ISSN 2348 – 7968

Experimental Analysis of Glass on Abrasive Jet Machine Using Taguchi Method.

MEET R. VADGAMA[1], KAUSTUBH S. GAIKWAD[2], HARSHIL K. UPADHYAY[3] and SIDDHARAJSINH G. GOHIL[4]

[1] UG Student in Mechanical Engineering, Vadodara Institute of Engineering, Vadodara, Gujarat, India.

[2] UG Student in Mechanical Engineering, Vadodara Institute of Engineering, Vadodara, Gujarat, India.

[3] UG Student in Mechanical Engineering, Vadodara Institute of Engineering, Vadodara, Gujarat, India.

[4] UG Student in Mechanical Engineering, Vadodara Institute of Engineering, Vadodara, Gujarat, India.

Abstract

The present experimental study is about drilling of glass at different thickness, pressure as well as stand of distance as input parameters. The abrasive jet machine is a non conventional machining process in which a abrasive particles are made to impinge on the work material at a high velocity. The jet of abrasive particles is carried by carrier gas or air. The high velocity stream of abrasive is generated by converting the pressure energy of the carrier gas or air to its kinetic energy. The high velocity abrasive particles remove the material by micro-cutting action as well as brittle fracture of the work material. Abrasive jet machining is generally good for cutting hard or brittle materials and is usually performed to furnish machining or finishing operation such as cutting, profile cut, deburring, etching, etc..

Keywords: *Abrasive material, Compressed Air or gas, Glass pieces, MRR, Taguchi Method.*

1. Introduction

Abrasive jet machining (AJM), also known as abrasive micro-blasting, pencil blasting and micro-abrasive blasting, is an abrasive blasting machining process that uses abrasives propelled by a high velocity gas to erode 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 form specific edge shapes. In abrasive jet machining, a focused stream of abrasive particles, carried by high pressure air or gas is made to impinge on the work surface through a nozzle and the work material is made to impinge on the work surface through a nozzle and work material is removed by erosion by high velocity abrasive particles. Material is removed by fine abrasive particles, usually about 0.001 in (0.025 mm) in diameter, driven by a high velocity fluid stream; common gases are air or inert gases. Pressures for the gas range from 25 to 130 bar and speeds can be as high as 300 m/s.

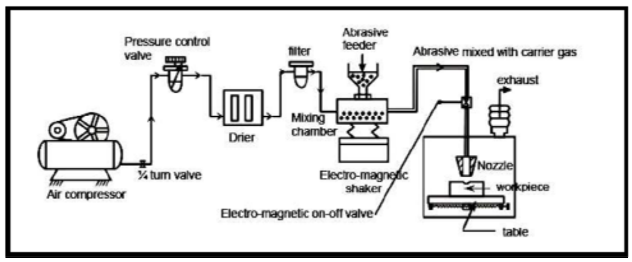

Figure 1: Schematic Diagram of AJM

This is a process of removal of material by impact erosion through the action of concentrated high velocity stream of grit abrasives entrained in high velocity gas stream. AJM is different from shot or sand blasting, as in AJM, finer abrasive grits are used and parameters can be controlled more effectively providing better control over product quality.

2. Literature Survey

Some of given below are the experimental and research done on the Abrasive Jet Machine process on different parameter i.e. Pressure, angle, mesh size, traverse speed, stand of distance etc.

Rupal V. Shah, Prof. Dhaval M. Patel presented study of Abrasive water jet machining process on granite material, considering Pressure, SOD & Traverse speed as input parameters at 5 levels. They after the experiment conclude that the traverse speed is most significant control factor in MRR and the MRR increases with increase in pressure.

Punit Grover, Sanjay Kumar and Qasim Murtaza presented study of Aluminum oxide Abrasive on Tempered Glass in Abrasive Jet Machining Using Taguchi Method, in which they used Pressure, Angle between the work piece and nozzle jet & Abrasive mesh size as input parameters. After the Experiment they conclude that the larger is better result for calculating MRR value also they analyzed AJM process using the conceptual signal-to-noise ratio approach, regression analysis and analysis of variance.

U.G. Gulhane, P.P. Patkar, P.P. Toraskar presented analysis of Abrasive Jet Machining parameters on MRR and Kerf width of Ceramic material. They consider nozzle diameter, pressure & stand of distance as input parameters, after experiment they conclude that the nozzle diameter is the most influential factor when it comes to the MRR and Stand of Distance is the most influence factor when it comes to the average kerf width.

