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A study on Non-Conventional Machining Processes

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Abstract – In the era of globalization, it is essential to produce components with precision. In order to meet these requirements, new technologies are evolving. One of such technology is non- conventional machining methods. This paper intends to study non-conventional machining process in a lucid manner for better understanding of diploma level students. This paper gives an overall idea about various non-conventional machining processes it's principle of working with sketches.

Key Words: Non-conventional machining, conventional machining, Ultrasonic machining, Chemical machining, Electro-chemical machining, Electro-chemical grinding, electric discharge machining, plasma gas machining, laser beam machining

1.Introduction

The hard materials like Titanium alloys can not be machined using conventional machining process like turning, milling. Intricate and complex shapes can not be machined using conventional machining process. Hence it is necessary to employ non-conventional machining methodologies for machining the hard alloys. In this paper various non-conventional machining methods are studied in a bird's eye view.

1.1 Various non-conventional machining processes

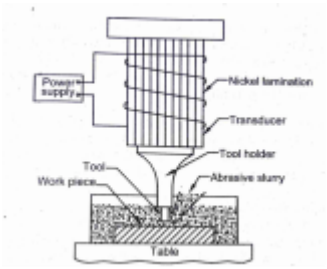
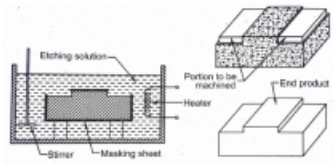
The non-conventional machining processes are listed below

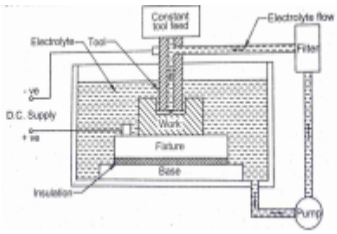
- Ultrasonic machining
- Chemical machining
- Electro-chemical machining
- Electro-chemical grinding
- Electric discharge machining
- Plasma gas machining
- Laser beam machining

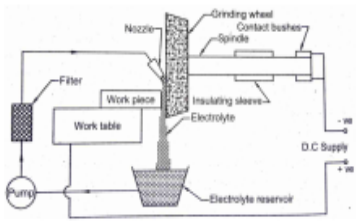
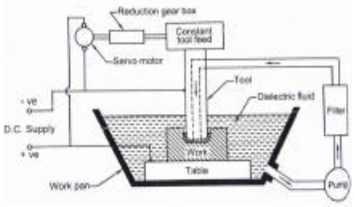
2. A comparative study of all non-conventional machining processes

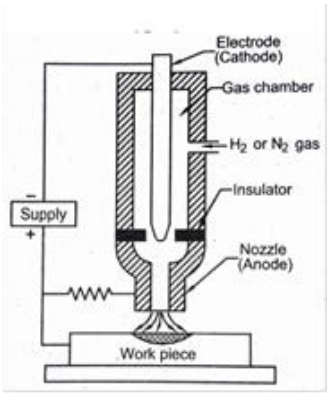
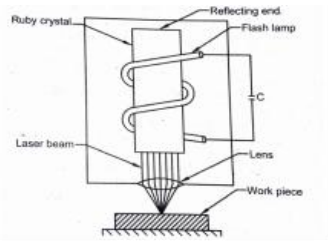
For easy understanding, non-conventional machining processes are compared in table-1

Table-1 comparative study of non-conventional machining processes

Non-conventional machining process	Theory
Ultrasonic machining 	This Consists of generator, amplifier, oscillator, transducer and tool. The generator generates low frequency electricity to high frequency and feeds oscillator and it is transferred to transducer. The transducer converts it to mechanical vibrations, which is used for machining. An abrasive slurry is used. Application: For machining ➢ Carbide ➢ Tungsten ➢ Wire drawing dies
Chemical machining 	This is the process in which machining is done using chemical action. This process consists of 4 stages ➢ Cleaning ➢ Masking ➢ Etching ➢ De-masking This is explained below • Cleaning of workpiece. • Covering the areas not to be machined. • Etchants in hot condition are used , which erodes the metal in non-masked

	area and dissolves as salt. • Removal of mask and cleaning. Application: For machining ➢ Curved and complex shapes ➢ Thin materials
Non-conventional machining process	**Theory**
Electro-chemical machining 	In This process, metal is removed from the workpiece in the form of electrons due to the action of electricity and electrolyte. When electric supply is given, the electrons are released from metal workpiece and are flushed by electrolyte. This process is opposite to electroplating. Key points: Supply-DC workpiece – positive Tool- negative Clearance gap between tool and work piece 0.2 mm which is controlled and adjusted automatically. Application: For machining ➢ Gas turbine blade ➢ Aircraft components ➢ For hard materials ➢ For intricate and complex components
Electro-chemical grinding	In this process, the metal is removed by abrasive action of grinding wheel along with an electrolyte. A grinding wheel with hard abrasive materials and mounted on a horizontal spindle. During

	machining, a abrasive jet of electrolyte for example sodium chloride or sodium nitrate with water is directed on the machining area. Workpiece acts as negative terminal and tool grinding wheel as positive terminal in DC supply. Application: For machining ➢ Tungsten carbide tipped tools. ➢ Very thin and hard materials ➢ Refractory materials
Non-conventional machining process	**Theory**
Electrical discharge machining 	The principle of this process is removal of metal by erosion caused due to the spark generated between tool and workpiece. A DC supply is used in which , workpiece acts positive terminal and tool acts negative terminal. The tool is made of copper , brass , tungsten with a narrow passage inside through an electrolyte is supplied. The gap between tool and workpiece is about 0.005 mm. As supply is given, a spark is generated between tool and workpiece which melts the metal and due to the action of electrolyte, the metal is removed as particles by erosion. Application: For machining ➢ Holes in nozzles ➢ Hard materials ➢ Complex shaapes
Plasma arc machining	An inert gas which is heated to very high temperature, it gets ionized. This ionized gas is called plasma.

	Machining takes place with the help of plasma is called plasma arc machining. A tungsten electrode acts as negative is enclosed in a chamber, in which inert gas like helium or argon is supplied and pass through nozzle. The workpiece is given positive terminal. When supply is given, an arc is formed between electrode and workpiece and the temperature is about 1200 degree Celsius. This temperature ionize the gas and it becomes plasma. As this plasma is directed on workpiece, machining is done. Application: For machining ➢ Stainless steel and aluminum alloys ➢ Super alloys
Laser beam machining 	LASER- Light Amplification by Stimulated Emission of Radiation. In this a laser beam is generated by using a flash lamp containing xenon gas and ruby crystal. The generated LASER beam is converged using a lense and machining is done. Application: ➢ To make very small holes ➢ Medical surgery.

3. CONCLUSIONS

This paper explains about various non- conventional machining processes with their working principle , application ,along with line sketches. This paper gives a birds eye view of various non-conventional machining processes, which will be an eye opener for diploma students for their better learning and understanding.

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