ABRASIVE JET MACHINING PROCESS- A REVIEW

Pramod Kumar
Mechanical department, Ideal Institute Of Technology, Maharashtra-421303
Corresponding author:pk.iitwada@gmail.com

Abstract

With the occurrence of Industrial revolution, automation of many industrial processes, rivalry in market, the industries constantly applied for best quality and competitive pricing with the convoluted design and with the best suited material for component which can be integrated with other part of facility. For that accuracy Abrasive Flow Machining (AFM) alone or in combination with other hybrid Non- Traditional processes finds the suitable application.Abrasive flow machining (AFM) is non-conventional machining method also named as Extrude honing and abrasive flow deburring. AFM is widely used for polishing, Deburr, Slanting, eliminate recast film and radius of components in various applications. Great extent of surface finish and adequate tolerance has been achieved for wide range of applications. Conventional finishing process are the most time intensive, Labour needs extreme in degree and obstacles in the area of manufacturing process . Finishing process consume 1/7th total of manufacturing cost to manufacture the ultra-precision parts .In Abrasive flow machining (AFM) material removal rate is slow. Now the time Abrasive flow machining (AFM) is assimilate with hybrid machine technique to increase material removal rate for better surface finish. The paper deals about abrasive jet machining process.

Keywords: **Abrasive jet machine, Abrasive flow machine.**

INTRODUCTION

Abrasive flow machining (AFM) process is developed by Extrude Hone cooperation in 1966. McCarty R. W. developed the method of honing by extruding, For the purpose of abrading the internal surface to remove the burrs [1-4]. A before this; ago some experimental studies has been put in practice for research work regarding a process mechanism. Various researchersexamined the effect of different machining processes to achieve the quality of work surface produced by abrasive flow machining (AFM)[5, 6].Conducted the study on rheological properties of abrasive media in AFM and the effect of process parameters of medium used in AFM[7].The finite element model for analyzing stresses and forces developed during flow of media in AFM process[8].

Basic principle of AFM process

In AFM process an abrasive laden media (semi solid) to abrading the internal and external surface. Abrasive laden media extrude under pre-define pressure across the surface which is to be finished with help of hydraulic actuators. Due to mechanical impact of abrasive partials with work piece a material is removing from surface. The media acts as limber tool. The special deformable property of limber tool is liable for its movement from restriction passage due to irregular surface. Generally fixtures are required to control the media in the passage of work piece.AFM Machining is classified into three categories according to guidance of movement of Abrasive Laden Media – One- way AFM, Two- way AFM and Orbital AFM. Its commonly used two-ways AFM, has Novel benefits of evenness movement of Abrasive Laden media through work piece and thus attaining more abrading, rapidly of the process, better surface finish of the part.

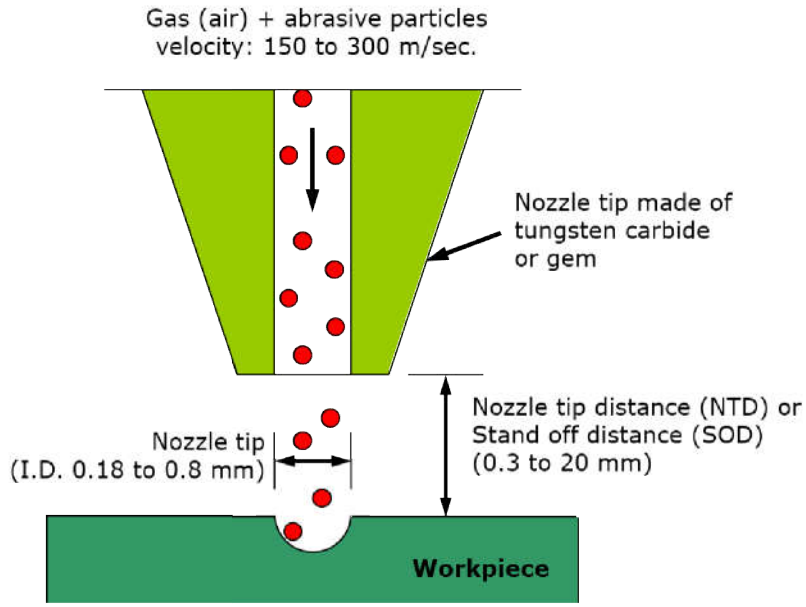

Fig.1: Schematic diagram for Principle of AFM

For finishing, the abrasive laden media is injected into lower cylinder. The work piece is placed between clamped between cylinder and work piece holder. A limber media is placed into lower cylinder (figure 1).Firstly heat up the media up to working temp. After properly placed the work piece, a limber media push upward in to the work piece by lower piston (figure 1). After that the process, upper piston push the media downward in to the work piece (figure 1).The machining cycle is repeated up to desired finishing is obtained.

