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Design and Analysis of Abrasive Machine for Surface Rust and Dust Removal

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Abstract: ***Mechanical engineering without production and manufacturing is meaningless and inseparable. Production and manufacturing process deals with conversation of raw materials inputs to finished products as per required dimensions specifications and efficiently using recent technology. In order to perform different operation in a lathe such as different types of turning, chamfering, polishing, grooving, thread cutting, filling, knurling etc. This paper is based on 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. In this paper, the job is held between the live and dead center and nozzle attachment is fixed over the work piece. From the nozzle the high velocity of air flow mixture of abrasive particles are fed in to the work piece and the material will be removed. The cutting action is cool because the carrier gas serves as a coolant. Design of abrasive chamber model with different sizes of nozzle is modeled in Pro-E software and different velocity result from models is analyzed by using Ansys 14.0 Software.***

Keywords: Carrier gas, High Speed Stream, Blasting.

I. INTRODUCTION

Abrasives generally rely upon a difference in hardness between the abrasive and the material being worked upon, the abrasive being the harder of the two substances. However, this is not necessary as any two solid materials that repeatedly rub against each other will tend to wear each other away (such as softer shoe soles wearing away wooden or stone steps over decades or centuries or glaciers abrading stone valleys).

A. Literature Survey

Dr. D.A.Axinte reviewed that Stepanian J.P (1967)[9] was the first to explain the effect of abrasive flow rate on material removal rate in AJM. Along with Liu and Gong(1976) concluded that the standoff distance increases the MRR and penetration rate increase and on reaching an optimum value it start decreasing. J. Wolak (1977) and K. N. Murthy (1987)[1] investigated that after a threshold pressure, the MRR and penetration rate increase with nozzle pressure. The maximum MRR for brittle and ductile materials are obtained at different impingement angles.

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For ductile material impingement angle of 15-20 results in maximum MRR and for brittle material normal to surface results maximum MRR. Dr.A. K. Paul &P. K. Roy (1987)[4] 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.

II. COMPONENTS

A. Air Compressor
B. Abrasive Chamber
C. Abrasive Powder
D. Nozzle

A. Working Operation

In abrasive jet cleaning, a focused stream of abrasive particles, carried by high pressure air or gas is made to impinge on the work surface through a nozzle and the work material is made to impinge on the work surface through a nozzle and the dust is cleaned by erosion by high velocity abrasive particles. In Abrasive jet cleaning abrasive particles are applied on the material at high velocity. Jet of abrasive particles is carried by carrier gas or air. The high velocity stream of abrasives is generated by converting pressure energy of carrier gas or air to its Kinetic energy and hence high velocity jet. Nozzles direct abrasive jet in a controlled manner onto work material. The high velocity abrasive particles remove dust on the material by micro-cutting action as well as brittle fracture of the work material. This is a process of removal of material by impact erosion through the action of concentrated high velocity stream of grit abrasives entrained in high velocity gas stream. Abrasive jet cleaning is different from shot or sand blasting, finer abrasive grits are used and parameters can be controlled more effectively providing better control over product quality.

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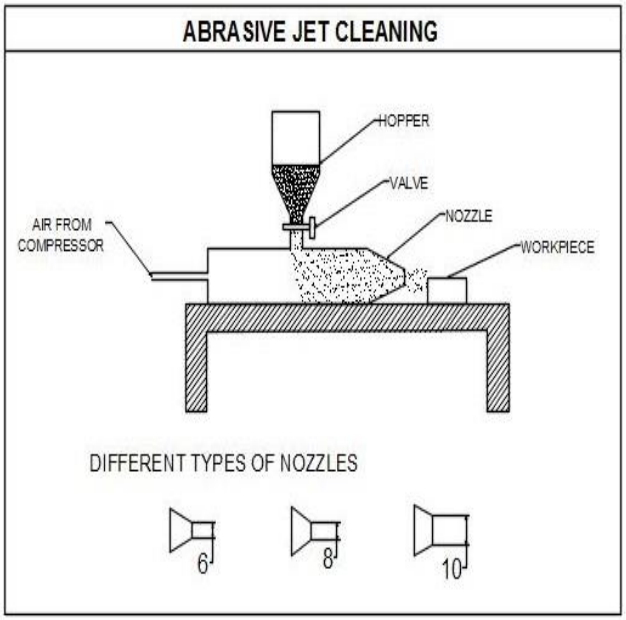


