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CONTENTS

CHAPTER ONE: Mechatronics System Design and Applications

CHAPTER TWO: Modelling and Simulation

CHAPTER THREE: Intelligent Systems

CHAPTER FOUR: Instrumentation, Dynamics and Control

CHAPTER SIX: Speech and Image processing

CHAPTER SEVEN: Robotics and Automation

CHAPTER EIGHT: MEMS and Materials

CHAPTER NINE: MEMS and Materials

CHAPTER TEN: MEMS and Materials

CHAPTER ELEVEN: MEMS and Materials

SURFACE ROUGHNESS OF CARBIDES PRODUCED BY WATER ABRASIVE JET MACHINING

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ABSTRACT

Applications of high pressure water jet with and without abrasives are well known for machining of different work materials. Since water is a soft material, it gives a smooth and clean cut without any heat affected zone. It is especially suitable for fibrous composites which cannot be machined by conventional techniques due to fiber pull-out. A lot of investigations have been carried out on machining of brittle materials like glass and ceramics by abrasive water jet that cannot be machined by conventional techniques. This paper presents the effect of jet pressure, abrasive flow rate and work feed rate on smoothness of the surface produced by abrasive water jet machining of carbide of grade P25. Carbide of grade P25 is very hard and cannot be machined by conventional techniques. Cutting was performed on a water jet machine model WJ 4080. The abrasive used in investigations was garnet of mesh size 80. It was tried to cut carbide with low and medium level of abrasive flow rate, but the jet failed to cut carbide since it is too hard and very high level of energy is required. Minimum rate of abrasive flow that made it possible to cut carbide efficiently was 135 g/min. It was found from the investigation that with increase in jet pressure the surface becomes smoother due to higher kinetic energy of the abrasives. But the surface near the jet entrance is smoother and the surface gradually becomes rougher downwards and is the roughest near the jet exit. Increase in abrasive flow rate also makes the surface smoother which is due to the availability of higher number of cutting edges per unit area per unit time. Feed rate didn't show significant influence on the machined surface, but it was found that the surface roughness increases drastically near the jet entrance.

1. INTRODUCTION

Carbides are well known for their high wear resistance and hardness, especially hot hardness. Due to these properties they have gained popularity as a tool material. They are extensively used for making dies and cutting tools. Hardened materials as well as difficult-to-machine materials can be machined by carbides. These carbides, made by powder metallurgy are difficult to machine by conventional techniques due to their high hardness. In order to cut carbide, first a fracture is to be developed. A fracture can be developed in the material if the force applied is more than the inter-granular bonding force. It was suggested that inter-granular fracture dominates the material removal at perpendicular impact angles [1, 2]. Guinot [3] and Magnnsson [4] also worked on force parameters involved in abrasive water jet machining. In the present work an attempt has been made to machine carbides with high pressure water jet. Carbide is a brittle material, but water is a soft material and produces a smooth surface. Again, since water jet machining is a cool machining technique without much heat generation, no metallurgical changes occur on the machined surface and the surface is almost free of residual stress [5]. It was stated by Tikhomirov [6] that material removal rate decreases almost linearly with increase in work material hardness. Since carbides are very hard materials, only high pressure water jet can be