



Study the Comfort Properties of Plasma and Enzyme Treatment of Hemp Fabric

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ABSTRACT –

In this study, atmospheric air pressure plasma and cellulase enzyme were treated with plain woven Hemp fabric. The important part of doing this surface modification is to study the comfort properties of the effect made by plasma and enzyme treated Hemp fabric. More attention was given to evaluating the air permeability, water vapour permeability, and wickability of the surface modified fabric. The results show that the plasma treated fabric outperforms the enzyme treated and untreated Hemp fabrics in terms of air permeability and wickability in the warp and weft directions with a 5 minute interval time. But in enzyme treated fabric, water vapour characteristics reveal the better characteristics compared to the others. Thus, this research work helps in understanding the comfort properties of surface modified Hemp fabric.

Key Words: Hemp Fabric, Plasma Treatment, Enzyme Treatment, Cellulose Enzyme, Air Permeability, Wickability

1. INTRODUCTION

This paper mainly discuss about plasma and enzyme treatment in hemp fabric in textile and garment manufacturers is the comfort of clothing. The human sensory response to clothing materials serves as the foundation for comfort, which is influenced by a number of thermal, physiological, and mechanical factors. Textiles have many comfort features that make clothing comfortable, including heat transfer, thermal protection, air permeability, moisture permeability, water absorption, water repellency, size and fit. In order to meet unique requirements for a variety of applications, the surface of textiles provides an important platform for functional modifications. The surface of textiles can be altered using a variety of methods, from conventional solution treatment to biological methods. Here, hemp fabric has been treated with plasma with atmospheric air and a cellulosic enzyme called cellulase to meet the variety of applications. Hemp fabric is a sustainable textile made of fibres of a very high-yielding crop in the cannabis sativa plant family. Historically used for industrial purposes, like rope and sails, hemp is known as one of the most versatile and durable natural fibres. This makes hemp fibre a natural and environmentally friendly product. Its main properties are Sustainable and environmentally friendly fibre and most durable natural textile fibres absorbs moisture, prevents bacteria formation, Superior durability, easily recyclable. The atmospheric air plasma was done on the fabric with system frequency of 60KHZ in aluminium electrode with the electrode gap of 7.5 cm at room temperature and cellulase enzyme was treated in the hemp fabric which is cellulosic in nature with the help of Master Linen's Inc., Karur. In this paper we are going to discuss whether the comfort qualities of hemp fabric have been impacted by surface modifications.

3. METHODOLOGY

3.1. Plasma treatment

An atmospheric plasma equipment "Plasma JetRD1004" supplied by Plasma treatment. This model has a plasma generator, which works at 50/60 Hz, 230 V and 16 A, with a discharge frequency of 17 kHz and a discharge voltage of 20 kV. Moreover, it has a high-voltage transformer and a pressure controller. A circular nozzle with a rotation speed of 1900 rpm was used for surface modification. The plate to confine the plasma and to enhance its effectiveness for the treatment. For surface treatment, PLA sheets were placed on the sample carrier and then, particular process conditions were applied. Atmospheric plasma was applied at different nozzle-substrate distances between 10 and 20 mm and at different sample advance rates ranging from 100 and 1000 mm. A sample of size 20 cm_20 cm was inserted in the chamber and treated by plasma. The magnetron was used in the base.

3.2. Enzyme Treatment

Cellulase is used to modify the surface and properties of cellulosic fabrics in order to achieve a desired surface effect. Cellulases have been widely used for manufacturing in the textile and laundry industries. They have been primarily used for bio-polishing and softening of cellulosic fibers and besides improving the softness, color, shine, and appearance. Likewise, alkaline cellulases are also used, favoring the complete elimination of stains on the fabric

and giving shine and softness to the clothes. The main advantage of cellulases is that they are easy to apply on the material and are biodegradable and thus do not pollute the environment. Cellulose enzyme was treated in the hemp fabric with the help of Master Linen's Inc., Karur.

3.3 Air permeability

An air tronic tester with model number 3240A and ASTM D737 (figure 1) is used to test air permeability. It has a volumetric counter with a minimum capacity of 50 litres per hour and a maximum capacity of 5800 litres per hour. It is also available with different testing areas of 20, 20, 10, 5, 2 cm². We tested organic cotton fabric that had been plasma and enzyme treated versus untreated using a test area of 10 cm² with a pressure drop of 100 Pa and a measuring volume of 10 litres per minute, and readings were recorded.



