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1. INTRODUCTION TO AJM

Abrasive jet machining process is the metal removal process and is a process, in which removed from the work piece due to impingement fine grain abrasive by high velocity gas stream. In case, the stream of a fine grained abrasive mixed with air or some other carrier gases, at high pressure, is directed by means of suitably designed nozzle on to work surface to be machined. This process differs from the conventional sand blasting, in the abrasive used is finer and the process parameters and cutting action is carefully controlled.

Abrasive jet cutting is applied to cut hard and brittle materials such as germanium, mica, glass, ceramics, etc.

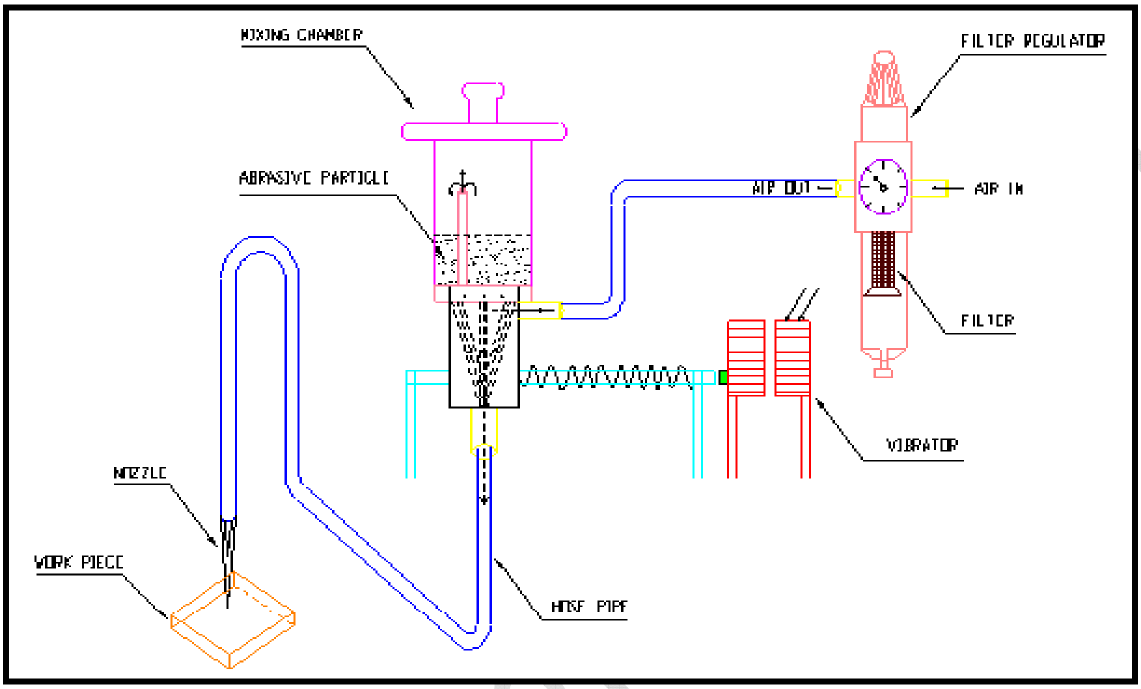
This process is free from vibration and chatter problems. As no current passes between the tool and work piece, there is no restriction on material to be machined. Thus, it cuts conductive as well non-conductive materials.

This process, however, is not conductive to machine soft materials [metal] due to the abrasive particles getting embedded the work materials.

High pressure air [carrier gas] from the compressor passes through filters and controls valve in to the mixing chamber. The fine abrasive particles and carrier gas [air in this case] are thoroughly mixed in the mixing chamber stream of abrasive mixed gases passes the nozzles.

Impact of high velocity particles strikes upon the work-piece surface and materials is sheared, fractured and material is removed. The cutting is cool, because the carrier gas is serves as coolant

SCHEMETIC LAYOUT AND PRINCIPLE OF OPERATION



WORKING OF AJM:-

Abrasive jet machining is a process in which material removal takes place due to erosive action of a stream of fine-grained abrasive particles mixed impacting at high velocity onto the work surface. Fine-grained abrasive particles mixed in suitable proportion with high pressure carrier gas, usually air, are directed through a suitably designed nozzle. The nozzle used imparts high velocity to the carrier gas and thereby to the jet of abrasive particles at the nozzle exit. This directed onto the work surface to he machined. Materials removal occurs due to erosion caused by the impact of high velocity abrasive particles onto the work piece.

The erosion of a surface by solids particles entrained in a fluid stream has received considerable attention from many investigators in the past. The theory of erosion phenomena in such situation is not fully understood and adequate data of its governing parameters are not available; some of these parameters are interdependent and difficult to control. The erosion phenomena in such situations may be considered in two phases.

The first phase involves the determine from fluid flow conditions, of the number, direction and velocity of abrasive particles striking the work surface. The second phase of the problem is then the estimation of materials removal from the work surface. The first phase is essentially two-phase (solids-gas suspension) flow problem and is beyond the scope of the present work. The discussion will, therefore, be confined to the mechanism of material removal or erosion rate. The erosion of materials by surface impact of hard particles is a complex phenomenon, consisting of several simultaneous and interacting processes, typically involving mechanical, chemical and material parameters as well as complex mechanisms.