Fig. 1. Block Diagram

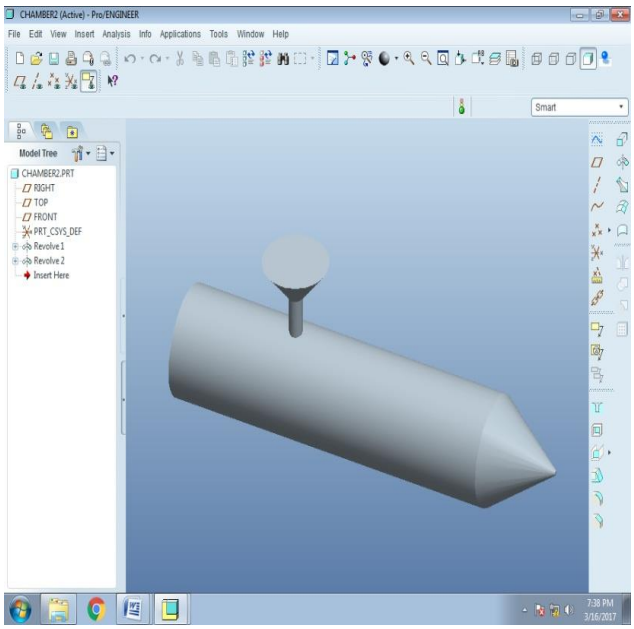
B. Advantages

1. High surface finish can be obtained depending upon the grain sizes
2. Depth of damage is low (around2.5 microns)
3. Process is free from chatter and vibration as there is no contact between the tool and work piece
4. Capital cost is low and it is easy to operate and maintain.
5. Thin sections of hard brittle materials like germanium, mica, silicon, glass and ceramics can be machined.