Fig- 1: Air tronic tester

3.4. Water permeability

The testing of fabrics in the Water Vapour Permeability Tester Model M261 (figure 2) with the specifications of ASTM E 96 is used with 46ml of water at 20 °C ± 2 °C in each open dish predetermined from the dimensions of the dish to give an air layer which is 10 ± 1mm deep between the surface of the water and the underside of the supported specimens. The specimens were placed over the turn table and the water vapour permeability readings of different fabrics were calculated.



Fig 2: Water vapour permeability tester (cup method M261)

3.5. Wickability

Wickability was tested using the manual method. In this test a strip of fabric is suspended vertically with its lower edge in a reservoir of distilled water. The rate of rise of the leading edge of the water is then monitored at different timings. The measured height of rise in a given time is taken as a direct indication of the wickability of the test fabric. The mass can then be expressed as a percentage of the mass of the length of dry fabric which is equivalent to the measured height of water rise and wickability test fabric absorbency values were calculated.

4. PHYSICAL PROPERTIES OF HEMP FABRIC :

The (Table 1) explain the physical properties of hemp fabric .

Table -1: Physical Properties of Hemp Fabric

Properties	Hemp fabric
Fabric weave type	Plain weave
Thickness (mm)	28
Fabric GSM (g/ m ²)	290
Picks per inch	95
Ends per inch	72

5.RESULT AND DISCUSSION

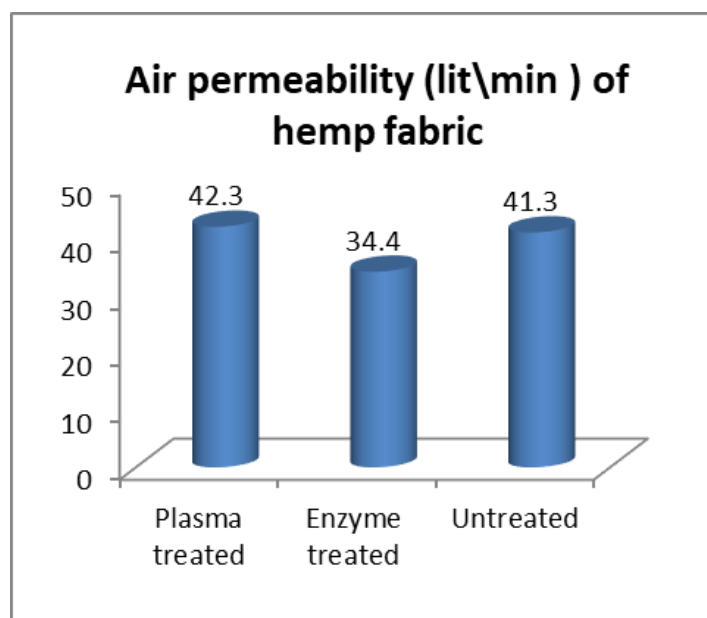
5.1 Air permeability

The air permeability of the fabric samples was tested and the results are given in(table no 2).The result shows that plasma treated hemp fabric has slightly higher air permeability characteristics when compared to the untreated hemp fabric, while the enzyme treated fabric has fewer air permeability characteristics than both the plasma treated and untreated hemp fabric samples. Test was carried out for the plasma treated and enzyme treated hemp fabrics with untreated fabrics and the results were analysed.

Table -2: Air Permeability of the Fabric samples

Fabric type	Air permeability (lit/min)
Plasma treated fabric	42.3
Enzyme treated fabric	34.4
untreated fabric	41.3

Chart -1: air permeability of the fabrics sample



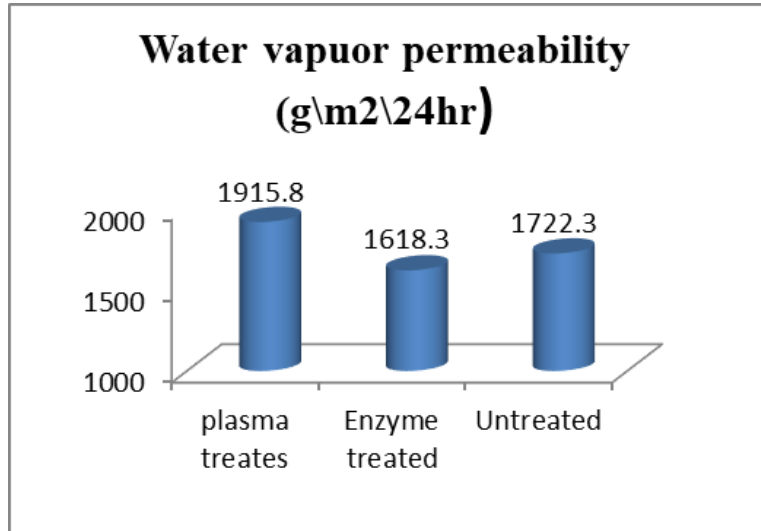
5.2.2 Water Vapour Permeability

The water vapour permeability of the fabric samples were tested and results were given in(table no 3 The weight of specimen of with and without fabric samples is calculated theoretically and reference sample is also taken into account. Among the various samples plasma, enzyme and untreated fabric. This water permeability of fabric depends upon the weave structure, cover factor, pore diameter, etc. Thus the given sample was tested using water permeability tester under standard conditions and the result is taken.