IMPECT OF ABRASIVE JET MACHINING PROCESS:-

The filtered gas is supplied under the pressure varies from 2 kgf/cm^2 to 9 kgf/cm^2 to the mixing chamber containing the abrasive powder and vibrating at 50 Hz entrains the abrasive particles and then passed in to a connecting hose.

This abrasives and gas a mixture emerges from a small nozzle mounted on a fixture at high velocity. The abrasive powder feed rate is controlled by the amplitude of the vibration of mixing chamber. A pressure regulator controls the gas flow and pressure. To control the size and shape of cut either the work piece or nozzle is moved by cams, pantographs or other suitable mechanisms.

The metal removal rate is depends upon the diameter of nozzle, composition of abrasive gas mixture, hardness of abrasive particles and that of work material, particle size, velocity of jet and distance of work piece from jet. [NTD].

❖ADVANTAGES:-

1. It can cut holes of intricate shapes in materials of any hardness and brittleness.
2. There is no mechanical contact between the tool and work.
3. It can machine thin section of hard and brittle materials such as germanium, mica, glass ceramics etc.
4. Ability to cut fragile and heat-sensitive materials without damages as no heart is generated due to the passing of gas or air.
5. Surface finish obtained damage is low.
6. Depth of surface damage is low.
7. Power consumption is low.
8. Capital cost is low.
9. No vigorous clamping is required to hold the work piece.
10. Both -conductive and non -conductive materials can be machined.
11. Metallurgical properties of the work piece remains intact.
12. Accuracy up to 0.05 mm can be obtained.

❖DISADVANTAGE:-

1. Metal removal rate is low its application are therefore limited.
2. Nozzle wear is high.
3. Stray cutting and tapering effect are unavoidable. Thus, machining accuracy is poor.
4. Abrasive becomes blunt after some use.
5. Additional cleaning of work surface may occur as there is a possibility of sticking abrasive grains in softer materials.
6. Process is noisy and it lends to pollute environment. So such dust collecting system is required.

❖APPLICATIONS:-

1. Removal of flash mid parting lines from the injection moulded part s.
2. Deburring and policing of plastic, nylon and Teflon components.
3. Cutting of thin sectioned fragile components made of glass, refractory, Ceramics, mica etc.
4. Production of high quality surface.
5. Removal of glue and paint from paining and leather objects.
6. Reproduction of designs on glass surface with the help of masks made Of rubber, copper etc.
7. Cleaning of metallic mould cavities which otherwise may be Inaccessible
8. Frosting of the interior surface of the glass tubes.
9. Etching of markings on glass cylinders.
10. for cleaning of the spark plug and casting.

