Sound absorption evaluation and analysis of different hemp fiber types

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Hemp fiber, as a sound-absorbing material, is a good alternative to mineral wools.

– The sound absorption coefficient reaches up to 0.99 at medium and high frequencies.

– Peaks in the sound absorption coefficient of 0.96-0.99 were achieved when testing fibers with densities of 50, 100, and 150 kg/m^3.

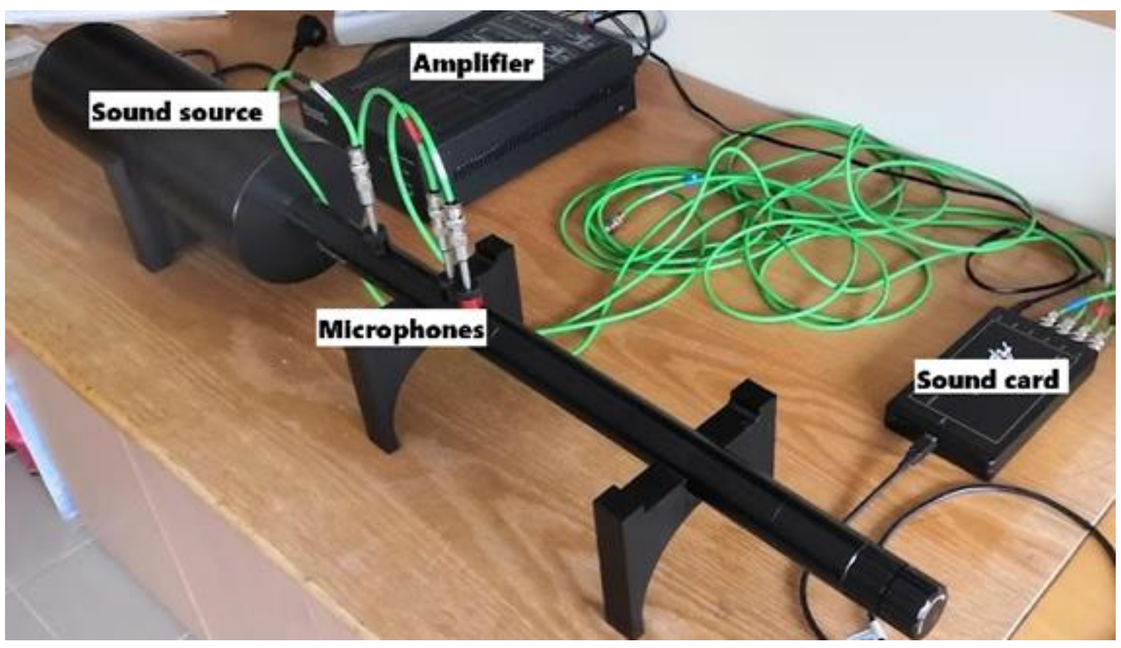
– Increasing the thickness of the hemp fiber sample increases sound absorption at lower frequencies. Sound absorption at lower frequencies also generally increases when using denser fibers.

Introduction

In recent years, the global conversation surrounding sustainable practices and environmentally friendly alternatives has gained significant momentum. Hemp fiber presents a compelling alternative to conventional sound-absorbing materials, such as fiberglass, foam, and mineral wool. Hemp fiber offers a plethora of positive environmental aspects from mitigating deforestation to reducing carbon emissions. In this study, six different types of hemp fiber samples were tested: Bleached hemp fiber (BHF), Cottonized hemp fiber (CHF), Boiled Cottonized hemp fiber (BCHF), Decorticated well stripped hemp fiber (DWSHF), Decorticated short, not combed hemp fiber (DSNCHF) and Decorticated short hemp fiber with 40% hurds (DSHFH). The hemp fiber samples were changed in thickness of 20, 40, 60 mm and density from 50 to 250 kg/m^3 in steps of 50 kg/m^3.

Methodology

The sound absorption was measured using the impedance tube, transfer function method in accordance with ISO 10534-2 standard.



The absorption ratio of a material is the inverse of the reflection ratio:

$$\alpha = 1 - |R|^2.$$

Results

Thickness, mm	Density, kg/m^3	Frequency, Hz	Sound absorption coefficient
DSHFH			
20 mm	150	2500	0,98
40 mm	150; 100	1250; 5000	0,97; 0,98
60 mm	100	1000; 3150	0,99; 98
CHF			
20 mm	100	3150	0,98
40 mm	100	1600; 5000	0,98; 0,97
60 mm	50	1250; 4000	0,99; 0,99
BCHF			
20 mm	50, 100	2500; 4000	0,96; 0,97
40 mm	50	1600; 5000	0,99; 0,99
60 mm	50	1250; 3150	0,98; 0,99
DSNCHF			
20 mm	200; 250	2500; 3150	0,98; 0,99
40 mm	150	1600; 5000	0,99; 0,99
60 mm	150	1000; 3150	0,99; 0,98
BHF			
20 mm	100	3150	0,99
40 mm	100	1600; 5000	0,99; 0,98
60 mm	50	1250; 4000	0,98; 0,96
DWSHF			
20 mm	150	3150	0,99
40 mm	100	1600; 5000	0,97; 0,96
60 mm	100	1000; 3150	0,99; 0,98