STUDIES ON THE WATER RETENTION PROPERTIES OF COIR NEEDLE PUNCHED NONWOVENS

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Abstract:. *Natural fibers like coir, kenaf and cotton are biodegradable and eco friendly. The effective utilization of the natural fiber in different filed of applications is gradually increasing due to the environment friendliness. Needle punched nonwoven samples was developed with coir/cotton and coir/kenaf fibres with 90/10 blend ratio. The areal density of the needle punched nonwovens is 950 grams per square metre and thickness of the samples is around 15 mm. The water holding capacity of the samples was tested at different time levels (5 to 45 minutes). Water retention property of soil with and without needle punched nonwoven bed was tested with different time levels. The effect of coir/cotton and coir/kenaf fibres based needle punched nonwovens with soil on plant growth also studied. The results shows that, the water holding capacity % of the coir / cotton needle punched nonwoven is 35.34 % and the coir/ kenaf needle punched nonwoven are 22 %.*

Keywords: *Coir, Kenaf, Natural fibre, Nonwovens, Water retention*

1. Introduction

Agricultural sector is one of the sectors which face many threats in the current scenario due to various reasons such as climate changes, water scarcity and modernization. Among this water scarcity and water management are the serious problems. Textile is one of the suitable sectors which can offer a better solution to this. The unique textile properties like large surface area, light weight, higher water retention properties, eco friendly and biocompatibility has made them a better alternative; i.e. water retention nonwoven bed is the better solution to this. Agrotech is one of the major areas in the group of technical textiles. Textile structures in various forms are used in shade house, green house and also in open fields to control environmental factors like temperature, water and humidity. Natural biodegradable textile fibers are grown as agricultural plants and are commonly used for the production of ropes, carpet backings, hand bags, etc. They are classified into three groups like bast fibers (flax, hemp, jute and kenaf), leaf fibers (sisal, pineapple and banana) and seed or fruit fibers (cotton and coir). Coir is a biodegradable organic fiber and hardest among other natural fibers, shows more advantageous in different application for agricultural textiles. The fiber is hygroscope with moisture content of 10 to 12% at 65 % relative humidity.

Coir is having a very high potentiality in agro textile application. Its moisture retention capability and high wet strength has been excellent and the characteristic has been made use extensively in agro textile applications [1]. In polypropylene nonwovens, the soil moisture retention functions were influenced both by pore size and geo textile fiber-water contact angle, and the relative influence of each factor varies among products [2]. The higher moisture absorption properties of the drum stick fibers create the possibilities in applications in geo and agriculture textiles [3]. Agro-tech possess various desirable properties such as protection from insects, light(ultra violet rays) or hail, lightweight, biodegradability, resistance to microorganisms, and high potential to retain water. Weather resistance, it must work effectively in cold as well as hot climatic conditions, resistance to microorganisms-it must resistant to microorganism to protect the living being, stable construction- the construction must be such that it must be stable for any application, lightweight- the weight of the fabric should be such that it will bare by the plant, withstand solar radiation, withstand ultraviolet radiations, high potential to retain water and protection property [4].

One of the requirements to be met by agricultural nonwovens is high potential to retain water so seeds can germinate and plants can grow. This is achieved by means of fibre materials which allow to take in much water and by filing in super absorbers [5]. In this research work, an attempt has been made to study the physical properties and water holding capacity of coir needle punched nonwoven and also study the utilization of water retention nonwoven bed for assistance in plant growth. Needle punched nonwoven samples was developed with coir/cotton and coir/ kenaf fibres with 90/10 blend ratio. The physical properties and water holding capacity of the coir/cotton and coir/ kenaf needle punched nonwoven was studied. The effect of coir/cotton and coir/kenaf fibres needle punched nonwoven water retention bed on the plant growth also studied.

2. Experimental

The natural fibre like coir, MCU5 cotton and kneaf fibers was selected for the study. The properties of the cotton fibre; 2.5% span length is 32.5 mm, Micronaire is 3.8 and tenacity of the fibre is 24 g/tex. The properties of the kneaf fibers; staple length is 40 mm, denier is 1.2 and tensile strength of the fibre is 5.7 gpd. The coir, cotton and kenaf fibre was opened and cleaned by using miniature carding machine. The cut raw coir fibre and cotton and kenaf fibre was mixed manually based on the required blend proportions. The carded webs of coir, kneaf and cotton with blend proportions 90:10 was produced with TRYTEX miniature carding machine. The 10 % of cotton and kneaf fibre was used to improve the stability of the needle punched nonwovens and to study its effect on water retention properties of the fabrics. The coir/cotton and coir/kenaf needle punched nonwovens was developed using DILO needle punched nonwoven machine. The thickness, areal density, air permeability and water holding capacity of the developed needle punched nonwoven samples were tested. The needle punched nonwoven samples was tested for its water holding capacity. To test water retention capacity of nonwovens, first a tray of dimension 11x 8 x 4 inches was taken and a hole of 5mm is drilled at the right bottom corner of the tray. Then the sample size of 8 x 8 inches was taken and placed inside the tray.150 ml of water was sprayed randomly over the nonwoven bed using a water sprayer. Then the amount of water drained was noted at periodic intervals till the bed reached its saturation level. Their corresponding value was used. The same procedure was repeated to test the water holding capacity of soil alone. Soil was filled in the tray in accordance with thickness of the sample. The same procedure was followed with soil filled in the tray for 15 mm and the sample placed above it .The amount of water drained was noted and their results was tabulated.