2. COMPONENTS OF AJM

Components involved in the construction of the "**Abrasive Jet Machine**" are

As follows

1. Compressor
2. Mixing chamber
3. Nozzle
4. Regulator and valves

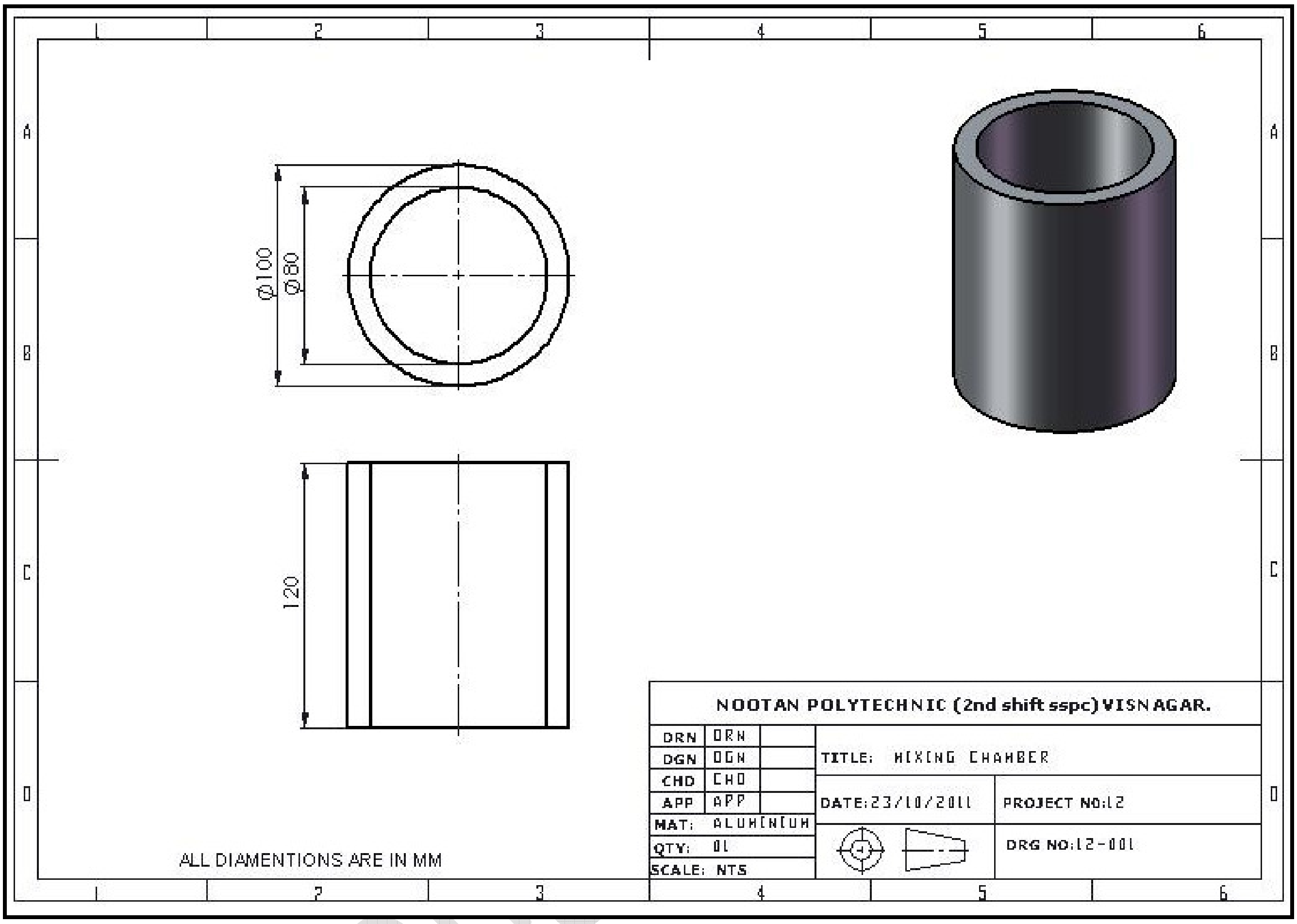
1. COMPRESSOR

Compressor

The Compressor consists of a cast iron or aluminium body with an oil tank, the base, the piston with piston ring, valves, connecting rods, cranks, crankshaft and bearings etc. As the piston is drawn in air is sucked through the suction valve via filter and is compressed in return stroke. The pressure switch is connected to the driving motor and is so set that it automatically trips off disconnecting the electrical connection to the motor as soon as the receiver achieves the desired set pressure. The safety valve is set to the same pressure limit and in case the pressure exceeds this automatically opens and excess pressure exhaust to the atmosphere, thus limiting the system pressure to the desired level.

Maximum compression ratio may be as high as 10 per stage. Multi stage can produce discharge pressure up to 300 kg./cm^2.As per cylinder arrangement compressor generally available in vertical, horizontal and radial designs.

2. MIXING CHAMBER



Mixing chamber is a closed, rigid, leak proof container employed for mixing in correct proportion the abrasive particles with air. Since the ratio of abrasive particle per unit volume of air abrasive mixture is a detrimental factor in controlling the material removal rate, it becomes necessary to check the inflow of the abrasive particles in to the chamber.

Also it is very important to make sure that the abrasive grains mix into the air uniformly. All these requirements can be met by using a certain set of accessories and attachments mounted on the mixing chamber, which are as follows:

1. HOPPER

To hold the grains before they are fed to the mixing chamber.

2. REGULATOR

To regulate the rate of flow of abrasive grains from hopper to the mixing chamber.

3. VIBRATOR

For proper mixing of abrasive particle in the air stream is provided vibrating motion to the mixing chamber.

4. INPUT & OUTPUT PORTS

To facilitate the input of compressed air and output of the abrasive air mixture.

