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Research Article

ENVIRONMENTAL FRIENDLY ACOUSTIC NON WOVEN MATERIALS FROM SANSIVERIA AND ARECA HUSK FIBRES FOR HYGIENE LIVING

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ABSTRACT

An environmental friendly non woven fabric was developed by needle punching technique using sansiveria and areca husk fibres at constant punch density (200). The influence of fibre content of sansiveria and areca husk fibres (100:0, 70:30, 50:50, 30:70 and 0:100) on tensile, thermal conductivity, air permeability and sound absorption properties of the needle punched non woven fabrics were investigated. It is found that the tensile strength of areca husk non woven fabric has shown higher tensile strength of 8.42 N and 32.20 N respectively in machine and transverse directions. The sansiveria non woven fabric has given higher thermal conductivity and air permeabiliy. Highest sound absorption coefficient of 0.08 is obtained at higher frequencies. The non woven fabric developed in this work can be used as a sound insulation material for health care applications.

Keywords: Sansiveria, areca, non woven fabric, needle punching, acoustics

INTRODUCTION

Noise pollution is one of the biggest threats for healthier living of human beings in the current scenario. Because, it causes great health hazards on human beings namely deafness, nervous disorder, disturbance to sleep, impairment of efficiency, obstacles to leisure activities, sensitivity to subjective noise, as well as noise load etc[1]. The general measure to control the noise is to utilize the suitable shielding materials or sound absorbing materials. These materials are used as inner lining materials in apartments, automotives, aircrafts which helps to reduce the reverberant noise[2].

Non wovens are high tech, engineered fabrics made by bonding the fibres together. They are used in wide range of technical applications such as geo textiles, medical & health care, agriculture & horticulture, filteration, automobiles etc. Non woven materials are highly preferred in civil and automobile industries due to its high sound absorption properties[3]. Several fibres from natural sources such as jute, coir, wool, sisal etc are used in non woven fabrics as porous sound absorbing materials.

Areca fibres belong to the species Areca catechu L., under the family Palmecea and originated in the Malaya Peninsular, East India[4]. Areca cultivation is coming up in a large scale basis in India. The average filament length (4 cm) of the areca husk fiber is too short compared to other bio fibers[5]. Sansiveria cylindrica is a wild plant found in the various parts of tropical Africa and Asia[6]. These fibres have very good potential to utilize in material science.

Hence in this study, non woven fabric is developed in needle punching technique using snsiveria and areca husk fibres. The tensile, thermal conductivity, air permeability and sound absorption properties of the sansiveria and areca husk fibre non woven fabrics are investigated by changing the fibre content.

MATERIALS AND METHODS

Sansiveria and areca husk fibres was used for the fabrication of needle punched non woven fabrics. The sansiveria cylindrica leaves and areca husk was collected from the farms around the city of Coimbatore and perur, India respectively. The sansiveria fibres were extracted using mechanical decortication[7]. The fibres were cut into 3 inches length manually. The areca fibres were dried in sunlight and immersed in water for 2 days for loosening the fibre. Then the loosen fibres were collected and dried[8]. The physical properties of the fibres are given in Table 1.

Table 1. Physical properties of fibres

Fiber	Sansiveria	Areca husk
Staple Length (cm)	7.6	4
Strength	65 g	14200 MPa
Elongation (%)	1.7	3
Density (g/m^3)	1.2	0.9

Preparation of non woven web

Cleaning of sansiveria and areca husk fibres was carried out in a lab model cleaning machine to remove the natural impurities present in the fibres. The fibres were blended in lab model blending machine at different blend ratios such as 100:0, 70:30, 50:50, 30:70 and 0:100 of sansiveria and areca husk fibres. Non woven webs were made in TRY TEX carding machine to convert into fibre web. The web was carded four times to improve its uniformity[9-12]. Six webs were superimposed one above the other to maintain the required weight in the non woven fabric.

Needle punching of fibre web

Figure 1. Needle punching of non woven web

Needle punching was carried out in Dilo needle punching machine having a working width of 8000-10000 needles per metre. Constant punching density of 200 was maintained for all the samples. The machine speed was maintained at 257 strokes/min and penetration depth of 11mm for barbed needle was maintained constantly for all the webs. The needle punching of non woven web is given in Figure1.

Measurement of tensile properties

The tensile strength of the needle punched non woven fabrics were evaluated as per ASTM D 2832 in Universal tensile strength tester at a cross head speed of 50 mm/min with a sample of size 50 mm. 10 samples were tested and the average values were taken.

Measurement of Thermal conductivity and Air permeability

The thermal conductivity of the non woven fabrics was evaluated as per ISO 8301 in thermal conductivity tester. The air permeability is measured as per ASTM D737-75.

Measurement of Sound absorption coefficient

The sound absorption coefficient of the non woven fabrics were measured using Impedance tube method as per ASTM E1050.

Scanning electron microscopy

SEM images of the needle punched non woven fabrics were taken using the ZEISS under 150 X.

