CHAPTER - 1

GENERAL INTRODUCTION

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There has been a rapid growth in the development of harder, and difficult to machine and high strength temperature resistance *(HSTR)* materials during the last three and half decades. Modern Metallurgical engineering and material science & technology based skills and knowledge have been continuously presenting newer and larger spectrum of material having wide ranging diverse properties including increasingly higher strength - a trend distinctly departing from conventional materials with well known manageable characteristics and properties particularly in the realm of manufacturing strategy selection.

In fact, with the development of such new high strength material, it becomes imperative to develop further improved materials for manufacturing of cutting tools necessary for machining those developed materials by applying the conventional metal cutting based manufacturing technologies. Although different types of carbon steel were the only tool materials used till 1870, tremendous developments have taken place in the field of machining technology based manufacturing process, initiated primarily by F W Tayler leading to the development and use of High Speed Steel, cemented carbides, coated carbides and ceramics which are now used extensively in industries all over the world including ours.

But even with such a versatile and potential range of tool materials effective machining technology based manufacturing for some of the newly developed materials, which are already extensively used for the purpose of increasing life and reliability of equipment and components intended to be used and or

operated in severe adverse environmental conditions. are still out of reach. The singularly significant reason being the fact that the conventional metal cutting process demands that the tool conditions previling during such machining operations. Congrauence with such requirement would necessiate using a better *(in the aspects already mentioned)* material. Such a condition implies participation in a never ending race in which as soon as any new material is developed and used, a better material must be developed to enable cutting tools being manufactured and so on.

Therefore it is evident that some new strategies of machining must be developed and adopted in order to overcome the problems created by the development and use of the high strength temparature - resistant and hard-to-machine alloys. Consequently a set of machining strategies commonly termed as *'non-traditional machining'* processes have been developed using some scientific principle already establised. Such processes were also found to be effective in producing complex profiles on hard to machine and brittle material. These technologies are also known as New Technology. Table 1.1 (page-4) gives a classification of the machining processes based on the type of energy used, the mechanism of metal removal, the source of energy requirements etc.

These nontraditional manufacturing processes can be classified into various groups according to the following basic charecteristics :

i) Types of energy required, namely, mechanical, electrical, chemical etc.

ii) Basic mechanism involved in the processes, like erosin, ionic

disolution, vaporisation etc.

iii) Source of energy required for material removal, namely, hydrostatic pressure, high current density, high voltage etc.

iv) Medium of transfer of these energies like high velocity particles, electrolyte, electron, hot gases etc.

To cope with fast changing machining technology and the difficulties caused by the development of hard-to-machine and high-strength-temperature resistant alloys, one of the various non-traditional techniques of machining is Electrical Discharge Machining.

TABLE 1.1

CLASSIFICATION OF MODERN MACHINING PROCESSES

Type of energy	Mechanism of metal removal	Transfer media	Energy source	Processes
Mechanical	Erosion	High velocity particles	Peneumatic/ hydraulic pressure	AJM, USM, WJM.
	Shear	Physical contact	Cutting tool	Convention-al machining
Electro chimical	Ion displacement	Electrolyte	High current	ECM, ECG
Chemical	Ablative relation	Reactive enviornment	Corrosive agent	CHM
Thermoelectric	Fusion	Hot gasses	Ionized material	IBM, PAM
		* Electrons	* High voltage	* EDM
	Vapourisation	Radiation	Amplified light	LBM
		Ion stream	Ionized material	PAM

NOTE

AJM- Abrasive Jet Machining
USM- Ultrasonic Machining
WJM- Water Jet Machining
ECM- Electro-chemical Machining
ECG- Electro-chemical Grinding
CHM- Chemical Machining
IBM- Ion Beam Machining
PAM- Plasma Arc Machining
EDM- Electric Discharge Machining
LBM- Laser Beam Machining