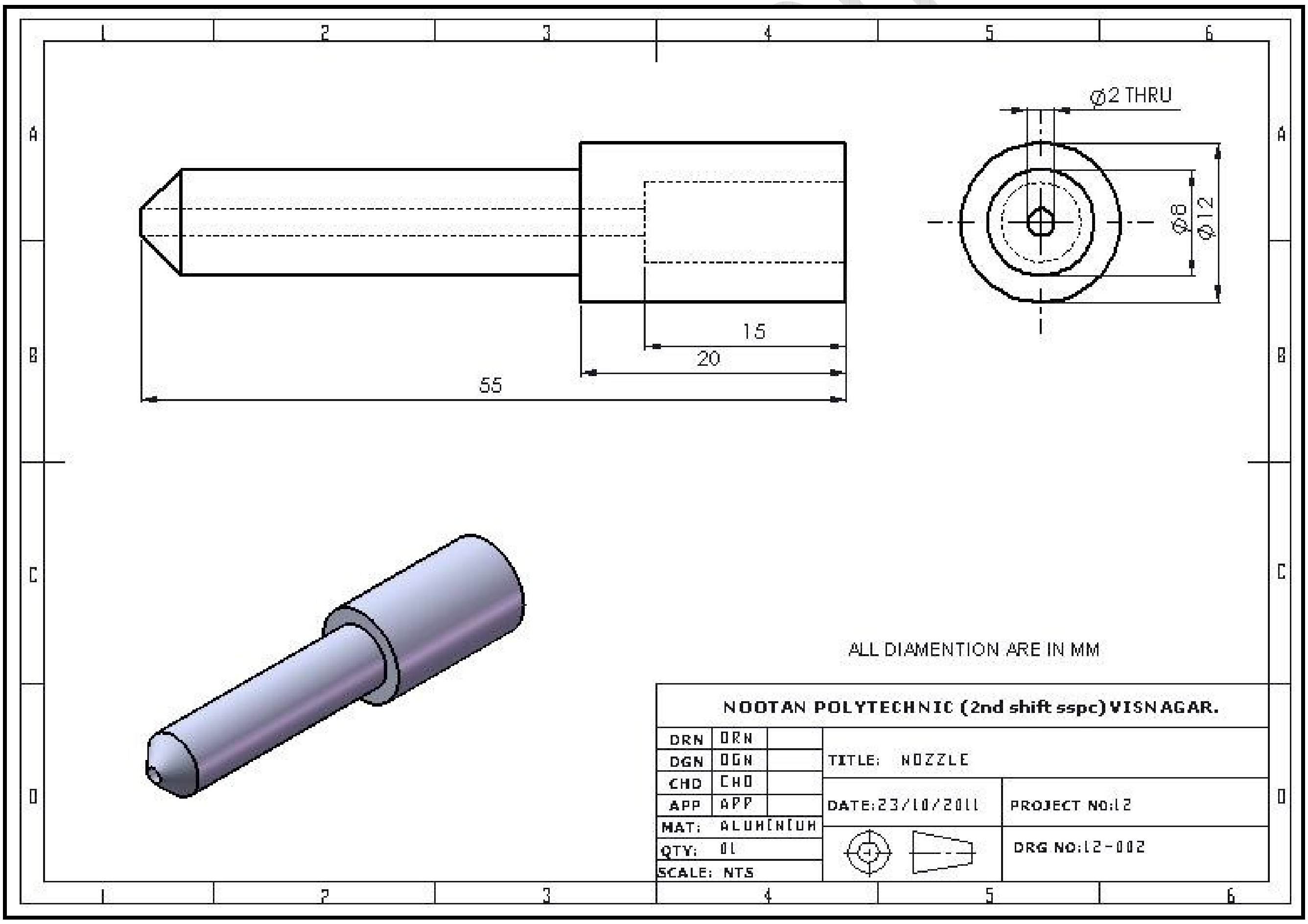
3. NOZZLE:-

Nozzle is used for:

1. Converting the high pressure jet into high velocity jet.
2. Directing the jet to the required point.
3. To concentrate the jet to a small point on the work surface.

There are two types of nozzles:

1. Straight head
2. Right angle head



A strong material is required for the nozzle as it is subjected to wear due to high velocity of abrasive. For this purpose, tungsten, carbide and sapphire are used as nozzle material.

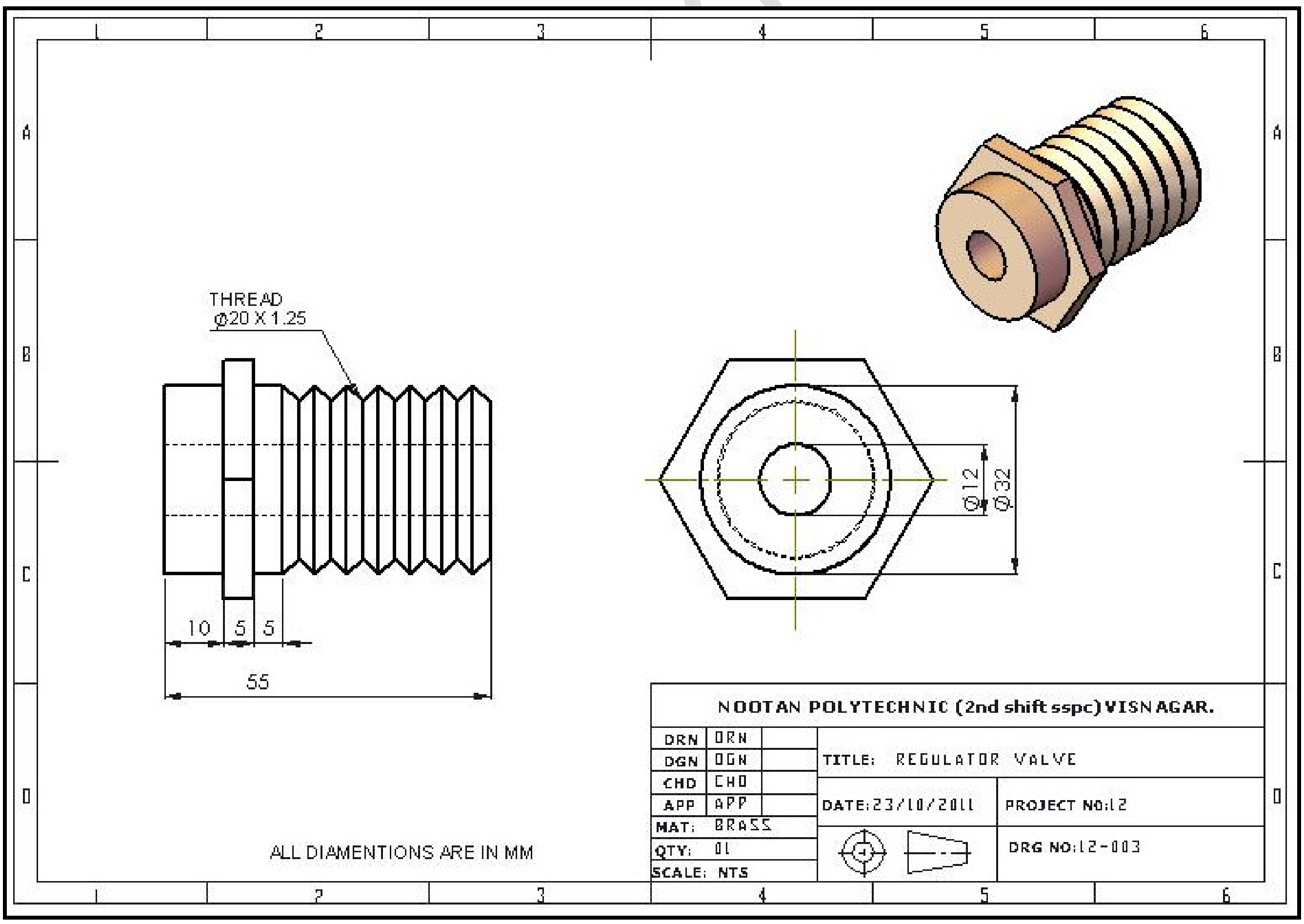
Tungsten carbide nozzle can be made in circular, rectangular or square cross-section but sapphire nozzle is available only in round configuration. The life of tungsten carbide is around 12 to 30 hrs and that of sapphire nozzle is 300hrs.