RESULTS AND DISCUSSION

The physical and tensile properties of the sansiveria and areca husk non woven fabrics are given in Table.2. The variation in the weight and thickness of the non woven fabrics are due to the variation in the physical properties of the fibres.

Table 2. Physical and tensile properties of non woven fabrics

Sample ID	Sansiveria: Areca husk	Weight (g/m^2)	Thickness (mm)	Tensile strength in Machine Direction (N)	Tensile strength in Transverse Direction (N)
SA1	100:0	216	3.87	1.42	22.12
SA2	70:30	210	3.58	1.08	19.80
SA3	50:50	212	3.52	0.98	21.72
SA4	30:70	208	3.44	3.44	27.46
SA5	0:100	200	3.20	8.42	32.20

Effect of blend ratio on tensile properties

The tensile properties of the non woven fabrics SA1, SA2, SA3, SA4 and SA5 with a needle punching density of 200 in the machine direction and transverse direction are given in Table 2. It is found from the results that the tensile strength of the non woven fabric is higher in transverse direction when compared to machine direction. The non woven fabric SA5 has given highest tensile strength of 8.42 N and 32.20 N respectively in machine and transverse direction. This is due to the better adhesion between the areca husk fibres than the sansiveria fibres. The areca husk fibres are finer when compared to sansiveria fibres. It is also evident from the SEM images in Figure 2 that better adhesion is achieved in the naon woven fabric in sample SA5.Non woven fabric samples SA2 and SA1 have given lowest tensile strength in both the directions when compared to other samples.

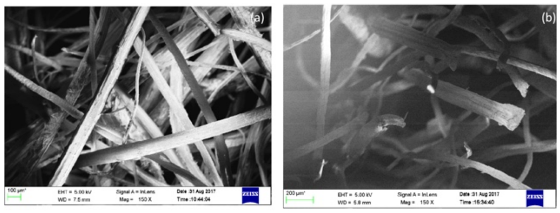

Figure 2. SEM images of needle punched non woven fabrics (a) SA 5 (b) SA1

Effect of blend ratio on thermal conductivity and air permeability

The thermal conductivity of the sansiveria and areca husk fibre needle punched non woven fabrics is depicted in Figure 3. It is observed from the results that SA1 sample has shown higher thermal conductivity of 0.051769 W/m.K where as sample SA5 shows lowest thermal conductivity of 0.032256 W/m.K. It is also found that a decrement in the value thermal conductivity due to increase in the areca husk fibre content in the non woven fabric. This may be due to the lowest thermal conductivity of areca husk fibre than sansiveria fibre which is given in Table. 1.

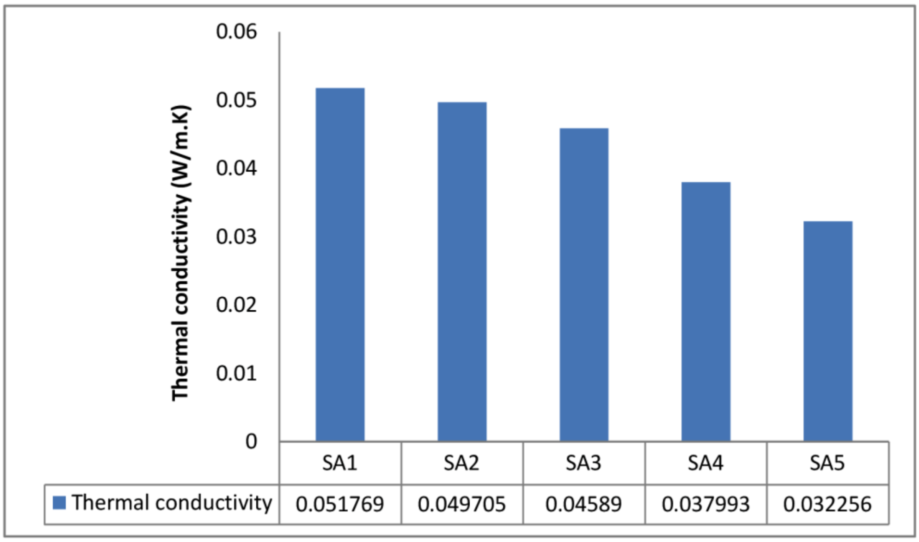

Figure 3. Thermal conductivity of needle punched non woven fabrics

The air permeability of the sansiveria and areca husk fibre needle punched non woven fabrics is shown in Figure. 4. Highest air permeability rate of 138.05 $cm^3/sec/cm^2$ is obtained in the sample SA1 followed by 121.94, 110, 87.5 and 68.33 $cm^3/sec/cm^2$ for the samples SA2, SA3, SA4 and SA5 respectively. The sample SA5 has shown low air permeability when compared to other samples. The areca husk fibres are finer than sansiveria fibres which lead to more number of fibres in a particular area of cross section of the non woven fabric. This is clearly seen in the SEM images in Figure 4. Further, it is also found that increase in the areca husk fibres in the non woven fabric reduces the air permeability property of the non woven fabrics.

