The influence of alkaline treatment on acoustical, morphological, tensile and thermal properties of Kenaf natural fibers

Article *in* Journal of Industrial Textiles · July 2020

DOI: 10.1177/1528083720944240

CITATIONS
0

READS
29

7 authors, including:

Seyed Ehsan Samaei
Tarbiat Modares University
32 PUBLICATIONS **92** CITATIONS
SEE PROFILE

Ali Khavanin
Tarbiat Modares University
121 PUBLICATIONS **1,066** CITATIONS
SEE PROFILE

Mohammad Faridan
Lorestan University of Medical Sciences
26 PUBLICATIONS **118** CITATIONS
SEE PROFILE

Ebrahim Taban
Tarbiat Modares University
31 PUBLICATIONS **148** CITATIONS
SEE PROFILE

Article

Journal of Industrial Textiles

0(0) 1–25

DOI: 10.1177/1528083720944240
journals.sagepub.com/home/jit
SAGE

The influence of alkaline treatment on acoustical, morphological, tensile and thermal properties of Kenaf natural fibers

Seyed Ehsan Samaei[1], Hasan Asilian Mahabadi[1], Seyyed Mohammad Mousavi[2], Ali Khavanin[1], Mohammad Faridan[3] and Ebrahim Taban[4]

Abstract

Among fibers with lignocellulosic origin, Kenaf fiber, because of its advantages and as a sustainable alternative to synthetic fibers has received increasing attention for manufacturing hybrid composites with reasonable acoustical and physical properties. The present study deals with the impact of chemical treatment of Kenaf fibers on the overall properties of hybrid composites fabricated from these fibers. Also, the results from predictive analytical model of sound absorption for these composites were employed for comparison with the experimental findings. Kenaf fibers were treated at room temperature with 6% concentration of sodium hydroxide (NaOH) and 4 h immersion time. Having manufactured the composites with the treated and untreated fibers, the normal sound absorption coefficients and tensile strength properties of

[1]Department of Occupational Health Engineering, Faculty of Medical Sciences, Trabiat Modares University, Tehran, Iran
[2]Biotechnology Group, Chemical Engineering Department, Tarbiat Modares University, Tehran, Iran
[3]Department of Occupational Health and Safety at Work Engineering, School of Health and Nutrition, Nutritional Health Research Center, Lorestan University of Medical Sciences, Khorramabad, Iran
[4]Department of Occupational Health Engineering, Faculty of Health, Mashhad University of Medical Sciences, Mashhad, Iran

Corresponding author:
Hassan Asilian Mahabadi, Department of Occupational Health Engineering, Faculty of Medical Sciences, Trabiat Modares University, Tehran, Iran.
Email: asilia_h@modares.ac.ir

these sample composites were determined according to ISO 10534-2 and ASTM C1557 – 14, respectively. The SEM analysis of the treated and untreated fibers revealed that in terms of fiber diameter and morphology the former was thinner and had better surface appearance. The experimental measurement of acoustic absorption coefficients of the composites made of treated fibers demonstrated superior sound absorption properties and tensile strength. The revised empirical models proposed by Delany & Bazley and Garai & Pompoli along with Nelder-Mead simplex method were employed and well predicted the sound absorption coefficients of the sample composites. There was also a fair consistency between the experimental and predicted results.

Keywords
surface modification, sound absorption coefficient, Young's modulus, natural fiber, composite

Introduction

Exposure to the higher levels of noise will contribute to physical and psychological health consequences and affect normal performance as well as quality of life [1]. However, several engineering approaches such as soundproofing techniques have been taken to reduce the noise levels and improve the quality of sound within a room [2]. Today, absorption of sound energy by porous/fibrous synthetic materials (such as glass wool, rock wool, polyester, polyurethane, etc.) is one of the well-established conventional strategies for sound proofing and noise control purposes worldwide [3]. The widespread manufacturing and use of these fibers, however, has been reported to be a source of air pollution and the major cause of skin irritation and eye and lung disorders [4]. The increasing awareness about the adverse health effects and environmental impacts associated with these nonrecyclable materials, has turned the focus of researchers on the use of sustainable eco-friendly natural fibers [3,5].

Natural sound absorbing materials have several considerable attributes such as good mechanical properties, high stability, easy processing, low price, abundance and availability, reduced fogging behavior, lower health problems and minimal occupational and environmental impacts during manufacturing, which have made them to be potential alternative for the synthetic sound absorbers [6,7].

Referring to such advantages, fibers with natural origin have received increasing attention for acoustic absorption purposes and research on the replacement of conventional absorbers with the "green" and sustainable ones has been widely considered by many researchers [4,8]. For instance, The sample of the study taken from Berardi and Iannace [8] in 2015 on acoustic properties of natural fibers of Kenaf showed that increasing the density from $50\,kg/m^3$ to $100\,kg/m^3$ increased the absorption coefficient up to 0.94 in the frequency band of 2000 Hz.