Nozzle specification:

- Must be hard material to reduce wear by abrasive:- wc , sapphire
- Cross sectional area of orifice is 0.05-0.02 mm^2.
- Orifice can be round or rectangular.
- Head can be straight, or at a right angle

4. REGULATOR AND VALVES:

A Valve is mechanical device usually used in the connection with a pressure-connecting vessel to completely stop or regulate flow. As a mechanical device, a valve selected to do the expected of it and should be properly installed it will then give long service before it starts to leak or wear out.



3. DESIGN AND FEBRICATION OF WORKING MODEL OF AJM SYSTEM

As an outline, the objective of this project is to study the abrasive jet machining process and design & fabrication the working model of AJM system.

❖DESIGN OF WORKING MODEL:-

Since no rigorous design procedure is involved and the design mainly concerns with providing the mixed flow [carrier gas, abrasive] in two phase flow. The design therefore has following main components:

1. Control panel design.
2. Mixing chamber,
3. Pneumatic system,
4. Nozzle design,

1. DESIGN OF MIXING CHAMBER:

A simple mixing chamber design is consider where an electro-mechanical system will vibrate a cylinder containing abrasive particles having orifice plate at its bottom, from which the abrasive access carrier gas and thus abrasives are entrained or mixed with carrier gas.

DESIGN OF ELECTOR-MECHANICAL VIBRATOR:

Stamping of E and I portion of transformer with no volt coil wound for 230 volts, single phase, 50 Hz, 1 amp, A.C. supply to take care of the weight of the abrasives, weight of cylinder and spring pre load.

DESIGN OF MIXINGCHAMBER:-

To design the mixing cylinder, the volume of the cylinder; data [this data is available from experiment done by others and the duration for which the mixing cone should supply the abrasives.

ILLUSTRATION:

Suppose, 54 grams/min. is the mass flow rate abrasive and the mixing cylinder should supply the abrasives for 1 hr. duration, for which the cylinder capacity would be worked out as,

Volume of cylinder = mass of abrasives / density of abrasives

Volume of cylinder = mass flow rate duration= 54 x (1 x 60)
=3240 grams /hr.

For factor safety, 20% extra capacity of cylinder is selected.

Mass of abrasive= 1.2 x (3240)
= 3888 gram
=3.888 kg.

Now, density of abrasive is 0.0027 kg/cm^3

Therefore, volume of cylinder = 3.888 / 0.0027
=1440cm^3

This will get us the volume of the cylinder. Once the volume of the obtained the next step is to decide the diameter and length of the cylinder. If, bigger diameter is selected, compared to length; there will be carrier gas leakage possibility, because of larger parameter of seal is envisaged.

Increase in the length of cylinder may lead to improper shaking problem. As a thumb rule one may select,

L=1.5D to 2D where, L = length of cylinder &

D= diameter of cylinder.

Now, volume of cylinder = (π/4) D^2 x L

Hence we get,

D =10.70 cm

L = 16.05 cm

DESIGN OF ORIFICE PLATE:-

The function of orifice plate is to pass the abrasive particles from the storage compartment of the cylinder to the carrier gas jet via mixing cone of the cylinder.

The size of the hole selected will depend upon the size of the abrasive particles which have to pass through it and the numbers of hole in the orifice plate will depend on the mass flow rate of abrasive from the nozzle.

ILLUTRASTION:-

Following procedure illustrate the orifice plate dimensioning.

- Required mass flow rate of abrasive = 54 grams / min
- Corresponding numbers of abrasive particles per min.(n)

N= 5 / (vol. of single abrasive x density)

- Suppose, for 10 microns abrasive particles would be
  =1 / (d x d) abrasives / μm^2

- Area of orifice hole would be =(π/4) x 100 x 100(in microns)

- Total no. abrasive particles passed from single orifice hole (n)

n=orifice area x packing density.

- Total holes required in orifice plate = N/n
  - Orifice diameter = 1 mm
  - Total holes required in orifice plate = 4/8

DESIGN OF MIXING CONE:-

The mixing cone in making chamber design is to allow the abrasive particles to mix with carrier gas and isolate the abrasive jet from the mixing chamber by providing pressure gradient. Threaded holes are made in the same line to prevent the pressure loss.

Gaskets are used to prevent leakage through the joint between the cylinder & mixing cone charger cover & cylinder.

2. PNEUMATIC SYSTEM:

The pneumatic system in abrasive jet application requires a supply of clean, dust free, moisture free, regulate pressure air. The moisture and dust free supply is insured by using a filter with moisture drain facility.

FILTER:

The selection of filter should also be considered. The piping features of the connections must be in harmony with other components of the system which it connects. In the present case, ¼ inch B.S.P. size is selected. The filter should be able to separate impurity as fine as 5 microns and moisture up 99%.

