© 2018 IJSRSET | Volume 4 | Issue 1 | Print ISSN: 2395-1990 | Online ISSN : 2394-4099
Themed Section : Engineering and Technology

A Review on Abrasive Jet Machining

Margin Mistry[1], Swapnil Palkhade[1], Vinit Patel[1], Deep Shah[1], Kishan Vyas[1], Sharvil Shah[2]
[1]UG Student, Mechanical Engineering, ITM universe, Vadodara, Gujarat, India
[2]Assistant Professor, Mechanical Engineering, ITM universe, Vadodara, Gujarat, India

ABSTRACT

A machining operation is basically material removal process, where material is removed in the form of chips. Abrasive Jet Machining is non-traditional material removal process, and a specialized for shot-blasting operation. It is an effective machining process for a variety of hard and brittle material. Further it illustrates the effect of various input parameter in abrasive jet machining (AJM) on the output parameter Metal removal Rate (MRR). It has various distinct advantages over the other non-traditional cutting technologies such as, high machining versatility, minimum stress on the work piece, high flexibility on thermal distortion and small cutting forces. In addition, extensive review of the current state research challenges and scope development in abrasive jet machining are also projected.

Keywords: Stand-Off Distance, Abrasive Mass Flow Rate, Material Removal Rate, Non-Traditional Machine, Flexibility.

I. INTRODUCTION

Abrasive jet machining (AJM) is a processing non-traditional machine which operates materials without producing shock and heat. AJM is a processing nontraditional machine which operators on no physical contact between tool and work piece so there is no thermal stresses and shocks developed. AJM is applied for many purposes like drilling, cutting, cleaning, and etching operation. In Abrasive jet machining abrasive particles are made to impinge on the work material at high velocity. A jet of abrasive particles is carried by carrier gas or air. The high velocity stream of abrasives is generated by converting the pressure energy of carrier gas or air to its Kinetic energy and hence the high velocity jet. Nozzles direct abrasive jet in a controlled manner onto work material. The high velocity abrasive particles remove the material by micro-cutting action as well as brittle fracture of the work material. Machining, Drilling, Surface Finishing are the Major Processes that can be performed efficiently.

The process parameters are used like variables which effect metal removal. They are carrier gas, abrasive, and velocity of abrasive, work material, and nozzle tip distance (NTD). Abrasive jet cutting is used in the cutting of materials like: Titanium, Brass, Aluminum, Stone, Any Steel, Glass, Composites etc.

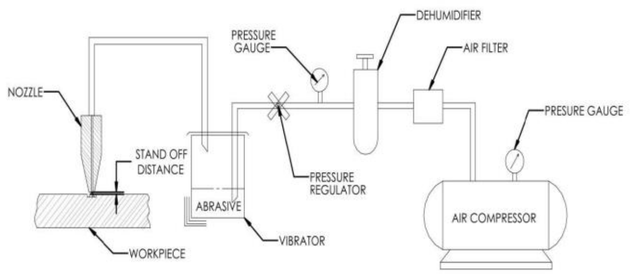

Figure 1. Schematic Diagram of AJM

II. BACKGROUND

This novel technology was first initiated by Franz to cut laminated paper tubes in 1968 and was first introduced as a commercial system in 1983. In the 1980s garnet abrasive was added to the water stream and the abrasive jet was born. In the early 1990s, water jet pioneer Dr. John Olsen began to explore the concept of abrasive jet cutting as a practical alternative for traditional machine shops. His end goal was to develop a system that could eliminate the noise, dust and expertise demanded by abrasive jets at that time. In the last two decades, an extensive deal of research and development in AJM is conducted.

III. LITERATURE REVIEW

In this section the experimental analysis of Abrasive jet machining is discussed. The experimentations conducted by various researchers by influencing the abrasive jet machining (AJM) process parameters on material removal rate, Surface integrity, kerf are discussed. The parameters like SOD, Carrier gas, Air Pressure, Type of Abrasive, Size, Mixing Ratio etc. are focused.

[1] **Dr. A. K. Paul** et al.carried out the effect of the carrier fluid (air) pressure on the MRR and the material removal factor (MRF) have been investigated experimentally on an indigenous AJM set-up developed in the laboratory. Experiments are conducted on Porcelain with silicon carbide as abrasive particles at various air pressures. It was observed that MRR has increased with increase in grain size and increase in nozzle diameter. The dependence of MRR on stand-off distance reveals that MRR increases with increase in SOD at a particular pressure.

[2] **Mr. Bhaskar** Chandra Studied the variation in Material Removal Rate according to change in Gas pressure and Hole diameter according to change in NTD. Various experiments were conducted on work piece material- glass using abrasive material alumina. The effect of gas pressure on the material removal rate is shown in figure 3.

