Chapter 1
A Brief Review of Engineering Materials in Industrial Applications

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ABSTRACT

In many different industrial applications, engineering materials are essential. Because of their vital mechanical and structural qualities, metals including titanium, steel, and aluminum are used. For a variety of goods, polymers provide processing simplicity and diversity. For demanding applications, ceramics offer wear resistance and stability at high temperatures. For high-performance applications, composites combine the greatest qualities of the materials that make up its constituents. Progress in material science keeps pushing the envelope of what's feasible, resulting in enhanced efficiency, lower expenses, and novel uses. It is crucial for engineers and designers to comprehend the characteristics and uses of these materials in order to choose the best material for every application and guarantee lifetime and peak performance. The development of engineering materials is essential to the progress of industry and technology. The current chapter discusses examines many engineering material groups and their uses in industry.

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1. INTRODUCTION

The field of materials science and engineering, or MSE, is perhaps the most significant in engineering. Entire periods are named after materials, demonstrating their eternal significance to the advancement of civilization. Following the evolution of the Stone, Bronze, and Iron Ages, we now find ourselves in the contemporary age with many customized materials available for usage. In actuality, we are in the Materials Age. The engineer may have access to over 50,000 different materials. How is the engineer to select the material that best fits the purpose from such a large menu while creating a structure or device? Errors can result in catastrophes [1]. A particular kind of welded commerce ship experienced severe damage during the Second World War, losses occurred from splitting in half at sea rather than from enemy assault because the steel's fracture toughness—and especially the welds'—was too poor. In more modern times, three Comet aircraft were destroyed before it was discovered that the material's fatigue strength was insufficient given the design of the window frames [2]. You are probably already aware of poorly designed plastic appliances, whose excessive “give” results in the designer's failure to account for the low modulus of the material. Together with other typical classes of property that the designer has to take into account when selecting a material, these bulk attributes are presented in Table 1. They are the cornerstone of this materials-based course. We also come across the material classifications depicted in Figure 1 and Table 2. Metals and alloys are used in the construction of more technical components than any other class of solid. However, metals are gradually being replaced by polymers because they provide a set of attributes that the designer finds more appealing [3]. Additionally, if we keep track around, you're probably aware that novel ceramics are a class of technical materials that are now being developed globally and have the potential to enable bearings with reduced friction, sharper knives, and heat engines that operate more efficiently. The engineer materials can combine the greatest qualities of these to create composites, of which fiberglass is the most well-known [4]. Engineering materials are vast and continually expanding, driven by the need for materials with specific properties to meet the demands of various industries. From traditional metals and polymers to advanced nano-materials and smart materials, the field of engineering materials is crucial for technological advancements and innovation in multiple sectors [5].

Table 1 below gives a clear idea of attributes & properties closely related from an engineering materials point of view. Composites provide particularly alluring sets of features. And lastly, natural materials like wood and leather offer qualities that are hard to match even with the advancements made by modern materials scientists. As such, one should not discount them.

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