PRESSURE REGULATOR:

The selection of pressure regulator will depend upon the gas pressure to be used and the size of the pipe it connects. For cleaning applications the carrier gas pressure would range between 2 to 4 kg / cm^2 and for machining it will range between 5 to 7 kg/ cm^2.

In present project, 0 to10 kg/cm^2 pressures for ¼ inch B.S.P. connection are available. Therefore, it will be selected.

Commercially, the pressure regulator and filters are available in integrated from and hence, this is selected.

3. NOZZLE DESIGN:-

The function of the nozzle is to convert the static head of abrasive jet into kinetic energy, required for machining. the present project considers general purpose nozzle with determined by orifice diameter, cone angle and ¼ inch B.S.P. connection.

4.CONTROL PANEL:

The entire abrasive jet machining system is required for control and operation at 230 volts, 50 Hz, and A.C. supply.

As far as the operation is concerned 230 volts is required for operating the mixing chamber. The control of carrier gas and abrasive jet is required for proper operation of the system.

The care must be exercised that cylinder is not vibrating when the jet supply to nozzle is switched –off, otherwise line chocking will result. Therefore, for switching-off the system, first vibrator is switched off, then blow off valve is opened to purge out the abrasive trapped in the piping and in the end, all the valves are switched -off.

To ensure fault free operation, a rotary selector switch is used. To operate the carrier gas, supply valve and blow off valve electrically, 230 volts A.C. solenoid valves are selected. The solenoid valve electrically, 230 volts A.C. solenoid valves are selected. The solenoid valve would be chosen according to the connection i.e.1/4 inches B.S.P. with non return valve (NRV).

4. FEBRICATION

FEBRICATION OF MIXING CHAMBER:

Mixing chamber fabrication is realized from fabrication of two components storage compartment and mixing cone.

Orifice plate is screwed at the bottom of the cylinder to facilitate separation of storage compartment without spelling the abrasive.

Mixing cone is made from nylon block and machining is done for conical mixing chamber and connection of carrier gas, abrasive jet and ¼ inch B.S.P. nipples. This involves drilling and threading (tapping).

Further, the mixing cone is welded with two piles at the bottom for bearing support during vibration.

Gaskets are cut-out from rubber sheet of size of flange with holes cut-out in the centre for cylinder and at pitch circle for bolt connection.

The electro magnetic vibrator has components, the stationary E and oscillating I. the stationary E is mounted on the base and oscillating I is fixed with mixing cone by welding.

The gap between the E and I is maintained by spring pre loaded stud connection of E & I.

2. FEBRICATION OF NOZZLE:-

Since nozzle is made of H.S.S. (C-series, high cobalt),it is difficult to machine for a given cone angle. Thus, only materials of corners will be required to be removed for making nozzle. At this stage, nozzle hardening is done by hardening process.

Copper electrode is made of the same taper as the internal cone of the nozzle. The removal of corners is carried out by EDM process.

3. FABRICATION OF CABINET FOR MACHINING UNIT:-

The cabinet for machining unit requires provision for adjustment and measurement of nozzle tip distance, fitting of the work piece, illumination of machining area, and sliding cover for removal and replacement of work piece is required.

The cabinet is made from angle frame box structure with sides other than front covered with plastics and the front sliding transparent shutter.

4. CLAMPING OF NOZZLE AND WORKPIECE:-

Since the clamping and locating the work piece as well as nozzle is very essential. During the high pressure operating condition the work piece may be slip and we cannot get exact point of operation, so as in nozzle it is required to hold it at 90^o for low time consumption and perfect machining.

For work piece, the small manually operated vice is provided for locating and locating at exact position. For nozzle, the stand is provided with lead screw, handle and scale. Scale is used for measuring NTD, which is having 0.4 mm accuracy.

5. WORKING PARAMETERS IN ABRASIVE JET MACHINE:-

Variable in that the rate of metal removal and accuracy of machining in abrasive jet machining process are:

1. Carrier gas.
2. Types of abrasive.
3. Size of abrasive grains.
4. Velocity of abrasive jet.
5. Mean number of abrasive particles per writ volume of carrier gas.
6. Work material.
7. Stand off distance.
8. Nozzle design.
9. Shape of cut.

1. CARRIER GAS:-

Carrier gas to be used in abrasive jet machining must not flare excessively when discharged from the nozzle into the atmosphere. Further, the gas should be non-toxic, cheap, easily available being dried and cleaned without difficulty. Gases hint crux be used are air, carbon dioxide, nitrogen, etc.

Air is most used owing its reliability and little cost. All abrasive powders supplied by tile manufacturers cart are run with clean shop nit provided air-filter have been installed in the filters in the air lines.

The quantity of abrasive particles in the gas is related to material removal rate. To a certain extent, the increase in mixing ratio increases the material removal rate; afterwards it falls. The pressure of the carrier gas ranges between 2 kgf/cm^2 to8 kgf/cm^2.

2. **TYPES OF ABBRASIVES:-**

The choice of abrasive in abrasive jet machining depends upon the type of machine operation e.g. roughing, finishing etc. The abrasive should have sharp and irregular sharpens be fine enough to remain suspended in the carrier gas and should have excellent flow characteristics.

Abrasive	Grain Size	Applications
Aluminium oxide	12, 20, 25μ	Cutting and grooving
Silicon carbide	25,40μ	-Do-
Sodium bicarbonate	27μ	Light finishing below 50^0 c
Dolomite	200mesh(approx.)	Etching and polishing
Glass beads	0.635 mm to 1.27mm	Light polishing and fine deburring.