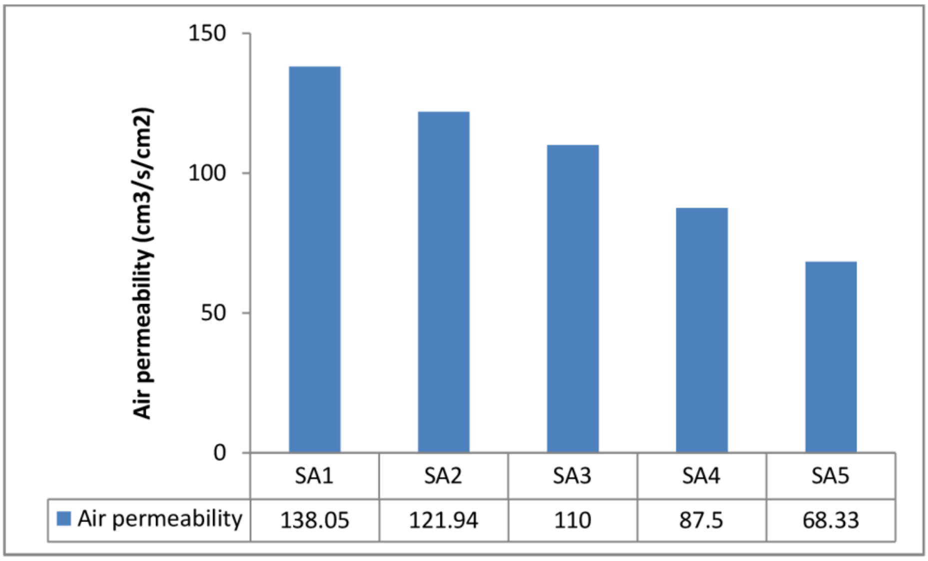

Figure 4. Air permeability of needle punched non woven fabrics

Effect of blend ratio on Sound absorption property

The sound absorption of the of the sansiveria and areca husk fibre needle punched non woven fabrics in the frequency range from 100 Hz to 2000 Hz is depicted in Figure 5. The sound absorption coefficient is low in all the non woven fabric samples at low frequency ranges. Sound absorption coefficient of 0.03 to 0.05 is observed in the frequencies range from 100 Hz to 400 Hz. The sound absorption coefficient is increased with increase in frequencies from 500 Hz to 2000 Hz. Highest sound absorption coefficient of 0.08 is found in the non woven fabric sample SA1 followed by the sample SA4.

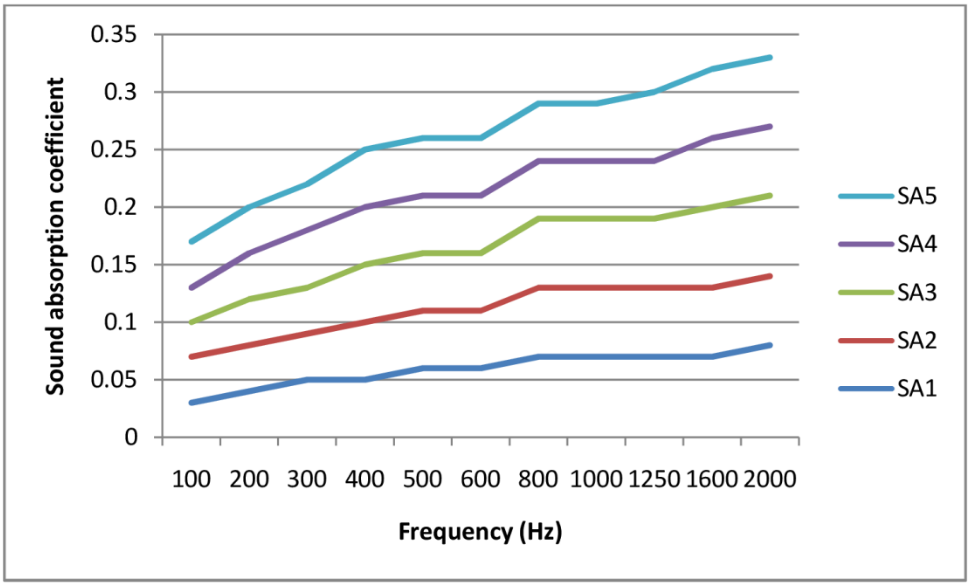

Figure 5. Sound absorption coefficient of needle punched non woven fabrics

CONCLUSION

Needle punched non woven fabrics were developed using sansiveria and areca husk fibres with uniform needle punching density. The influence of fibre content on the tensile, thermal conductivity, air permeability and sound absorption properties were studied. It is found from the results that areca fibre non woven fabric has given highest tensile strength in machine and transverse directions. It is also found that the higher thermal conductivity and air permeability was observed in the sansiveria fibre non woven fabric. The sound absorption coefficient is low in low frequencies and high in higher frequencies. The needle punched non woven fabric developed from this study can be used for acoustic applications for hygiene living.

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