Process parameter for AFM process

The AFM process parameters are classified as given below

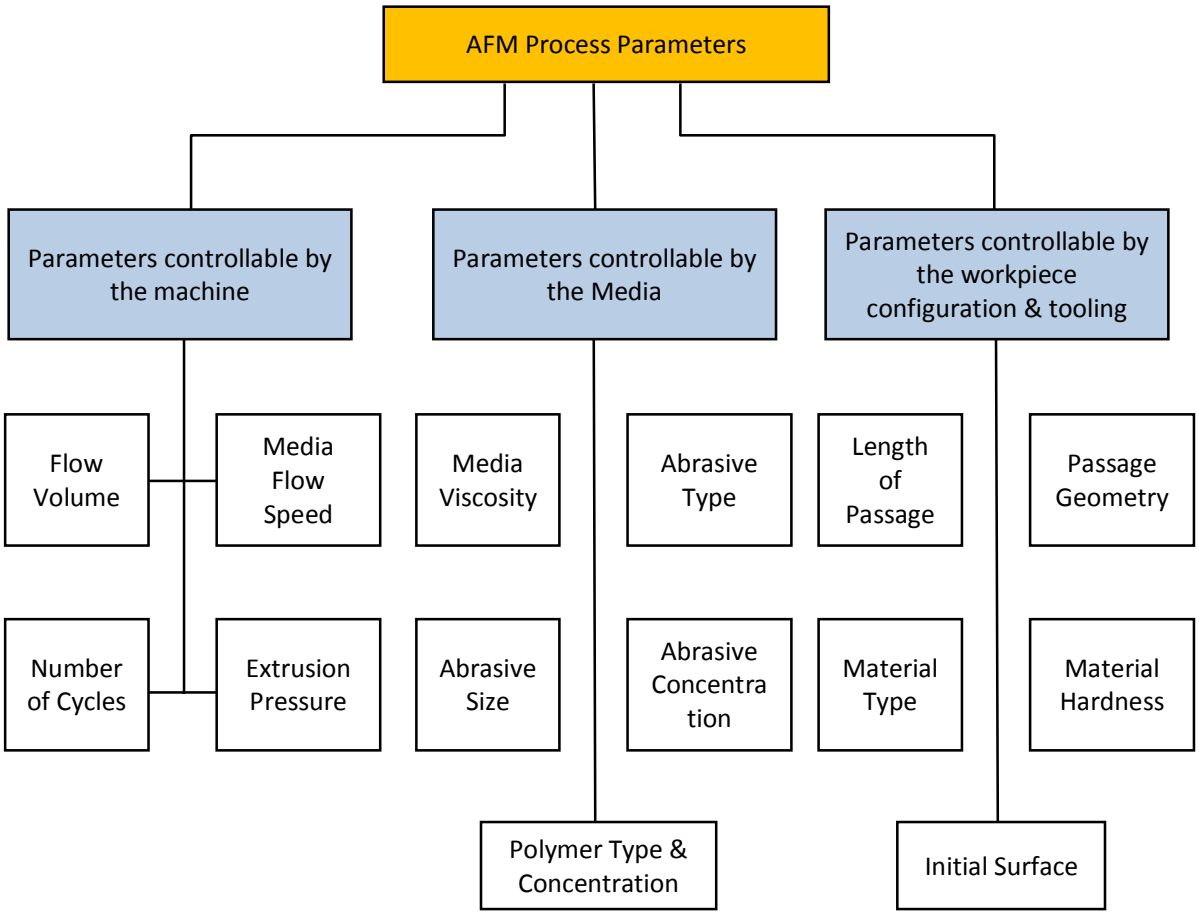

Fig.2: Representation of AFM process parameters in process flow chart

AFM Tooling

Nylon, steel, aluminum, Teflon, urethane or a mixture there of used to make the fixture or work piece holder. Improving the fixture to increase the productivity of AFM. The abrasive particles of silicon carbide, aluminum oxide, boron carbide and diamond as the abrading medium containing with non – Newtonian liquid polymer and additives. The consternation of abrasive, media of flow and viscosity can be varied. The flow ability and rheological properties of media controlled by additives.

Literature Review

The literature review on Abrasive flow machine process, FEM model, process parameters and combination of new hybrid techniques with Abrasive flow machining. The recent trends in the development of Hybrid Abrasive Flow Machining Processes has been described in detail below .Magneto Abrasive Flow Finishing (MAFM) process for the purpose of increase in the material removal rate and improvement in surface roughness of component by polymer base abrasive laden media mixed with ferromagnetic abrasive particles (CIPs) in AFM. In the new hybrid technique in which two poles are surrounded by coil arranged in such way to provide strong magnetic field in AFM, resulted in increased application of magnetic field with AFM, to enhance vibrant dynamic grains involved in cutting action. Cutting force acting on the surface gets increased by magnetic field because of the particle impinges upon the surface with the change in incidence angle. It observes that

