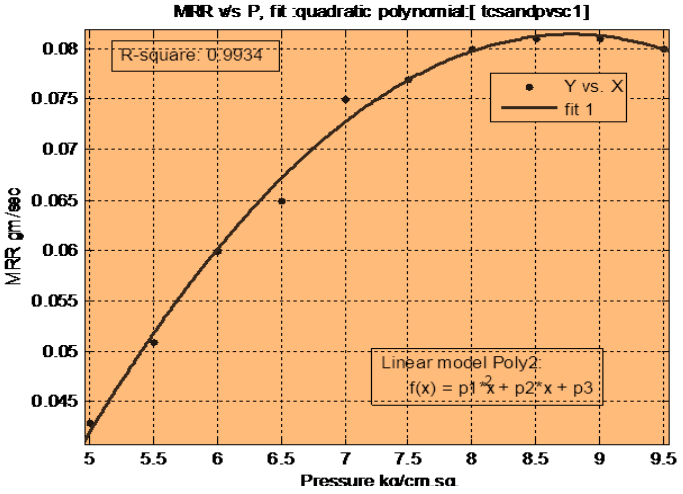
In this work process the material removal rate and powder flow rate were calculated in different condition apply for set up. The high turbulence is created in vibrating chamber with compressed air by which the particle moves with high speed of stream. The impact through nozzle cause severe erosion or material removal gm/sec. the erosion of material surface depends upon velocity of particle direction and brittleness of work piece. Some studies are showed that erosion rate depend upon impact angle.

Table No: 2.when pressure variable and standoff distance constant.

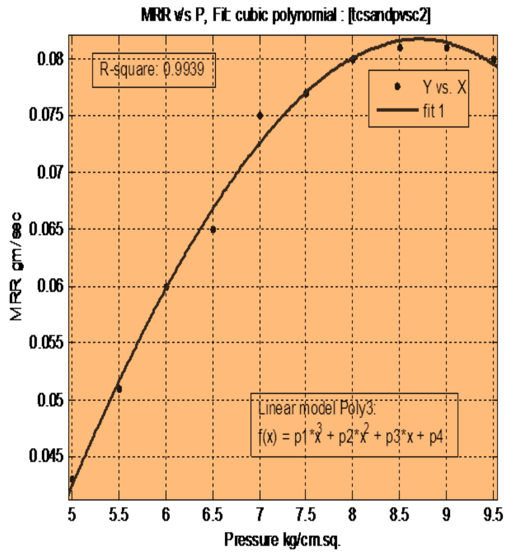
Sr. No	P Kg/cm^2	SOD mm	MRR W/T = gm/sec)	PFR Wa/T = gm/sec	DOC mm
1	5	8	0.043	1.10	4.5
2	5.5	8	0.051	1.21	4.7
3	6	8	0.060	1.34	5.0
4	6.5	8	0.065	1.50	5.1
5	7	8	0.075	1.73	5.1
6	7.5	8	0.077	1.73	5.2
7	8	8	0.080	1.74	5.4
8	8.5	8	0.081	1.75	5.6
9	9	8	0.081	1.75	5.4
10	9.5	8	0.080	1.76	5.5

The quadratic and cubic polynomial model fit for MRR v/s pressure shows the R square value are not much more differ and the percentage of difference is 0.5 % which is very less. The graphical representation of material removal rate and pressure show the nature of sand abrasive with different condition. The depth of cut is slightly increase as the SOD is increased. It is observed that sprinkling of abrasive is more then DOC is also more.

Graph No. 1 Effect on MRR v/s Pressure at R-square value is 0.9934

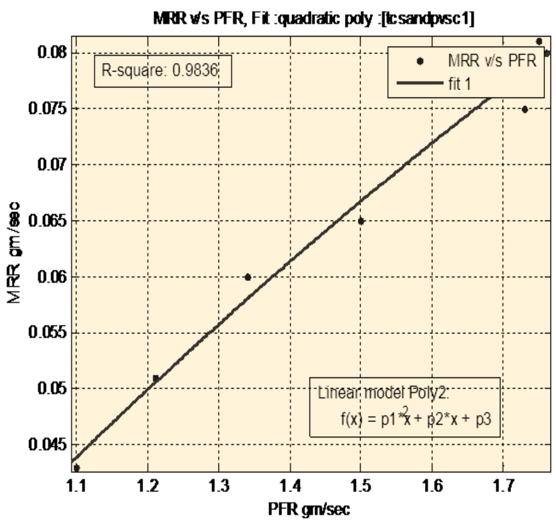


Graph No.2 Effect of MRR v/s Pressure at



R-square value is 0.9939

Graph No :3 behavior of MRR v/s PFR at quadratic polynomial fit at R-square value 0.9836



Graph No :4 behavior of MRR v/s PFR at cubic fit at R-square value 0.9903 which is not much differ

