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Fabrication of Working Model of Abrasive Jet Machine

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ABSTRACT

Abrasive Jet Machining (AJM) is the process of material removal from a work piece by the application of a high speed stream of abrasive particles carried in a gas or air medium from a nozzle. The material removal process is mainly by erosion.

The AJM will chiefly be used to cut shapes in hard and brittle materials like glass, ceramics etc. the machine will be automated to have 1 axes travel. The different components of AJM are Compressor, Vibrator, dehumidifier, Pressure Regulator, and Dust filter, Nozzle, Pressure gauge etc.

The different components are selected after appropriate design calculations. In this project, a model of the Abrasive Jet Machine is designed using available hardware and software etc. taking into consideration of commercially available components.

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Care has been taken to use less fabricated components rather than directly procuring them, because, the lack of accuracy in fabricated components would lead to a diminished performance of the machine

In this project we are proving this concept with single axis moment.

Introduction

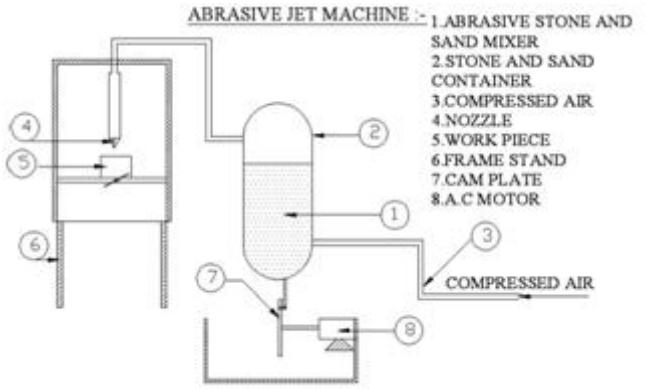
Abrasive Jet Machining (AJM) is the removal of material from a workpiece by the application of a high speed stream of abrasive particles carried in gas medium from a nozzle. The AJM process differs from conventional sand blasting in that the abrasive is much finer and the process parameters and cutting action are carefully controlled. The process is used chiefly to cut intricate shapes in hard and brittle materials which are sensitive to heat and have a tendency to chip easily.
The process is also used for deburring and cleaning operations. AJM is inherently free from chatter and vibration problems. The cutting action is cool because the carrier gas serves as a coolant.

Equipment

The filtered gas, supplied under pressure to the mixing chamber containing the abrasive powder and vibrating at 50 c/s, entrains the abrasive particle and is the passed into a connecting hose. This abrasive and gas mixture emerges from a small nozzle at high velocity.

The abrasive powder feed rate is controlled by the amplitude of vibration of the mixing chamber. A pressure regulator controls the gas flow and pressure.

The nozzle is mounted on a fixture. Either the workpiece or the nozzle is moved by cams pantograph or other suitable mechanisms to control the size and shape of the cut. Hand operation is sometimes adequate to remove surface contaminations or in cutting where accuracy is not very critical. Dust removal equipment is necessary to protect the environment. Commercial bench mounted units including all controls, motion producing devices, and dust control equipment are available



WORKING PRINCIPLE

Abrasive jet machining (AJM) removes material through the action of a focussed stream of abrasive-laden gas. Micro-abrasive particles are propelled by inert gas at velocities of up to 300 m/Sec. When directed at a workpieces, the result in erosion can be used for cutting, etching, cleaning, deburring, polishing, and drilling.

Material removal occurs through a chipping action, which is especially effective on hard, brittle materials such as glass, silicon, tungsten, and ceramics. Soft, resilient materials, such as rubber and some plastics resist the chipping action and thus are not effectively processed by AJM.

No work piece chatter or vibration occurs with this process because the large enables AJM to produce fine, intricate detail extremely brittle objects. The AJM processed eggshell provides a graphic example of the delicate nature of the process. In addition, because heat carried away by the abrasive propellant gas, workpieces experience no thermal damage.

APPLICATIONS

The manufacturer prepares a reusable rubber stencil for each model panel. The rubber stencil is then placed on the surface of the panel and the abrasive jet is used to etch the exposed areas providing permanent

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marking. In this particular use, the Abrasive Jet Machining (AJM) costs only 1/3 of the cost required for label method of production.

A variety of diverse jobs has been successfully performed by AJM. These include cutting threads into glass rods, deflation small castings, die and mound touch up, cutting titanium fink and drilling glass wafers.