The abrasive generally employed are aluminium oxide, silicon carbide, glass powder, dolomite or specially prepared Sodium Bicarbonate etc. used for cleaning, etching, deburring and polishing. Reuse of abrasive is not recommended because not only its cutting ability decreases but contamination will clog the orifice of the nozzle.

3. **SIZE OF ABBRASIVE GRAINS:**

Rate of material removed in abrasive jet machining depends upon the size of grain. Larger sizes are used for good surface finish and precision work. Moreover, a finer grain tends to stick together and chock the nozzle. The most favourable grain size in abrasive jet machining ranges from 10 microns to 50 microns and they are generally available in 10, 27, 40 and 50 microns sizes.

Particles size is important and best cutting results have been obtained, if, bulk particles vary between 15 microns to 40 microns.

4. VELOCITY OF ABRASIVE JET:-

The kinetic energy of the jet is utilized in removing the metal from the work-piece. The velocity of the abrasive stream should be high of the order of about 300 m/sec. the experiment conducted by finny and Sheldon have shown that a minimum jet velocity is necessary for cutting. In their experiment sodium bicarbonate, abrasive grain size 25 microns on glass, the minimum jet velocity was found to be 150 m/sec.

The jet velocity in abrasive jet machining is function of the nozzle pressure, nozzle design, abrasive grain size and mean number of abrasive per unit volume of the carrier gas.

MEAN NUMBER OF ABRASIVE GRAIN PER UNIT VOLUME OF CARRIER GAS:-

An idea about the mean number of abrasive grains per unit volume of the carrier gas can be obtained from the mixing ratio [M]. It is defined as "the ratio of volume flow rate of the abrasive per unit time to the volume flow rate of the carrier gas per unit time". A large value of mixing ratio should be higher rate of material removal but, large abrasive flow rate have been found to influence, adversely the jet

Velocity and sometimes clog the nozzle. Thus, for the given conditions, there is an optimum mixing ratio [M] that leads to maximum material removal rate.

The maximum cutting rate is obtained for the fixed nozzle dimensions and stand off [NTD] usually lies between 2 to 20 mm.

6. WORK MATERIAL:-

Abrasive jet machining is recommended for the processing of brittle materials such as glass, ceramics, refractory, etc.

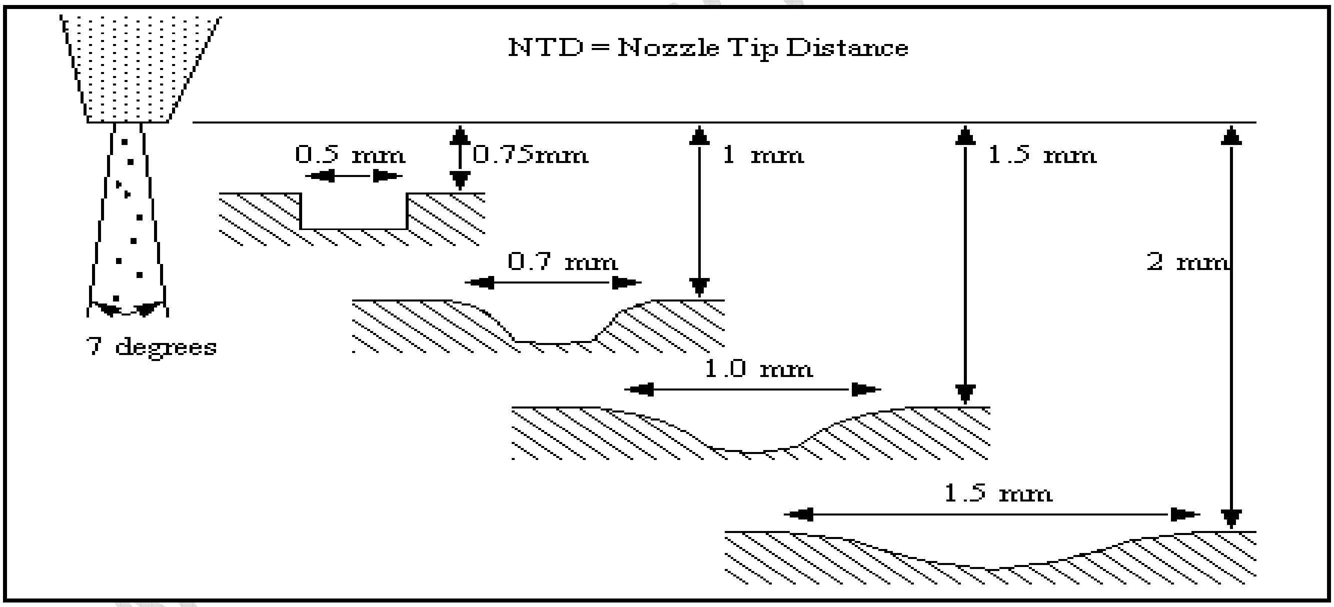
Most of the ductile materials are practically not machine able by an abrasive jet machining due to abrasive particles getting embedded in the work piece.

7. STAND OFF DISTANCE:-

The distance between the face of the nozzle and the working of the work piece is known as Tip Distance [NTD] or Stand-Off Distance [SOD].

Small metal removal rates at low stand-off distance is due to a reduction in nozzle pressure with decrease in distance, whereas it drop in metal removal rate for large stand-off distance is due to a reduction in the jet velocity with increasing distance.

