Ahsanullah University of Science and Technology

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Project Name: Abrasive Jet Machining

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ABRASIVE JET MACHINING

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ABSTRACT

In this era of advancement, the whole world is looking for something advanced. Abrasive jet machining (AJM) is one of the popular advanced machining processes used to create a hole in brittle and ductile materials. Abrasive jet machining (AJM) is one of the nontraditional machining process techniques. It can create Holes in glass using compressed air and abrasive particles(sand). High-pressure air from the compressor passes through FRL and pressure gauge into the mixing chamber. The abrasive particles and the compressed air are adequately mixed in the mixing chamber. A stream of abrasive mixed air passes through a nozzle. Nozzle increases the velocity of high pressurized discharged air mixed with the abrasive particle. Due to the high velocity of compressed air and sand, the material is removed from the workpiece, and we get our desired drill. We have designed every part of the AJM using Solidworks and manufactured it from the local market as per the designed parameters. We will use the machine fabricated in this project for further process optimization of AJM parameters for ductile, brittle, and plastic materials.

INTRODUCTION

Abrasive Jet machining is a micro machining process which was considered to be a nonconventional method but since there was a lot of research and development in the last few decades the method is pragmatically employed in the modern manufacturing industry and plays a key role in production facilities across the globe. AJM is used to make holes in the brittle and ductile materials. The fundamental principle of the abrasive jet machining involves the use of high speed stream of abrasive particles carried by a high pressure compressed air on the work surface through a nozzle. The material is removed due to erosion caused by the abrasive particles impacting the work surface at high speed.

FEATURES OF THIS PROJECT

1. Abrasive jet machining has ability to cut intricates holes in any materials of hardness and brittleness.

2. High surface finished can be achieved.

3. Depth of surface damage is low.

4.The process can be utilize conventionally in drilling, deburring, polishing, and cleaning process.

5.The cost of this machining is low.

COMPONENT LIST

1. **Compressor:** We have used a 1 HP compressor which was taken from our thermodynamics lab to compress air.

2. FRL Unit: It consists of a filter, a regulator and a lubricator. The compressed air is filtered via this component.

Specification	AW2000-20
Applicable Medium	Air
Rating Flow (L/min)	550
Filtration	20-40 micro meter
Applicable Pressure Range	0.05~0.85MPa
Applicable Temperature	0~60°C
Type of Valve	Relief Type
Gauge Port Size	G1/8

3. Pressure gauge: Pressure of filtered air can be measured using this pressure gauge. The range of this equipment is 0-15 kg/cm^2 or 0-200 psi.