MAFM used for non-ferromagnetic work material. Fixture or work holders were made of nylon for the purpose of maximum magnetic field production inside the work piece for the abrading. The application of providing magnetic field to AFM results in enhanced material removal rate and better surface finish in terms of quality [1]. Enforced magnetic force in the development of flexible magnetic brush, which provide comparative movement opposed to metal surface, polish that surface[2]. Ultrasonic Flow Polishing (UFP) by integrating AFM with ultrasonic Machining. AFM does not give better surface finish in closed die; however do give excellent finish in open die. But USM is suitable for precise material removal method for closed dies. In UFP, Abrasive medium within slurry was vibrant with tool, which was attached to piezoelectric transducer for providing vibrations for the purpose of mirror like image of tooltip on the surface of work piece. The USP hybrid technique of surface finish improvement up to 10:1 was recorded.Forthe purpose of finish such parts with intricate geometries used Ultrasonic Assisted Abrasive Flow Machining (UAFM) process. The surface Anatomy of intricate geometries gets better conclusion in glassy texture possessing to increase density of dynamic grains in the given time[3-5].Ultrasonic Assisted Magnetic Abrasive Finishing (UAMAF) process by combination of two non-traditional purposes USM & MAF to improve the surface finish within short period. On the hardened steel work piece the value obtained by UAMAF for surface roughness was as low as 22 nm within 80 seconds. A 65 percent improvement was recorded by selecting the ideal parameter in UAMAF in terms of surface finish**.**Centrifugal Force Assisted Abrasive Flow Machining (CFAAFM) process for provide rotation to media by Centrifugal force generating (CFG) Rod inside which are co-axial with cylindrical hollow work piece. So Abrasive Laden media was subjected to two pressures- extrusion pressure and centrifugal pressure. So due to these forces, Abrasion particles are more abrading the work piece which give better surface finish[6]. Taguchi method to optimize the process parameter, developed FEM model to analyses the stresses and forces in flow media, increase the productivity of AFM by improved fixturing. It has been recorded that centrifugal force increase the material removal rate and improved the abrading in surface in AFM. Drill Bit-Guided Abrasive Flow Finishing (DBG-AFF) process to improve the efficiency of AFM process in terms of surface finish and material removal rate. The Tooling is a major difference between DBG-AFF process and AFM Machines. In DBG-AFF Process twine slot fixture plates is used to assist the drill bit co-axial with the finishing zone. In DBG-AFF process the annular slug gets separate into two divisions, during coming in the finishing area; at the outlet these two divisions re-associate, resulting in greater intermixing of media. Self-deformability of Abrasive Laden media is not only reason of Abrasive intermixing, but also drill bit being exerted a pressure on the media for intermixing. In place of CFG Rotating Rods rotating drill bit produce more centrifugal force in the media. Thus Material removal rate of work piece and surface finish is better in terms of quality [7-13]. Helical Abrasive Flow Machining (HLX_AFM) by Co-axial stationary drill bit placed in a hollow work piece to increase the performance of simple AFM process, Due to stationary drill bit no extra power drive was needed so its experimental setup was simple and robust in infrastructure. The abrasive laden media pass through a circular space between work piece and drill bit. It was recorded 78.89% contribution of drill bit in the total Machining process increase the material removal by factor 2.66 than the basic Abrasive Flow Machining (AFM) process and 70.53% contribution of drill bit in percentage improvement in ΔR_a.Three star helical abrasive flow machining for ductile materials in which three star drill bit is placed coaxially inside the hollow cylindrical work piece to produce centrifugal force by providing curvature in path of abrasive laden media to flow along the flute for better material removal rate.it It were recorded extrusion pressure has 20.43% contribute, number of cycle has 26.9% contribute and process parameter with contribution of 29.57% for response parameters of MR**.** Electro-chemical Assisted Abrasive Flow (ECAFM) for fine finishing of flat surfacesElectro-chemical Aided Abrasive Flow Machining (ECA^2FM) process for internal holes and recesses in this ECA^2FM process Nylon Fixture was used to hold the conducting cylindrical work

piece made as an anode and coaxial Copper electrode made as Cathode in the work piece. Anodes lose the metal to cathode. The principle of electrolysis is used with combination with Mechanical impact of Abrasive particles with work piece for better surface finish and higher material removal rate. Media used for investigation consist of silicon base polymer, hydrocarbon gel and AL_2O_3 Abrasive particle with NaI salt, grit size 600 has been used. It is very suitable for thin and delicate parts because electrochemical action can be operated at low pressure.

CONCLUSION

The research reports of various researchers point out that they do not end out towards common effects of some of variables on the research parameters.Some rigid but narrow parts need very low pressure to avoid their breakage. Hybridization of Helical Abrasive Flow Machining (HAFM) process can be used in such cases.There is lack in fitting the ingredients and adequate theory, satisfactory models about the process mechanism.It requires the development of new processes because of the limitation of traditional processes not being able to correct the geometrical shape of existing processes.Hybridization of Helical abrasive flow machining (HLX-AFM) process with magnetic finishing process has not been carried out by any researcher.

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