3. Experimental Work and Results

Experiment was conducted to study the MRR (Material Removal Rate) of plain glass at different parameters of AJM and these parameters are pressure, glass thickness and stand of distance. The parameters and levels were selected primarily based on the literature review of some of the studies.

Table 1: Process Parameters

Parameter	Level 1	Level 2	Level 3
Pressure, bar	50	70	90
Glass Thickness, mm	3	4	6
SOD, mm	11	13	15

Taguchi method stresses the importance of studying the response variation using the signal to noise ratio, resulting in minimization of quality characteristic variation due to uncontrollable parameter. The material removal rate was considered the quality characteristics with the concept of "larger-the-better".

Initially weight the glass work piece which is square in shape (Dimensions are 150*150 mm at different thickness 3,4 & 6 mm respectively) with the help of digital balance and weight after machining is measured by using digital balance for calculating the MRR. Thus MRR is calculated using the formula:

MRR = (Initial weight – final weight) / machining time

Nine experiments were conducted with different parameters. For this Taguchi L9 orthogonal array was used, which has nine rows corresponding to the number of test, with three columns at three levels.

Table 2: MRR of Taguchi L9 Orthogonal Array

Pressure, bar	Glass Thickness, mm	SOD, mm	MRR, gm/sec
50	3	11	0.0000285
50	4	13	0.0000222
50	6	15	0.0000169
70	3	13	0.0000317
70	4	15	0.0000416
70	6	11	0.0000190
90	3	15	0.0000487
90	4	11	0.0000183
90	6	13	0.0000144

The statistical software with an analytical tool of taguchi is used to determine which parameter significantly affects the performance characteristics.

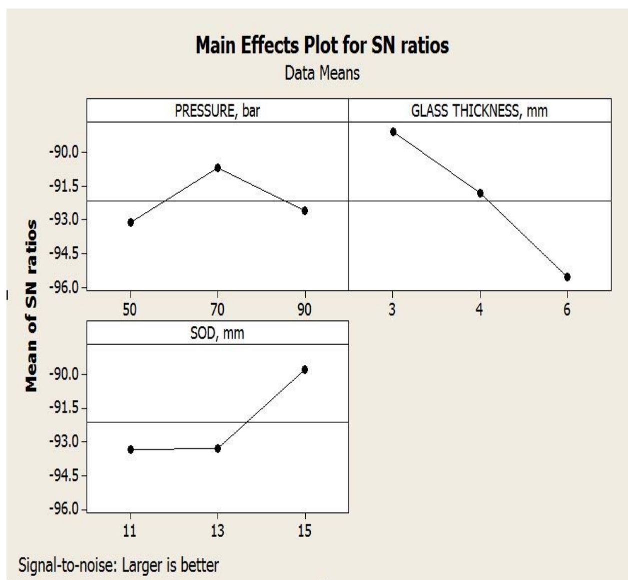

Figure 2: Graph Showing S-N Ratio, Larger is better

Using optimal factorial design of experiment total 9 nos. of experiments has been carried out at 150*150 mm length and thickness are 3, 4 & 6 mm respectively of glass material. Specimen after machining is shown in figure:

ISSN 2348 – 7968


Figure 3: Specimen after machining 150 mm*150 mm*3 mm

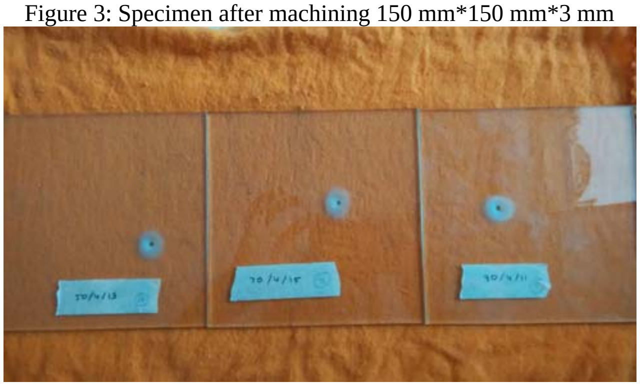
Figure 4: Specimen after machining 150 mm * 150 mm * 4 mm


Figure 5: Specimen after machining 150 mm * 150 mm * 6 mm

4. Conclusions

The MRR increases with increasing in pressure and decreasing in glass thickness and SOD. MRR is proportional to the pressure. With the increase in pressure the kinetic energy of the abrasive particle is responsible for material removal by erosion process. The MRR increase with the SOD increases for certain limit, beyond the limit with increase in SOD there is decrease of MRR. With the decrease in SOD the work piece and nozzle jet and abrasive mesh size the MRR increase because the abrasive mixture impinge on the work piece more directly without deflecting, with a large force, thus results in greater removal rate.