The AJM has been successfully employed to manufacture small electronic devices consisting of a 0.38 tungsten disk. After the two materials were were brazed together. The silicon wafer must be trimmed and beveled without harming the tungsten disk. To accomplish the task an AJM nozzle is mounted at the desired angle and directed at slowly rotating part with this technique the unwanted silicon is trimmed off each part in less than one minute. An example of debugging plastic parts with AJM is cited by Lacourte (1979) in an application involving the manufacture of small biomedical analysis packages. Small plastic cubes are cross drilled with two 0.34mm diameter holes. Tiny burrs are created internally at the intersection of the two holes must be removed without providing scratches. It is not only able to meet this difficult quality requirement, but it also was able to reduce devouring time by 80% when compared with the old method of debarring.

ADVANTAGES

- AJM provides cool cutting action, no heat damage occurs to the delicate work materials.
- Cutting action is shockless.
- Ability to cut fragile and heat sensitive materials without damage.
- Ability to cut intricate hole shapes in materials of any hardness and brittleness.
- No variation due to surface irregularities and tool wears as in conventional machining.
- Low capital cost.
- AJM units are easy to operate and maintain.

DISADVANTAGES

- Stray cutting is unavoidable if not properly controlled.
- AJM yields low material removal rates.
- Nozzle life is limited.
- Replacement of rubber hoses which carry abrasives may be necessary.
- A suitable dust collection system is required to prevent pollution.
- Embedding of the abrasive on the workpiece surface may occur while machining softer materials.

Conclusion

In this project, a complete model of abrasive jet machine is fabricated. This method is used to cut plate acrylic of 2-5mm thickness. Also non-straight profiles can be cut by moving the guide way (x table). Glass fumes or powder is not generated during drilling. Also the surface finish obtained is better than the diamond tool. The process is non-contact, simple and clean. But, the material removal rate is low.

Future Scope

The project can go beyond its current position and capabilities by employing automation into it. 2-D profiles can be converted into G-codes and M-codes and can be sent to the machine to perform machining operation. This can be done by using stepper motors or DC motors interfaced with standard PLC controllers. Accuracy can also be increased by using controllers.

REFERENCES

[1] Bhaskarchandra and Jagtar singh. ‘A study of effect of process parameters on abrasive jet machining’.

[2] Deng Jianxin, Wu Fengfang, Zhao jinlong. ‘Wear mechanism of gradient ceramic nozzles in abrasive air jet machining’ Department of mechanical engineering, Shandong University, Jinan 250061, Shanlang province, PR China.’

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A Peer Reviewed Open Access International Journal

[3] D.V. Srikantha and Dr. M. SreenivasaRaob. 'Metal removal and Kerf analysis in abrasive jet drilling of glass sheets' Procedia Materials Science 6 (2014) 1303 – 1311.

[4] E.S. parekh, K Sadashivapa, Vince Joseph, M singaperumal 'Non-conventional cutting of plate glass using air jet: Experimental studies'.

[5] Ghobeity, a. Spelt, j. K. Papini. 'Abrasive jet micro- machining of planar areas and transitional slopes' publication: journal of micromechanics and micro engineering, volume 18, issue 5, pp. 055014.

[6] Gyanendra Prasad Bagri, Sanjeev kumar gupta, Manvendra pratap singh, Vikas singh. 'Design and fabrication of abrasive jet machine' International journal of applied engineering research ISSN 093-4562 volume 9, number 4 (2014) pp.379-384.

[7] Hajara Chaudhary. 'Workshop Technology' Vol – 2

[8] Khan, ahsan Ali awang, Mohd efendee bin, Annuar, Ahmad azwari bin. 'Surface roughness of carbides produced by abrasive water jet machining' publication: journal of micromechanics and micro engineering, volume 18, issue 5, pp. 055014.

[9] K. Kowsari, H. Nouraei, D.F. James, J.K. Spelt. 'Abrasive slurry jet micro-machining of holes in brittle and ductile materials' Journal of material processing technology 214 (2014) 1909-1920.

[10]M.L.Neema and P.C. pandey. 'Erosion of glass when act upon by an abrasive jet' Proceeding on international conference on wear of materials, 1977.

[11]R. Balasubramanium, J Krishnan, N.ramakrishnan. 'A study on the shape of the surface generated by abrasive jet machining' Central workshop, Bhabha atomic research centre, Mumbai, India Department of mechanical engineering, Indian institute of technology, Bombay, India.

[12]S. Naveen and Aslam Hirani. 'Design and fabrication of abrasive jet machining' International journal of mechanical and production engineering research and development ISSN (P): 2249-6890; ISSN (E): 2249- 8001.

[13]Umberto Prisco, Maria Carmina D'Onofrio. 'Three- dimensional CFD simulation of two-phase flow inside the abrasive water jet cutting head' publication: International journal of computational methods in engineering science and mechanics 9 (5), pp. 300-319.