Chapter 1
Introduction

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In the modern engineering, the pursuit of innovative and sustainable materials has taken center stage. In this context, cork has emerged as a remarkable contender in revolutionizing engineering applications. In an era where environmental concerns drive technological advancements, cork-based materials emerge as an exemplar of sustainability. Cork, sourced from the bark of the cork oak tree, boasts inherent eco-friendliness, renewability, and biodegradability. By harnessing the potential of this naturally abundant resource, engineers and researchers are paving the way for a greener future.

Cork is a natural material derived from the bark of the cork oak tree (*Quercus suber L.*), primarily found in Mediterranean regions such as Portugal, Spain, and North Africa. It is renowned for its unique cellular structure, composed of microscopic air-filled pockets surrounded by a matrix of suberin, a waxy substance that renders cork impermeable to liquids and gases. This structure gives cork its exceptional properties, making it lightweight, flexible, buoyant, and highly compressible [1].

In recent years, cork has transitioned from its traditional roles as a bottle stopper and bulletin board material to a versatile and sustainable solution in various engineering applications. The distinct attributes of cork make it a valuable contender for addressing multiple challenges across different engineering fields such as thermal insulation, acoustic insulation, vibration isolation, energy attenuation, shock absorbing, and impact protection. The trapped air pockets in cellular structure of cork provide excellent thermal insulation. It is utilized in construction materials, walls, floors, and roofs to maintain indoor temperatures and enhance energy efficiency [2]. Similar to thermal insulation properties, sound-absorbing properties of cork stem from air content in the structure, resulting in its ability to reduce noise transmission

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[3]. It finds use in spaces where noise control is essential such as theaters, recording studios, and residential buildings. Accordingly, flexibility and compressibility of cork make it effective in absorbing vibrations, reducing the impact of vibrations caused by machinery, equipment, and transportation on nearby structures [4]. On the other hand, the cushioning and shock-absorbing properties of cork make it valuable in absorbing and dissipating energy, preventing damage and reducing risks in various applications, including packaging, transportation, and sports equipment [5]. Resilience and impact resistance in cork contribute to its effectiveness in shock-absorbing applications, such as in footwear, sporting gear, and automotive components. The combination of lightweight nature and its ability to absorb energy makes it useful in designing impact-resistant materials for safety equipment and protective structures [6].

This book takes a holistic approach to address a spectrum of engineering challenges. Whether it is enhancing energy efficiency through superior thermal insulation, creating serene environments via effective acoustic insulation, or improving structural integrity by minimizing vibrations and shocks, cork-based solutions offer a fresh paradigm for eco-friendly and sustainable engineering solutions.

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