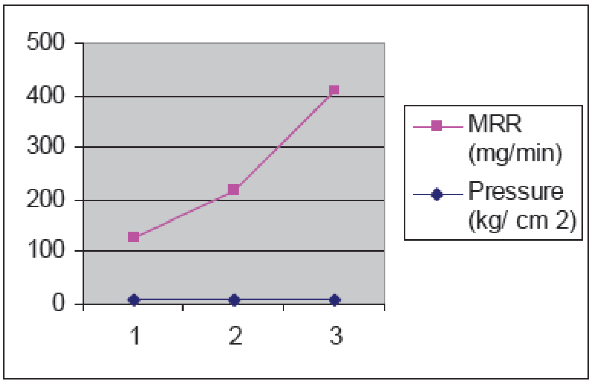

Figure 2. Graph shows the Relationship between pressure and material removal rate (MRR) at thickness 8 mm and NTD 12 mm

[3] **F. Anand Raju** et al.stated that as abrasive size is increased that is the grit no. is increased the MRR decreases i.e. the finer the abrasive, less is the material removed. But if the pressure is increased keeping Stand-off distance to optimum the MRR can be increased to some extent. If coarser abrasive is used for machining then MRR is high to a wide range of stand-off distance. Also it is stated that as the stand-off distance increases material removal decreases. At optimum value of stand-off distance the material removal rate is maximum which decreases if the stand-off distance is varied on either side of the optimum value as pressure is increased the amount of material removed also increases. Where material removal is of prime importance, there stand-off distance should be kept optimum, abrasive of coarser size should be used and high pressure should be employed. While in cases where surface finish is of prime importance low stand-off distance high pressure and finer abrasive should be used.

[4] **R. H. M. Jafar** et al (2013) presented experimental data on the effect of particle size, velocity, and angle of attack on the Surface roughness of unmasked channels machined in borosilicate glass using AJM. Single impact experiments were conducted to quantify the damage due to the individual alumina particles. Based on these observations, the assumed location of lateral crack initiation in a relatively simple analytical model from the literature was

modified, and used to predict the roughness and erosion rate.

[5] **Jukti PrasadnPadhy** carried the drilling experiment on glass work piece using aluminum oxide as abrasive powder. Experimental work was done by considering stand-off distance (SOD) and pressure as machining parameter to study material removal rate (MRR) and overcut (OC). The effect of observed value of MRR and OC was analyzed by Taguchi design. From analysis it was concluded that the pressure and SOD both are significant for MRR and only pressure is significant for OC. Individual optimal settings of parameters are carried out to minimize the OC and maximize the MRR.

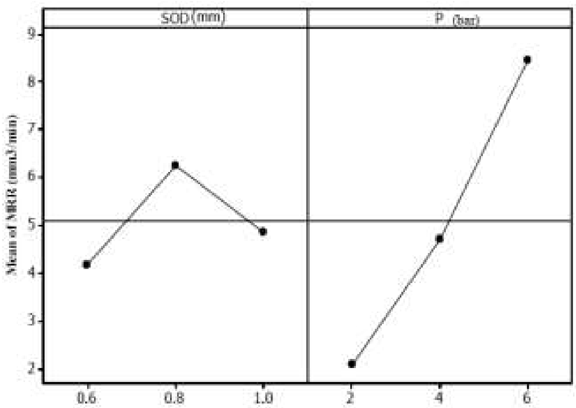

Figure 3. Main effect of Material Removal Rate

[6] **Dr. M. Sreenevasa Rao** reviewed that Ingulli C. N. (1967) was the first to explain the effect of abrasive flow rate on material removal rate in AJM. Along with Sarkar and Pandey (1976) concluded that the standoff distance increases the MRR and penetration rate increase and on reaching an optimum value it start decreasing. J. Wolak (1977) and K. N. Murthy (1987) investigated that after a threshold pressure, the MRR and penetration rate increase with nozzle pressure. The maximum MRR for brittle and ductile materials are obtained at different impingement angles. For ductile material impingement angle of 15-20 results in maximum MRR and for brittle material normal to surface results maximum MRR.

IV. PROPOSE METHODOLOGY

Abrasive jet machining is an abrasive blasting machining process that uses abrasives, propelled by a high velocity gas to erode/remove material from the work piece. Common uses include cutting heat-sensitive, brittle, thin, or hard materials. Specifically it is used to cut intricate shapes or produce specific edge shapes.