Table - 3: Water permeability of the fabric sample

S. no	Sample Type	Water permeability (g/ m ² /2 hr)
1	Plasma treated fabric	1915.8
2	Enzyme treated fabric	1618.3
3	Untreated fabric	1722.3

Chart -2: Water permeability of the fabric Samples



5.2.3 Wickability

The wickability of the fabric samples was tested, and the results are given in (table no 4 and 5).Wicking property of the woven fabric is observed , the distance of water that travels up in the fabric material is measured in various intervals and it is resulted that wicking property, in weft direction is higher than warp direction of the fabric.

Table -4: Wicking property of weft Hemp fabric Samples

Time in minutes	Plasma	Enzyme	untreated
1 min	3.3	2.3	2.6
3 min	5	3.1	3.8
5 min	6.1	4.8	5

Table 5: Wicking property of warp Hemp fabric Samples

Time in minutes	plasma	Enzyme	untreated
1 min	3.1	2.3	2.5
3 min	4.7	3.4	3.9
5 min	5.8	4	5

Chart -3: Wickability of the fabric sample in weft direction

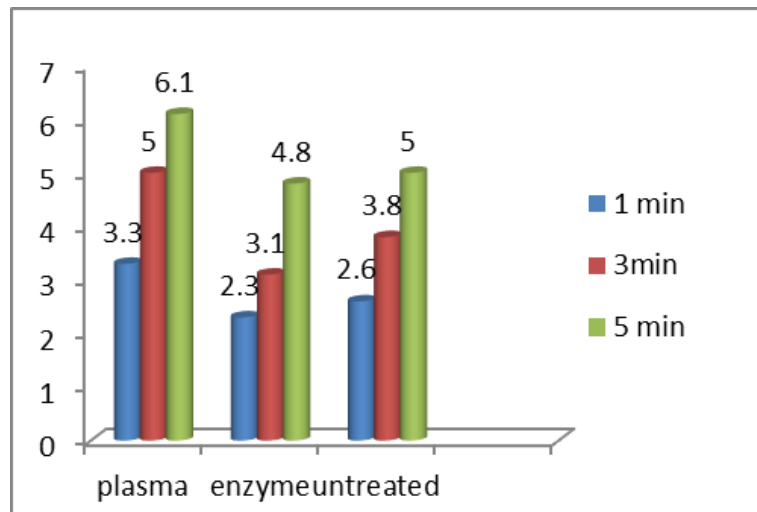
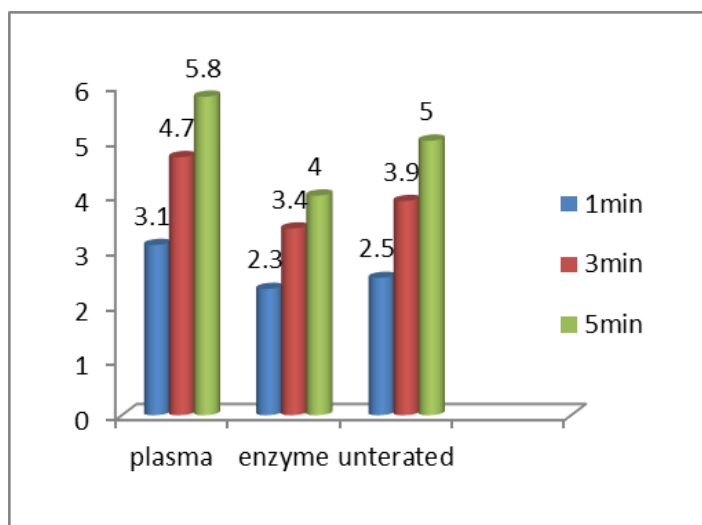


Chart -4: Wickability of the fabric sample in warp direction

3. CONCLUSIONS

From the analysis of the results, it is found that the plasma treated hemp fabric has a higher air permeability property. In the water vapour permeability test, enzyme treated fabric performed the best of the others, and at least in the wickability test, the warp direction and weft direction of the plasma treated fabric had the higher wicking property. Thus, this study demonstrates that there are slight changes that occur in the comfort properties of surface modified fabrics, and each surface modified fabric performs differently in each comfort property such as air permeability, water vapour permeability and wickability.

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