As mention in graph which shows S-N ratio of larger is better in which glass thickness is 3 mm, SOD is 15 mm, and pressure 70 bar gives the maximum material removal rate which we can obtain from our experiment.

Acknowledgments

Authors would like to thanks the Prof. Prakash N. Vasava faculty guide of Mechanical Engineering Department, Vadodara Institute of Engineering, for providing continues technical support to carry out this research work.

References

[1] B. S. Raghuwanshi, Workshop Technology Vol. 2 Machine Tool, Dhanpat Rai & Co. Ltd., 2014.
[2] Punit Grover, Sanjay Kumar, Qasim Murtaza, "Study of Aluminum Oxide abrasive on Tampered Glass in Abrasive Jet machining Using Taguchi Method", International Journal of Advance Research & Innovation, ISSN 2347 – 3258, Volume 1, March 2014.
[3] Rupal V. Shah, Prof. Dhaval M. Patel, "A Study of Abrasive Water Jet Machining Process on Granite", International Journal of Engineering Research and Application. ISSN 2248 – 9622, Volume 2, Issue 4, July-August 2012.
[4] Peeyush Yadav, Nafees Ahmed, S.C. Gupta, "Optimization of Abrasive Jet Machining Process on Tapered Glass using Taguchi Method", 4th Recent Conference on Recent Advances in Manufacturing (RAM-2014), 26-28 June, 2014.
[5] N. Jagannatha, S.S Hiremath, & K. Sadashivappa, "Analysis and Parameter Optimization of Abrasive Hot Air Jet Machining for Glass Using Taguchi Method and Utility Concept", International Journal of Mechanical and Materials Engineering, Vol. 7, 2012.
[6] Kamlesh Kadia, Prof. A.H. Mahwana, "Investigation of Process parameters on Improvement of MRR and Surface Roughness on Abrasive Water Jet Machine for Inconel 600", International Journal for Scientific Research & Development, Vol. 2, Issue 4, 2014.
[7] D. Sidda Reddy, A. Seshu Kumar, M. Sreenivasa Rao, "Parametric Optimization of Abrasive Water Jet Machining of Inconel 800H Using Taguchi Methodology", Universal Journal of Mechanical Engineering, vol. 2, Issue 5, 2014.
[8] Chirag M. Parmar, Mr. Pratik K Yogi, Mr. Triolk D. Parmar, Optimization of Abrasive water jet machine process parameters for AL- 6351 using taguchi method, IJAERD, ISSN: 2348 – 4470, vol. 1, issue 5, May 2014.
[9] F. Anand Raju, V. Gnana Prakash, Dr. M.L.S. Deva Kumar, Fiber Glass cutting by using abrasive jet machining and analysis of process parameters, IJCTT,ISSN: 2231- 2803 vol. 4, issue 7, July- 2013.

Meet R. Vadgama has received a Diploma in Mechanical Engineering from Parul Institute of Engineering & Technology (DS) (GTU) in 2012. Currently studying as a final year student in Vadodara Institute of Engineering College (GTU). His research interests are CAD/CAM/CIM, Manufacturing processes, Industrial engineering, Automobile & Aviation System, Analysis & Simulation and so on.

ISSN 2348 – 7968

Kaustubh S. Gaikwad has received a Diploma in Mechanical Engineering from Butler Polytechnic (GTU) in 2012. Currently studying as a final year student in Vadodara Institute of Engineering College (GTU). His research interests are Kinematics of Machine, Automobile Engineering, Manufacturing & Production, Theory of Machines, Robotics, and Analysis & Simulation and so on.

Harshil K. Upadhyay has received a Diploma in Mechanical Engineering from K. J. Polytechnic, Bharuch, (GTU) in 2012. Currently studying as a final year student in Vadodara Institute of Engineering College (GTU). His research interests are in Production Processes, Metallurgy, Internal Combustion engine &so on.

Siddharajsinh G. Gohil has received a Diploma in Mechanical Engineering from Government Polytechnic, Chhotaudepur (GTU) in 2012. Currently studying as a final year student in Vadodara Institute of Engineering College (GTU). His research interests are in Production Processes, Metallurgy, Maintenance field & so on.