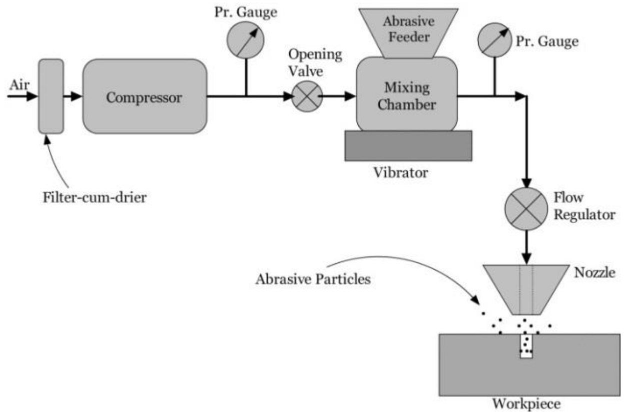

Figure 4. Layout of working AJM

In this section the experimental analysis of Abrasive jet machining is discussed. The experimentations conducted by various researchers by influencing the abrasive jet machining (AJM) process parameters on material removal rate, Surface integrity, kerf are discussed.

The parameters like Stand-off Distance, Carrier gas, Air Pressure, type of Abrasive, hole size of the tip, Mixing Ratio, will be focused. The experiment will be conducted for various working parameters of abrasive jet machine and are used for increasing MRR, for better surface finish and achieving more accuracy.

V. CONCLUSION

According to the various research papers available till date, lot of work has done on abrasive particles and its geometry, different process parameters, volume of material removal during machining. An extensive review of the research and development in the AJM has been conducted in this paper. It was shown that AJM process is receiving more and more attention in the machining areas, particularly for the processing of difficult-to-cut materials. Its unique advantages over other conventional and un-conventional methods make it a new choice in the machining industry. Very less research has been done on study of effect of abrasive flow rate on performance characteristics. Hence there is scope for improvement for the study of effect of abrasive flow rate on performance characteristics like material removal rate and taper angle. Improper mixing chamber construction causes various problems such as abrasive powder stratification, powder compaction, powder humidification etc. This affects the machining results undesirably.

VI. REFERENCES

[1]. Dr .A. k. Paul &R. K. Roy "some studies on Abrasive jet machining the Journal of the Institution of Engineers (India) Vol. 68 part PE 2 November 1987.

[2]. R. Balasubramaniam, J. Krishnan, N. Ramakrishnan, (2001) 'A study on the shape of surface generated by abrasive jet machining' Journal of materials processing technology, vol. 121, pp.102-106.

[3]. El-Domiaty, H.M. Abd El-Hafez, M. A. Shaker, (2009) 'Drilling of Glass Sheets by Abrasive Jet Machining' World Academy of Science, Engineering and Technology, vol. 32 pp. 61-67.

[4]. AlirezaMoridi, Jun Wang, Yasser M. Ali, Philip Mathew and Xiaoping Li. „Drilling of Glass Sheets by Abrasive Jet Machining.‟‟‟ Key Engineering Materials, vol. 443, pp. 645-651, June 2010.

[5]. Bhaskar Chandra Kandpa, Naveen Kumar, Rahul Kumar, Rahul Sharma, SagarDeswal(2011) 'machining of glass and ceramic with alumina and silicon carbide in abrasive jet machining' International Journal of Advanced Engineering Technology (IJAET) vol. 2, pp. 251-256.

[6]. Mr. Bhaskar Chandra. , "A Study of effects of Process Parameters of Abrasive jet machining" International Journal of Engineering Science and Technology, vol.3, pp.504-513, Jan. 2011.

[7]. Shyam Kumar Karna, Dr. Ran Vijay Singh, Dr. RajeshwarSahai, (2012) 'Application of Taguchi Method in IndianIndustry' International Journal of Emerging Technology and Advanced Engineering, vol.2, pp. 387-391.

[8]. F. AnandRaju, V GnanaPrakash, Dr, M. L. S. Deva Kumar, "Fiber Glass Cutting by using Abrasive Jet Machining and Analysis of process parameters," International Journal of Computer Trends and Technology (IJCTT)-volume 4 Issue 7–July 2013.

[9]. R.H.M. Jafar*1, M. Papini2, 1, J.K. Spelt1, 2, "Surface roughness and erosion rate of abrasive jet micro machined channels: Experiments and analytical model",-2013-Elsevier.

[10]. JuktiPrasadnPadhy, "Optimization and effect of controlling parameters on AJM using Taguchi technique"Int. Journal of Engineering Research and Applications ISSN: 2248-9622, Vol. 4, Issue 3 (Version 1), pp.598-604, March 2014.

[11]. Dr. M. SreenevasaRao, D. V. Shrekanth, Abrasive jet machining-Research Review‟ International journal of advanced engineering Technology", Vol. 5, pp.18-24, April-June. 2014.

[12]. Dr. M. SreenevasaRao, D. V. Shrekanth, "Abrasive jet machining-Research Review", International journal of Advanced engineering Technology, Vol. 5, pp.18-24, April-June. 2014.