The accuracy of the machine parts also is dependent on stand-off distance. The jet which is initially parallel to the work surface flares up resulting In stray machining and poor accuracy. For one particular situation, there is always one such NTD which gives maximum material removal rate. For cutting and drilling operation NTD should be set so as to get minimum jet diameter. For deburring, cleaning and polishing operations, higher NTD will be better, because of diverging effect of jet, more area will be covered



Nozzle Material	Round Nozzle Diameter (mm)	Rectangular Shape, slot Dimension (mm)	Nozzle life (Hours)
Tungsten Carbide	0.2 to 1.0	0.75 x 0.5 to 0.15 x 2.5	12 – 30
Sapphire	0.2 to 0.8	-	300

8. STAND OFF DISTANCE:

The high velocity jet containing abrasive particles is directed on the work surface through the nozzle. Due to this, the nozzle has to sustain maximum wear due to abrasion. Secondly, the accuracy of working and the metal removal rate depends upon the nozzle wear. The material used for nozzle should therefore, have high wear resistance. The nozzles should be designed such that the pressure loss due to bends, friction etc. is as small as possible. Thus, selection of nozzle is very important in AJM; because it is a costlier component in setup. The nozzle material and geometry of the hole should be designed for the maximum nozzle life.

Size and shape of the hole is also important, because it ultimately affects jet, in usual practice, the nozzles are made of Tungsten Carbide or Sapphire of having regular round or square hole.

It is difficult to establish and average life of nozzle. Nozzles made from Tungsten Carbide last for 12 to 30 hours; while made from Sapphire have a life about 300 hours when used with 37 microns.

9. SHAPE OF CUT: -

The accuracy of machining is also dependent upon the shape of cut. With abrasive jet machining, it would not be possible to machine the components with sharp corners because of stray cutting.

6. SOME EXPERIMENTAL INVESTIGATION:-

The effect of stand-off distance on volumetric material removal rate and penetration rate are shown in charts. The profiles of the machined cavity at several stand-off distances are also indicated. The charts show that both material removal rate and penetration rate first increase with in stand-off distance and then decrease giving an optimum value. The maxima of the penetration rate and the volumetric removal rate do not occur at the same stand-off distance for the specified machining conditions. Photographs of the machined cavity at different stand-off distances are shown in fig.10. The top diameter of the eroded cavity increases with increase in stand-off distance but tend to saturate beyond a certain stand-off distance.

a) Working parameters:

Abrasive material = Al_2o_3(60 grit size)
Work piece material = ceramic tiles
Working pressure = 60 PSI

7. INVESTIGATED RESULTS

Experimental results shows that the material removal rate first increases with increase in standoff distance and then decreases giving an optimum value. This pattern of curve is essentially due to inertia effects in suspended particles. The carrier fluid attains a maximum velocity at nozzle exit. On exit from the nozzle the jet flares up due to entrainment of the surrounding stagnant fluid and the carrier fluid velocity decreases. At some stage in the jet region the carrier fluid velocity and the velocity of abrasive particles attain the same value i.e. the velocity of slip reduces to zero. Beyond this the jet flares significantly and the particle velocity decreases and eventually reaches a value when no erosion can take place. At this stage the abrasive particles and work material will essentially have elastic impacts.

The variation of penetration rate with stand off distance is shown in figures. It is clear that the penetration rate also attains an optimum value but the corresponding stand-off distance is much smaller than the value where maximum material removal rate is obtained. The penetration rate essentially depends on the impingement velocity, whereas material removal rate is a function of both the impingement velocity and the area of impingement.

The results show that the taper ness and the top diameter of cavity created are increasing with the increase in the nozzle tip distance (NTD).The reason for this behaviour is the cone shape of the jet coming out from nozzle
In some cases, the results are deviated from general behaviour, as there is the presence of errors due to instruments, human.

8. COST ESTEIMATION:-

Sr. No.	Part Name	Cost (Rs.)
1	channel	50
2	Ball Valve	55
3	Pipes	50
4	Ragulator	45
5	Abrasive powder	250
6	Mixing cone	200
7	Abrasive nozzle	50
8	Pressure gauge	215
9	Vibrator	150
10	Frame and Cover	500
11	Miscellaneous +Transportation	150
	Total	1715

Note: the above cost is experimental cost to not a selling cost of machine .the original cost of this machine will be consider in next semester in project-2 with include its all bought out items (BOI) & bill of materials (BOM)

8. CONCLUSION:-

❖Abrasive jet machining can be used for polishing, deburring and other finishing operations where the rate of material removal is important, while in operations such as micro-drilling and cutting it is the erosion depth which is more relevant.

❖ **As part of solution of above mention title we will focus on design of abrasive jet machine, and doing its fabrication in next semester.**

10. <u>FUTURE SCOPE OF WORK</u>

1. Mixing ratio can be obtained by using calibrated vibrator.
2. We can vary MRR by using different size and shape of nozzle
3. We can also increase life of nozzle by using high strength materials like Sapphire, WC.
4. We can reduce waste of abrasive and increase the life of solenoid valve by providing filter before mixing unit.
5. We can generate complex shape with higher accuracy of surface finishing providing some table arrangements, for this purpose, automation is necessary.

11. OUR TARGETED NEXT SEMESTER WORK.

1. our next targets will be we tried to fabricate all machine components .

2. we also tried to cost of the machine should be reasonable .

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