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Develop a Setup for Abrasive Jet Machine Research Review Paper

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ABSTRACT

As Abrasive jet machining (AJM) is similar to sand blasting and effectively removes hard and brittle materials. AJM has been applied to rough working such as deburring and rough finishing. With the increase of needs for machining of ceramics, semiconductors, electronic devices and L.C.D., AJM has become a useful technique for micromachining. The abrasive jet machining is a method based on the effects of the fine abrasive particles transported and directed to the work piece surface by means of compressed air jet. The nozzle shape, size, nozzle tip distance are the most important parameters in abrasive air-jet machining equipment. Materials with high wear resistance will have great potential as abrasive air-jet nozzle materials. Abrasive jet machining is an effective machining process for processing a variety of Hard and Brittle Material. And has various distinct advantages over the other non-traditional cutting technologies, such as, high machining versatility, minimum stresses on the work piece, high flexibility no thermal distortion, and small cutting forces. This paper presents an extensive review of the current state of research and development in the abrasive jet machining process.

Keywords:Material Removel Rate(MRR), Abrasive jet machine(AJM), material removal factor (MRF), Stand Of Distance (SOD).

I.INTRODUCTION

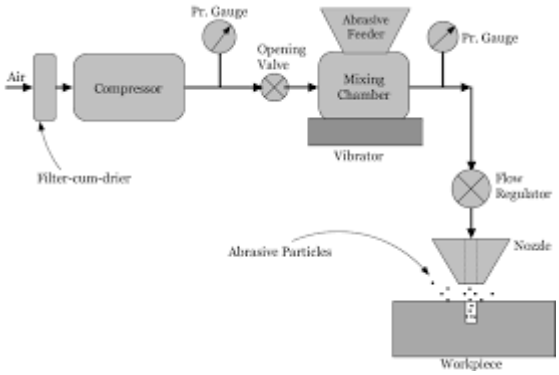
As the world is advancing forth technically in the field of space research, missile and nuclear industry, very complicated and precise components having some special requirements are demanded by these industries. This challenge is taken by new development taking place in the manufacturing field. The most basis requirements of future manufacturing technology are:

1. Sustained productivity in the face of rising strength barrier.
2. Higher accuracy consistent with increasing demand for higher tolerance.
3. Versatility of automation.

In recent years some non-traditional of manufacturing have been invented In order to supplement affectivity the machining problems of hard to machine and brittle materials. Once of these non- traditional techniques is Abrasive Jet machining (AJM). The abrasive jet machining can be suitable employed for machining super alloys and refractory type material. The process is also very much suitable for cutting, grooving, cleaning, finishing

and deburring operations of hard and brittle materials like germanium, glass, ceramics and mica. Abrasive jet machining (AJM) is the process in which a material is removed from the work piece due to the impingement of fine grained abrasive by high velocity gas stream. The stream of abrasive mixed gas is directed to the work piece by suitably designed nozzles. The process differs from conventional sand blasting. In that abrasive particles used are finer and the process parameters and cutting actions is carefully controlled. Abrasive jet machining is applied to cut hard and brittle material such as mica, germanium, glass, ceramics etc. The process is free from vibrations and chatter problems. As no current passes from the tool and the work piece. There is no restriction to material to be machined. Thus it cuts conductive as well as non-conductive materials. The process however is no conductive to machine soft due to abrasive particles getting embedded in the work material.

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. Based on the extensive literature review of AJM Process the works on this can be classified based on the performance measure considered in to Four different categories, namely Experimental Modeling, Analytical modeling, Optimization modeling, Hybrid modeling.

2.1 TYPES OF AJM

An AJM set-up may be of two types: one a vortex-type mixing chamber and the other using a vibratory mixer.

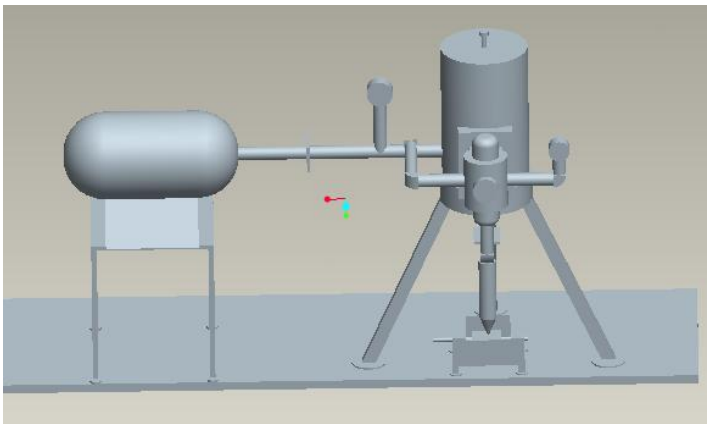


Fig -1 Schematic representation of Vertical type abrasive jet machine setup.

