Review Article

ABRASIVE JET MACHINING- RESEARCH REVIEW

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ABSTRACT

Abrasive jet machining is an effective machining process for processing a variety of Hard and Brittle Material. And has various distinct advantages over the other non-traditional cutting technologies, such as, high machining versatility, minimum stresses on the work piece, high flexibility no thermal distortion, and small cutting forces. This paper presents an extensive review of the current state of research and development tin the abrasive jet machining process. Further challenges and scope of future development in abrasive jet machining are also projected. This review paper will help researchers, manufacturers and policy makers widely.

KEY WORDS:versatility, flexibility, nontraditional.

INTRODUCTION

Abrasive jet machining (AJM) is a processing non-traditional machine which operates materials without producing shock and heat. AJM is applied for many purposes like drilling, cutting, cleaning, and etching operation. In Abrasive jet machining abrasive particles are made to impinge on the work material at high velocity. A jet of abrasive particles is carried by carrier gas or air. The high velocity stream of abrasives is generated by converting the pressure energy of carrier gas or air to its Kinetic energy and hence the high velocity jet. Nozzles direct abrasive jet in a controlled manner onto work material. The high velocity abrasive particles remove the material by micro-cutting action as well as brittle fracture of the work material. Machining, Drilling, Surface Finishing are the Major Processes that can be performed efficiently. The process parameters are used like variables which effect metal removal. They are carrier gas, abrasive, and velocity of abrasive, work material, and nozzle tip distance (NTD). Abrasive jet cutting is used in the cutting of materials as diverse as: Titanium, Brass, Aluminum, Stone, Any Steel, Glass, Composites etc.

BACKGROUND

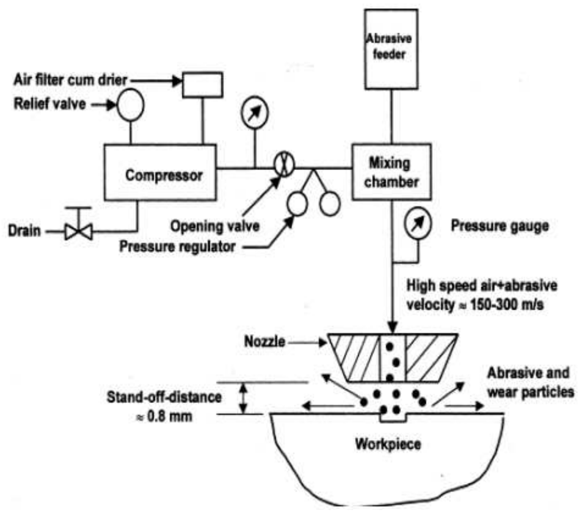

Fig 1: Schematic Diagram of AJM

This novel technology was first initiated by Franz to cut laminated paper tubes in 1968 and was first introduced as a commercial system in 1983... In the 1980s garnet abrasive was added to the water stream and the abrasive jet was born. In the early 1990s, water jet pioneer Dr. John Olsen began to explore the concept of abrasive jet cutting as a practical alternative for traditional machine shops. His end goal was to develop a system that could eliminate the noise, dust and expertise demanded by abrasive jets at that time. In the last two decades, an extensive deal of research and development in AJM is conducted.

Based on the extensive literature review of AJM Process the works on this can be classified based on the performance measure considered in to Four different categories, namely Experimental Modeling, Analytical modeling, Optimization modeling, Hybrid modeling.

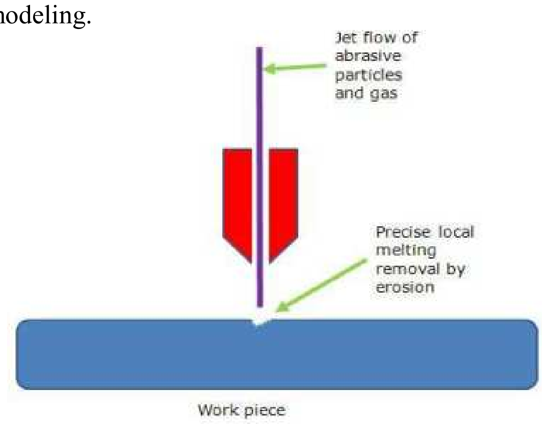

Fig 2: Metal Removal by Erosion

EXPERIMENTAL MODELLING

In this section the experimental analysis of Abrasive jet machining is discussed. The experimentations conducted by various researchers by influencing the abrasive jet machining (AJM) process parameters on material removal rate, Surface integrity, kerf are discussed. The parameters like SOD, Carrier gas, Air Pressure, Type of Abrasive, Size, Mixing Ratio etc. are focused. Various experimental models are highlighted.

Neema & Pandey (1977) proposed an equation for material removal rate by equating the kinetic energy of the particles impinging on to the work of deformation during indentation.

$$Q = k N d^3 v^{3/2}(\rho a_{/12\sigma y})$$

Where k is a constant; N is the number of abrasive particles taking quite a time; d= the size or diameter of an abrasive particle; fa= the density of the abrasive material; v= the velocity of the abrasive particle; and **σ** y, =the yield stress of the work material. [2].

Dr.A. K. Paul &P. K. Roy (1987) 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