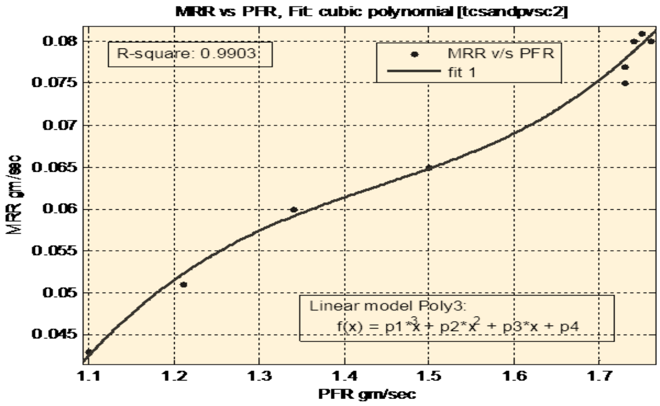


Table no:3 when SOD is constant

Sr. No	P Kg/cm²	SOD mm	MRR W/T = gm/sec)	PFR Wa/T = gm/sec	DOC Mm
1	8	9.5	0.082	1.80	5.1
2	8	9.5	0.082	1.81	5.0
3	8	9.5	0.081	1.81	5.1
4	8	9.5	0.082	1.81	5.1
5	10	9.5	0.081	1.80	5.0

III. ANALYSIS

Analysis is carried out even the effect of some vibration , grain size of sea sand, was properly analysis by good fitting curve. It was tested under different polynomial fit i.e. linear polynomials, quadratic polynomial, cubic polynomial, 4th degree poly fit etc. above all cubic polynomial fit gives their good fitting of curve and R square value is 0.9934 and 0.9939 The linear model equation of polynomials is

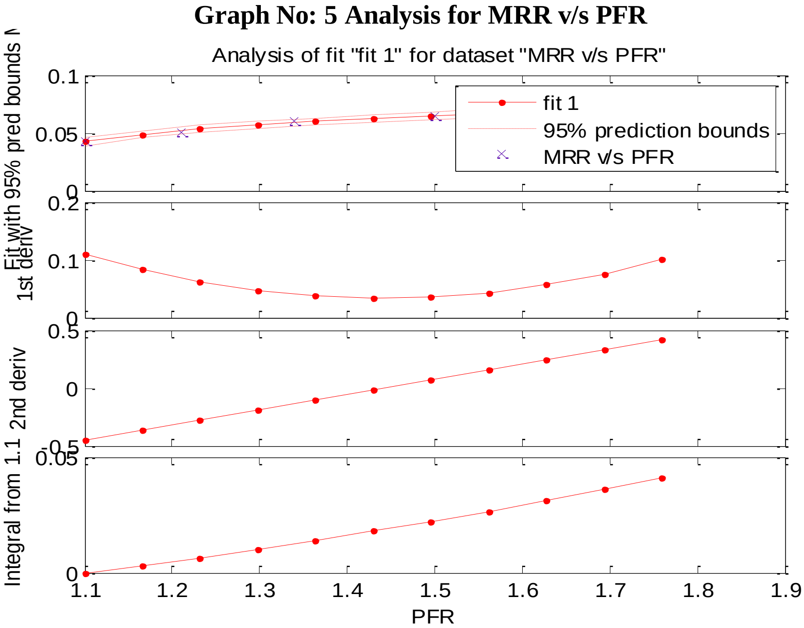
F(x)= p1*x^3+p2*x^2+p3*x+p4 and

In this experimental study the assumption were made in present analysis condition and simplifying equation

F(x)= 0.219*x^3-0.947*x^2+1.399*x^1-0.6417

The analysis of MRR v/s PFR of first derivation, second derivation, and first integration are obtained with 95% prediction bond are

Graph No: 5 Analysis for MRR v/s PFR



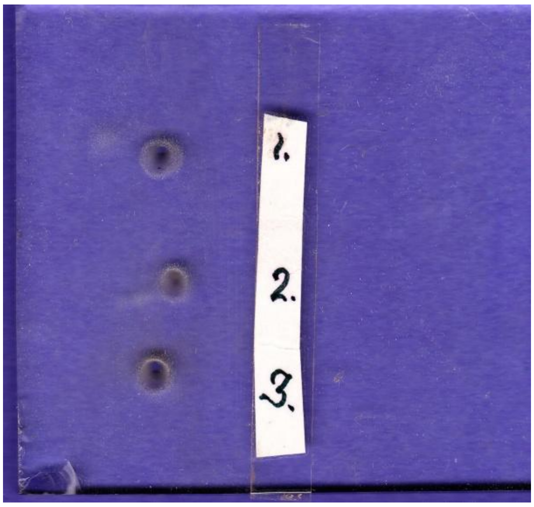


Fig No: 2 photograph of cut section of work piece:

IV. DISCUSSION

Photograph shows the actual diameter of cut of brittle material. The value of material removal rate and powder flow rate were obtained by varying pressure and SOD and constant then after. The observation and all relevant value of MRR and PFR are obtained by cubic polynomial fit for this observational set

V. CONCLUSION

The following conclusion are made at the end of analysis.

a) As the pressure increases the MRR is also changing
b) The value of R-square very near to 1 i.e. 0.9934 and 0.9939.
c) If the SOD is constant there is no more effect on MRR
d) The validation of work i.e. the value of MRR at pressure 5 kg per cm sq. is 0.043 gm/sec by concluding observation and the by using linear polynomial model

F(x)= 0.219*x^3-0.947*x^2+1.399*x-0.6417

F(x)= 0.0421 and the percentage of error is very less

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