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Noise Suppression Via Composite Polymeric Membranes Derived from Agricultural Wastes: A Mini Reviews

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Thana Chotchuangchutchaval*

Center of Sustainable and Energy Engineering Materials, Department of Mechanical Engineering Technology, College of Industrial Technology, King Mongkut's University of Technology North Bangkok, Thailand

***Corresponding author:** Thana Chotchuangchutchaval, Center of Sustainable and Energy Engineering Materials, Department of Mechanical Engineering Technology, College of Industrial Technology, King Mongkut's University of Technology North Bangkok, Bangkok 10800, Thailand

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Abstract

Sound absorption material are mostly porous in nature, light weight, contain low thermal expansion coefficient and readily available. Therefore, this makes polymer most well suited to act as matrix component to form the porous noise absorption media due to its high versatility. However, its intrinsic flaws such insufficient glass transition temperature, yield strength and creep resistance still need to be reinforced. Here, the recently emerged composite polymeric membranes have been introduced to mitigate these intrinsic drawbacks as well as to further supplement the noise absorption efficiency. Toward eco-friendly plastic as well as to lessen agriculture wastes globally, many scientific researchers tried to incorporate recycled plastic and chemically treated micro/nano cellulose fibrils derived from various agriculture wastes to form composite polymeric membranes which could potentially replace pre-existing commercial noise absorption materials. In this paper, the comparison of the noise absorption efficiency along with the mechanical and thermal properties between commercial and composite polymeric membranes derived from the agriculture wastes will be made.

Keywords: Noise absorption; Composite polymeric membranes; Cellulose fibrils; Agricultural wastes

Introduction

Sound and noise are both caused by the oscillation of a transmission medium when acoustic wave travels [1-3]. Nevertheless, human brains categorize each type of incoming wave according to incoming wave amplitudes, wave patterns and frequencies. Continuously being exposed to excess noise could harm humans who are located within vicinity in more ways than one ranging from short term anxiety or permanent hearing threshold shift [4]. At present, many commercial noise pression medias are made available to reduce any noise pollution as much as possible. A summary of the commercial noise segregation materials is listed in Table 1. It is derived from the (Table 1) that there are several types of noise insulation materials that are commercially available [5,6]. The major problem remains that the degradation rates of these commercial products are too slow [7-9]. On average, only 9 % of the 9 billion tons of plastic has successfully been recycled annually [10]. When malfunction occurs during usage, these products are being replaced rather than being recycled. Should the current plastic production and waste management persist as is, approximately 12,000Mt of this waste will end up in landfills by 2050 [10]. Ultimately, recycling polymer [11-14] and nano fibrils [15-20] derived from agriculture byproducts is introduced to combat this impending crisis.

Table 1: List of commercially available material to be used as a noise suppression media [5,6].

List	Properties	Materials	Usages	References
1	Light, fuzzy and porous	Fiber glass Asbestos insulation Cellulose Foam	Depending on their intrinsic density and mechanical properties. Suitable to filter high frequency noise	[5,6]
2	Perforated	Gypsum board Bagasse Cork board	Increase surface area for sound pickup	[5,6]
3	Physical Membrane	Multilayer wall, double glazing Attaching curtains to walls/openings	Filter low frequency sound	[5,6]
4	Sheet	Cylence Zandera Sheet	Installed on the wall of the room	[5,6]
5	Sheet	Sound absorbing acoustic M board	Installed on the ceiling of the room	[5,6]
6	Sheet	Echo Bloc ceiling panels covered with fiber-type sound absorbing material	Perforated Gypsum cotton sheet	[5,6]

Composite Polymeric Membranes

Even though sound pollution could be reduced significantly when commercial noise absorption materials are to be installed near noise generator locations, numerous polymeric wastes are continuously being piled up days by days. To alleviate this issue, many researchers aim to replace existing commercial materials with polymeric media originated from agriculture byproducts [11-14]. Via proper incorporation between recycle polymeric matrix and cellulose nano fibrils, many reports that agriculturally derived composite media exhibited excellent noise segregation properties as well as high retention of thermal insulation properties and material integrities after the composite formation process [15-20]. However, excess addition of polymeric matrix could dampen mechanical properties while a surplus of the chemically treated fibrils is likely to cause phase segregation between the matrix and the fiber components [18]. To conclude, a high degree of precision is required to create polymer composite media especially when both components are derived differently depending on the primer sources.

Polymeric matrix

There are several types of polymeric material to form sound absorption media such as polyurethane, polyester, and high density polyethene etc. Here, the majority portion of these sound absorption materials are derived from thermoplastic. However, it is still preferable when polymeric primer could be recycled or reused with ease to form polymeric sound absorption scaffolds. Recently, several researchers reported the new use for polymeric matrix derived from used oil palm oil after refinement processes [11,18]. Generally, the oil refinement method involves chemical processes such as epoxidation and hydroxylation reaction to convert unwanted double bonds into desirable hydroxyl groups within the used cooking oils [11,18]. With proper polymeric refinement procedure, more used oil can be recycled, and promising green alternative materials can be realized.

Fibril materials

There are two types of fiber – 1) synthesis fiber such as glass fibers, carbon fiber and polyester 2) natural fibers such as wool, silk and cellulose fibers. Nowadays, natural fibers are growing in demand to be incorporated with polymeric matrix due to its low density, low cost, ease of availability while still retaining its high modulus strength. When degraded naturally, the residual is unharmful to the environment. In addition, cellulose fiber is found to be well suited as sound absorption material when the outer layer such as hemicellulose and lignin is being peeled from the inner cores by many researchers. Some of the examples of natural fiber that manage to help minimize noise, increase glass transition temperature as well as reinforce the composite material integrity are coconut fiber [20], bamboo fiber [15], pineapple fiber [21], hemp fiber [22], water hyacinth fiber [18] etc.

Conclusion

In this review paper, the eco-friendly methods to convert agricultural waste into composite noise suppression media are discussed. Comparatively, commercial noise isolation membranes degrade much slower and are more harmful to the world than that of naturally derived composite medias. With proper incorporation between the natural fiber and recycled polymeric matrix to from the composite media, thermal properties, noise segregation properties as well as mechanical properties are optimized. Regardless, precise care is needed during the composite formation process due to a highly complex interaction between polymeric and fiber components.

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