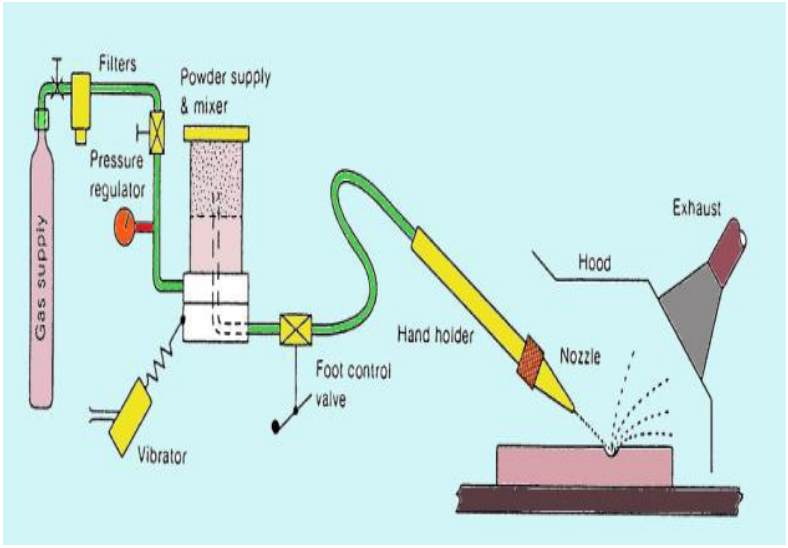


Fig.2 schematic representation of vibratory type abrasive jet machine setup

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. Abrasives are accelerated by compressed air jet or gases, and are forced through a nozzle and finally collide with the work piece. The accuracy of the surface structure depends on the accuracy of the mask, constant flow of abrasives, scan strategy and density and velocity profile of the particle beam. Abrasive jet micromachining with micro-jet utilizes finer abrasive powders and a smaller nozzle inner diameter.

III. PROCESS PARAMETERS OF AJM

In this section the process parameters of Abrasive jet machining is discussed. The parameters like SOD, Carrier gas; Air Pressure, Type of Abrasive, Size, material removal rate etc. are focused. Various experimental models are highlighted.

3.1 Stand Of Distance:

Dr. A. K. Paul &P. K. Roy (1987) [2]Carried out the effect of the carrier fluid (air) pressure on the MRR, AFR, and the material removal factor (MRF) have been investigated experimentally on an indigenous AJM set-up developed in the laboratory. Conducted Experimentation on the cutting of Porcelain with Sic abrasive particles at various Air pressures. Observed that MRR has increased with increase in grain size and increase in nozzle diameter. The dependence of MRR on standoff distance reveals that MRR increases with increase in SOD at a particular pressure.

3.2 Carrier gas and Air pressure

Carrier gas to be used in AJM must not flare excessively when discharged from the nozzle into the atmosphere. Further the gas should be Nontoxic, cheap, casily available and capable of being dried and cleaned without difficulty. Air, Nitrogen and Carbon Dioxide is generally used as carrier gas. Commercially filled cylinder gases can also be used satisfactorily. Air is widely to easy availability and little cost. AJM units are operated usually at pressures of 2-8 Kg/cm2. Higher pressure results in high nozzle wear and lower pressure results in reduced material removal rate (mrr).

3.3 MRR

It is seen that mrr increases with an abrasive flow rate. It is found that fine grain size shall give higher mrr as no. of particles/ unit mass increases with fineness of abrasive. Also fine abrasive particles shall attain readily the air velocity of the jet. Mr. Bhaskar Chandra [2] 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.

IV. CONCLUSION

In our country even today abrasive machine is a relative unknown process. So much so, people often consider it similar with grinding which is traditionally branded as finishing operations usually proceeded by planning, milling, turning but in many shapers it has been proved beyond doubt that the abrasive machining as primary as well final abrasive replaces non-abrasive process and compares favorably productivity and economy wise. In great majority of cases well fine abrasive machining useful to cut down costs. Due to low capital an operative cost the AJM is compatible to other processes. In future with slight modifications, AJM will become important

machine tool on shop floor.

There is some scope for future work.

1) Study of nozzle wear.
2) Dimensional analysis for calculating theoretical metal removal rate.

Study of characteristic of abrasive particles and type of abrasive particles.

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