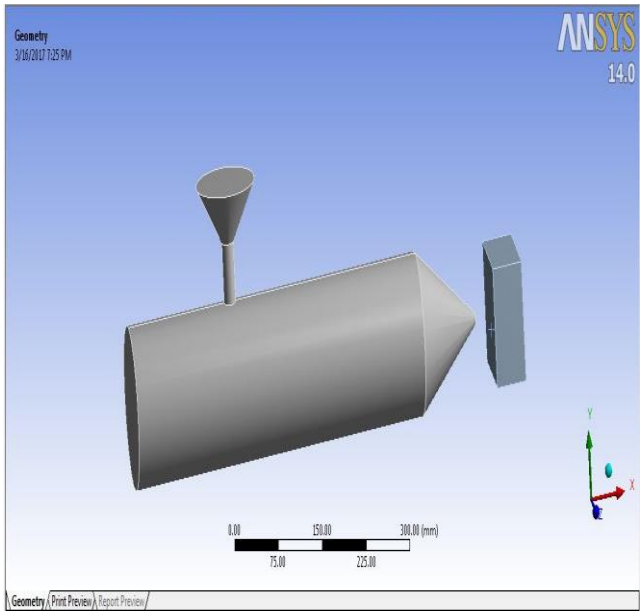
C. Applications

1. To remove dust particles without contact of work piece areas.
2. All Industrial cleaning applications.

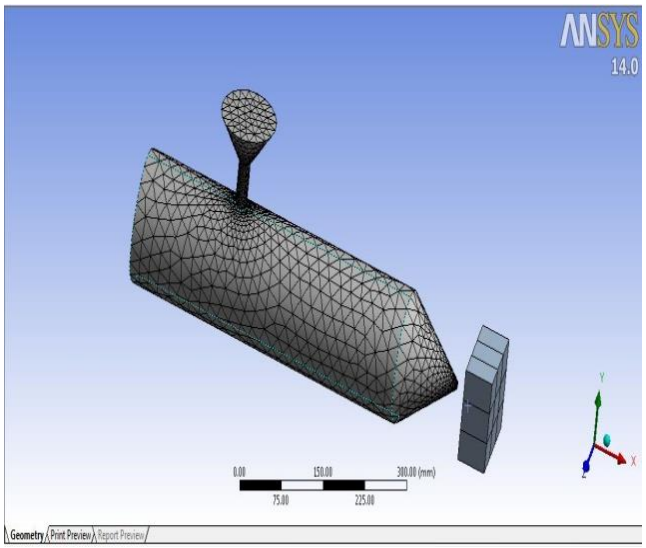
III. DESIGN AND ANALYSIS



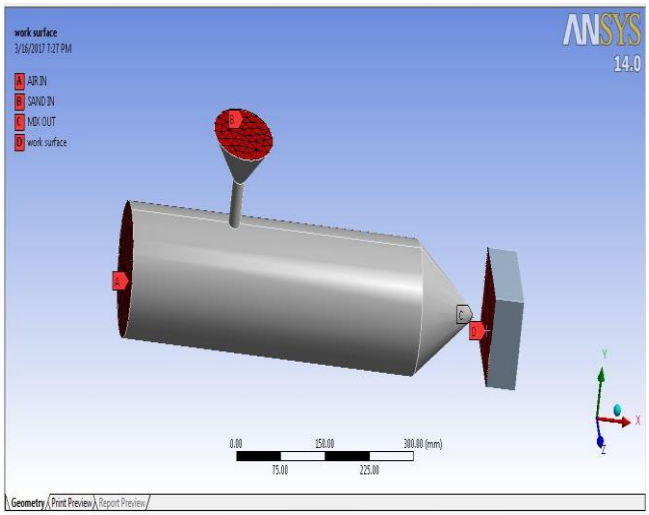
Modeling by using Pro-E



Imported Model



Mesh Model



Inlet & Outlet Selection

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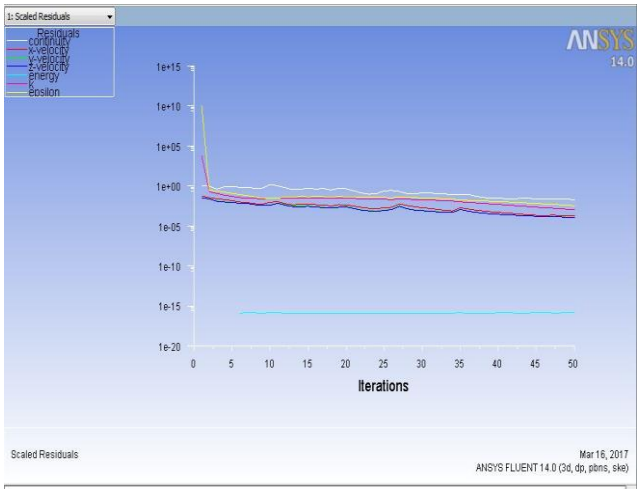
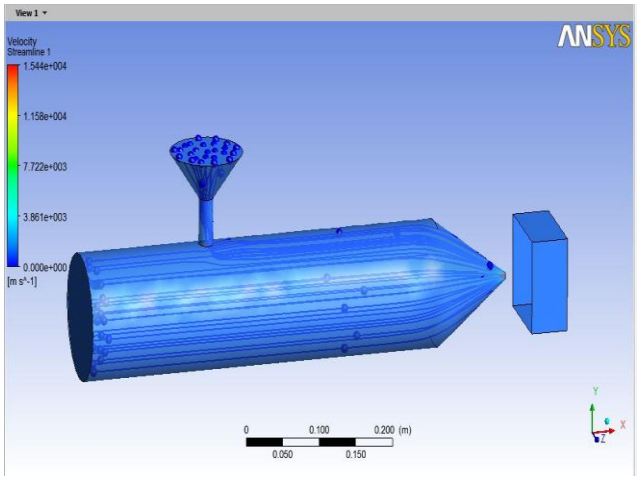


Calculate Iterations



CFD result (velocity streamline)

IV. CONCLUSION

In this paper, a complete design and fabrication of Abrasive Jet Cleaning Machine was provided and also the report details with design and fabrication of Abrasive jet cleaning attachment for the un-conventional cleaning process are given. This Paper carried out by us made an impressing task in the works of any type of work piece (glass, metal, silicon, aluminum etc, It is very useful for the labors to make required to clean work piece dust. This paper has been designed using Pro-E and CFD analysis using Ansys 14.0 to perform the entire requirement task.

REFERENCES

1. Dr. J. Wolak and K.N.Murthy, "Viscous flow analysis in Convergent-Divergent nozzle". Proceedings of the international conference on Aero Space Science and Technology, Bangalore, India, June 26-28, 2008.
2. H.K.Versteeg and W.MalalaSekhara, "An introduction to Computational fluid Dynamics",British Library cataloguing pub, 4th edition, 1996.
3. DavidC.Wil Cox, "Turbulence modelling for CFD" Second Edition 1998.
4. Dr. A.K.Paul and P.K.Roy, "Grid generation for Arbitrary 3-D configuration using a Differential Algebraic Hybrid Method", CTFD Division, NAL, Bangalore, April 1995.
5. Layton, W.Sahin and Volker.J, "A problem solving approach using Les for a backward facing-step" 2002.
6. M.M. Athavale and H.Q.Yang, "Coupled field thermal structural simulations in Micro Valves and Micro channels" CFD Research Corporation.
7. Lars Davidson, "An introduction to turbulence Models", Department of thermo and fluid dynamics, Chalmers university of technology, Goteborg,
8. Sweden, November, 2003.
9. KazuhiroNakahashi, "Navier-Stokes Computations of two and three dimensional cascade flow fields", Vol.5, No.3, May-June 1989.
10. D.A. Axinte and J.P. Stepanian,"An introduction to Abrasive flow rate on material removal"Vol.49,Issues 3-4,March 1967.

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