

Non-Traditional Machining Techniques in Manufacturing Industries – An Overview

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Abstract. This comprehensive study provides an in-depth analysis of non-traditional machining techniques in the manufacturing industry. Focusing on mechanical, electrochemical, chemical, and thermal machining processes, the research explores recent advancements and their implications. The study adopts the action research method to gain a deeper understanding of the challenges associated with these techniques. Through a thorough examination of the machining processes, this work delves into various concepts, including the operations involved in each process and their corresponding outcomes. The analysis sheds light on the significance of non-traditional machining in the manufacturing industry, highlighting its potential for producing complex components and meeting design requirements that traditional machining methods may struggle to achieve. By exploring recent developments in non-traditional machining, this study aims to provide an overview of the advancements made in this field. It emphasizes the importance of understanding these techniques to unlock their full potential and enhance manufacturing capabilities. The findings of this research contribute to the existing knowledge base and serve as a valuable resource for professionals and researchers in the field of non-traditional machining.

1 Introduction

In ancient times, during the early stages of human civilization, tools were crafted primarily using stones. However, as time progressed, mankind made significant advancements in materials technology, leading to the discovery and utilization of other substances, such as iron [1], [2]. Fast forward to the present day, material products manufactured in the 20th century have evolved to become highly durable and sophisticated. As a result, a majority of these materials have become non-machinable, posing a challenge to the manufacturing industries. To address this challenge, the industry turned towards the development and implementation of advanced materials such as alloy steel, carbide, ceramics, and diamond as cutting tools [3]. These materials possess unique properties that make them suitable for working with non-machinable substances. Alloy steel, for instance, is a combination of different metals, resulting in enhanced strength and resistance to wear. Carbide, composed of carbon and a metal such as tungsten, offers exceptional hardness and durability. Ceramics and diamond, known for their extreme hardness, provide excellent performance when used as cutting tools. The inability to machine these modern materials presents a hurdle for manufacturing industries [4]. Traditional machining techniques, such as cutting, drilling, and grinding, may not be effective or feasible for these advanced materials. As a result, innovative manufacturing processes, such as electrical discharge machining (EDM), laser cutting, and abrasive waterjet cutting, have been developed to overcome this challenge [5]. These techniques utilize the unique properties of these materials and employ controlled energy sources to shape, cut, or form them precisely. Overall, the fundamental difference between conventional and non-traditional machining lies in the approach to material removal. While traditional machining relies on the application of sharp tools for plastic deformation, non-traditional machining encompasses a range of energy-based methods that allow for the machining of advanced materials, complex geometries, and achieving superior surface finishes and accuracies [6]. Figure 1 illustrates some of the tools that were

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