4. Mixing chamber: The mixing chamber is made of iron. Sand and air is being mixed here.

5. Ball valve: It is one kind resistor to velocity.

6. Nozzle: The Nozzle is made of ABS. It increases the inlet velocity.

7. Vice: This is made of iron and used to hold the workpiece.

8. Machine Frame: Frame is made of mild steel. All the components is situated on the frame.

9. Glass Frame: It is used as safety. It helps to recycle sand used to drill.

10. Hose pipe: It passes the air and sand.

11. Hose clamp: Hose clamp prevents the leakages.

DIAGRAM

Fig: Compressor

Fig: FRL Unit

Fig: Pressure Gauge

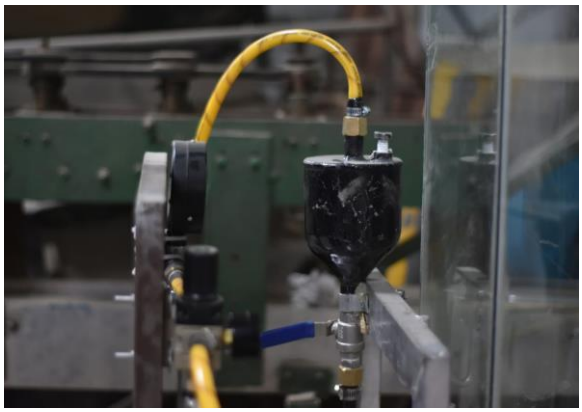

Fig: Mixing Chamber

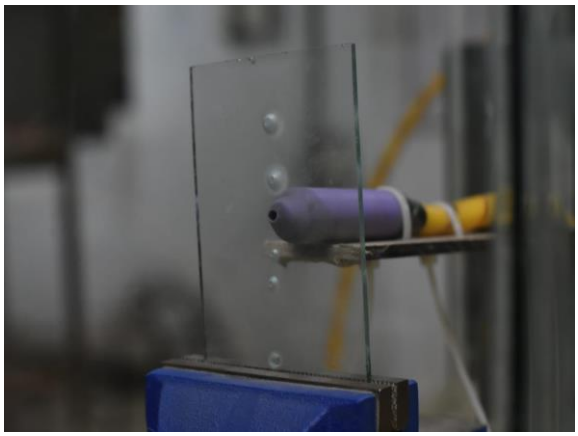

Fig: Nozzle and Fixed Workpiece by The Vice

Fig: Machine Frame

RESULTS & DISCUSSION

For the result, We have tested on three glasses thickness of 2.5mm,3.5mm and 5mm. We have also changed the cut off distance two times for each glass which was 1mm and 3mm.Nozzle diameter was 3mm as well as jet pressure was 6 bar for all the operations.

For Cut Off Distance 1mm					
Observation-1		**Observation-2**		**Observation-3**	
Work piece thickness	2.5mm	Work piece thickness	3.5mm	Work piece thickness	5mm
Sand weight	750gm	Sand weight	1.35kg	Sand weight	1.7kg
Machining time	34.74sec	Machining time	42sec	Machining time	71 sec
Hole diameter	1.5mm	Hole diameter	2.06mm	Hole diameter	2.5mm

For cut off distance 3 mm					
Observation-1		**Observation-2**		**Observation-3**	
Work piece thickness	2.5mm	Work piece thickness	3.5mm	Work piece thickness	5mm
Sand weight	750gm	Sand weight	1.35kg	Sand weight	1.7kg
Machining time	25sec	Machining time	27.66sec	Machining time	71sec
Hole diameter	2.20mm	Hole diameter	2.35mm	Hole diameter	2.65mm

From the Observations, we can see that the hole diameter is increasing gradually along with the increasing of cut of distance.

COST

NO	Components	Price
01	Frame	4850
02	F R L	1200
03	Pressure gauge	600
04	Ball valve	450
05	Hose pipe	550
06	Fittings	1500
07	Mixing chamber	800
08	Nozzle	2100
09	Vice	2450
10	Spray	360
11	Board	480
12	Glue gun	400
13	Silicone glue	200
14	Foster + Banner	580
15	Glass (Frame + Workpiece)	2480
16	Gip Tye + Scotch tape + Thread tape	380
17	Transportation	1400
18	Others	750
	Total	21530

LIMITATIONS

1. Not suitable for soft and ductile materials.

2. Limited nozzle life.

3. As nozzle is fixed, we can make only hole to the workpiece but cannot cut any desired shape.

FUTURE IMPROVEMENTS

We have some plans for our Abrasive jet machine's improvement in the future. As abrasive particle we have used sand (SiO_2) but in this machining process we can also use Aluminium oxide, Silicon carbide etc. As workpiece we have used different shapes of glass like 2.5mm,3.5mm and 5mm but in future we can also use plastic, ceramic, plywood etc as workpiece.

CONCLUSION

In this project a complete design of the Abrasive Jet Machine is given. The embedment of the abrasive particles was found to be the major reason of decrease in machining efficiency. There is great scope on material behavior to determine optimum values of crucial governing parameters like stand-off distance, pressure and feed rate for a variety of materials. Nozzle design can be optimized for faster production. In fabrication of AJM, abrasive feeder chamber and mixing chamber are incorporated in such a way that they receive the air separately through the air distribution system. This allows the restriction of abrasive particles from mixing in air when required. This air which does not contain the abrasive particles remove the embedded abrasive particles which will result into better machining efficiency.

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