



## FABRICATION OF ABRASIVE JET MACHINE

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### ABSTRTAC

*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 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. The machine will be automated to have three axes travel. The different components of AJM are Horizontal motion module (X- Y Table), Vertical motion module (Z- motion), Vibrator, dehumidifier, Pressure Regulator, and Dust filter etc.*

**Keywords:** *Wheel table, Nozzle, Pressure Gauge, Air Filter, Air compressor, Mixer Chamber etc.*

### 1. INTRODUCTION

Abrasive Jet Machining (AJM) is used for removal of material from a work piece 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 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.

### 2. COMPONENTS

#### 2.1 Abrasive

These are the main particles which take part in machining process. These particles should have high metal removal rate and accuracy. The most common abrasive particles used are aluminum oxide, silicon carbide, boron carbide etc. The selection of abrasive particle is depends upon material of work piece, speed of machining, and machining environment.

#### 2.2. Air Propulsion System

The main purpose of air propulsion system is to provide clean and dry, high velocity air or gas for machining. Mostly air, carbon dioxide, Nitrogen etc. are used as air in air propulsion system. This system consists,

compressor, air filter and drier. The air used in this system should easily available. First air is compressed into a compressor. This compressed air sends to filler and drier where all dust and unwanted particle along with moisture remove from it. Now these clean airs send to mixing chamber.

### 2.3 Machining Chamber

It is fully closed air tight chamber witch control the concentration of abrasive particle around work piece. This is equipped with a vacuum dust collector which collect used abrasive particle and removed material from mixing chamber.

### 3. WORKING

The basic concept of abrasive jet machining is abrasive erosion or metal cutting by high velocity abrasive particle. Its working process can be easily summarized into following point:-

- First gas or air is compressed into air compressor. There the density and pressure of air increases.
- Now this compressed air sends to filtration unit, where dust and other suspended particle removed from it.
- This clean air sends to drier, which absorb moisture from it. It is used to avoid water or oil contamination of abrasive power.
- Now this clean and dry air sends to mixing chamber where abrasive feeder feed abrasive particle in it. The abrasive particle is about 50 micro meter grit size.
- This high pressuring abrasive carried air send to nozzle where its pressure energy converted into kinetic energy. The velocity of abrasive particle leaving the nozzle is about 200m/s.
- The standoff distance between work piece and nozzle is about 2mm.
- Now these high velocity abrasive particles impinge on work piece. These high velocity abrasive particles remove the material by micro cutting action as well as brittle fracture of the work material.



Fig.1- AJM

#### 4. EQUIPMENTS

The major equipment is:

- Air compressor.
- Air filter OR Filter regulator
- Pressure Gauge.
- Nozzle.
- Vibrator or Mixer.
- Arrangement to hold the work piece

##### 4.1. Air compressor

Air compressor is a mechanical device that increases the pressure of the air by reducing volume an air compressor Converts electrical energy in the form of the air. Air compressor is the model : HL-25 and capacity is 120 L/Min .



Fig.2- Air compressor

Model	HL – 25
Volatge	220 V / 50 Hz
Motor	3 HP
Tank box	25 L
Pressure	8 Bar
Speed	2880 rpm
Capacity	120 L/Min

Table.1 Details of Air compressor

#### 4.2. Air filter and Pressure gauge

Air filter and pressure gauge is the model of AFR -2000(Air compressor water filter with regulator air tool cleaning)



Fig .3- Air filter and Pressure gauge

MODEL	AFR-2000
MAX PRESSURE	9.9 KGF/CM2
RANGE	0.5-0.9 KGF/CM2

Table.2 Details of Air filter and Pressure gauge

#### 4.3. Nozzle and Vibrator or Mixer

The nozzle is the model of the LIBRA. This purpose of abrasive jet nozzle is to provide efficient mixing of the abrasives and the air (gas) and to form the high velocity abrasive air –jet combination.



Fig.4- Nozzle



Fig.4.1-Mixer



Fig.4.2- Nozzle and mixer

MODEL NOZZLE	LIBRA
MIXER BOX	LIBRA
TURN OF ANGLE	120*

Table.3 Details of Nozzle and mixer

#### 4.4. Pressure regulator

A pressure regulator is a control valve that reduces the input Pressure of air (gas) to desired value at its output.



Fig.5- Pressure regulator

#### 4.5. Arrangement to hold work piece

The bench vice which is sometimes called the parallel vice, is used to clamp or hold work pieces. The body is screwed to the work bench to provide secure holding.



Fig.6- Arrangement to hold work piece

## 5. CHARACTERISTICS OF DIFFERENT VARIABLES

Medium	Air , CO <sub>2</sub> ,N <sub>2</sub>
Abrasive	Sic, Al <sub>2</sub> O <sub>3</sub> (of size 20 $\mu$ to 50 $\mu$ )
Flow rate of abrasive	3 to 20 gram/min
Velocity	150 to 300 m/min
Pressure	2 to 8 kg/cm <sup>2</sup>
Nozzle size	0.07 to 0.40 mm
Nozzle life	12 to 300 hr
Standoff distance	0.25 to 15 mm (8mm generally)
Work material	Non Metals like glass, ceramics, and Granites. Metals and alloys of hard materials like germanium, silicon etc
part application	Drilling, cutting, deburring, cleaning

Table.4 Details of Characteristics



## **6. APPLICATION**

The major application of Abrasive jet machining process is in the machining of essentially brittle materials and heat sensitive materials like glass, quartz, sapphire, semiconductor materials, mica and ceramics. It is also used in cutting slot, thin sections, counterering, drilling, for producing integrate shapes in hard and brittle materials. It is often used for cleaning and polishing of plastics nylon and Teflon components. Delicate cleaning, such as removal of smudges from antique documents, is also easily done with Abrasive jet machining.

## **7. ADVANTAGES**

- Ability to cut intricate holes shape in materials of any hardness and brittleness.
- Ability to cut fragile and heat sensitive material without damage.
- No change in microstructure as no heat is generated in the process.
- Low capital cost.
- There is only one tool.

## **8. LIMITATIONS**

- Material removal rate is low and hence its application is limited.
- Stray strings can occur and hence its application is limited.
- Embedding of the abrasive in the work piece surface may occur.
- While machining softer material.
- The abrasive material may accumulate at nozzle and fail .

## **9. CONCLUSION**

In this project a complete of the Abrasive Jet Machine is given. The total assembly is taking in account of currently available components in the market. The designing and assembling of very large number of components was a tremendous task and was completed on time. However because of some parts couldn't be purchased the whole assembly was limited to some basic manufacturing operation.

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