3. Results & discussion

The Table 1 shows the physical properties of the needle punched nonwoven samples was developed with coir/cotton and coir/kenaf fibres with 90/10 blend ratio.

Table 1: The physical properties of the *coir/cotton and coir/kenaf fibres (90/10)*

S.No	Properties	Coir / Cotton	Coir / Kenaf
1	Thickness, mm	14.72	15.13
2	Areal density, g/m^2	977	1057
3	Air permeability, cm^3 / cm^2/ s	352	242
4	Packing density	0.0474	0.0499
5	Fabric porosity, %	95.26	95.01

The thickness and areal density of the coir/kenaf needle punched nonwoven was quite higher compared to that of coir/cotton needle punched nonwoven. It may be due to the, coarseness of the kenaf fibres compared to that of cotton. The air permeability of the coir/kenaf needle punched nonwoven was lower compared to that of coir / cotton needle punched nonwoven, the coir /kenaf sample doesn't allow much air to pass through the samples, coir /kenaf was denser than the other samples.

3.1 Effect of time on the water retention capacity of coir/cotton and coir/kenaf needlepuched nonwovens

The water retention capacity of the coir/cotton and coir/kenaf was tested, in addition to that water retention capacity of soil, water retention capacity of soil with needle punched nonwoven also tested. The Table 2 shows the amount of water drained with respect to time of the coir/cotton and coir/kenaf needle punched nonwoven.

Table 2: The amount of water drained with respect to time of the *coir/cotton and coir/kenaf needle punched nonwoven*

Time (min)	5	10	15	20	25	30	35	40
Coir / Cotton	75	83	90	96	97	97	97	97
Coir / Kenaf	40	98	108	113	113	113	113	113

It was clear that coir/cotton needle punched nonwoven have drained in the given period of time was low or water retention property of the coir/cotton needle punched nonwoven was higher. The results shows that, the water holding capacity % of the coir / cotton needle punched nonwoven is 35.34 % and the coir/ kenaf needle punched nonwoven are 22 %.

3.2 Effect of time on the water retention capacity of soil with different thickness level

The water retention capacity of soil alone was tested. Soil was filled in the tray with 13, 14.5 and 15.5 mm height and then water was sprayed evenly over the soil surface. The Table 3 shows the amount of water drained with respect to time of the coir/cotton and coir/kenaf needle punched nonwoven.

Table 3 The amount of water drained with respect to time of soil with different thickness level

Time (min)	5	10	15	20	25	30	35	40
13 mm soil height	5	11	15	16	18	18	18	18
14.5mm soil height	2	9	12	15	16	17	17	17
15.5 mm soil height	3	8	10	12	15	15	15	15

It was observed that, there is no significant difference in water holding capacity of soil with different height**.** The result shows that, the water holding capacity % of the soil with 13 mm height is 88 % and the soil with 15 mm height is 90 %.

3.3 Effect of time on the water retention capacity of coir/cotton and coir/kenaf needlepuched nonwovens with soil

The combined water retention capacity of coir/cotton and coir/kenaf needle punched nonwovens with soil height of 15mm was tested.

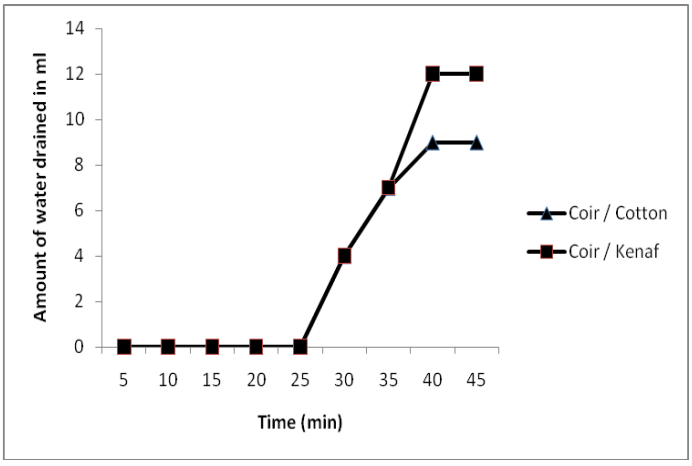

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Figure 1. Comparison of amount of water drained from coir/cotton and coir/kenaf needle punched nonwovens with soil height of 15mm

From The figure 1 it was clear that only 10 to 13 ml of water drained from the sample and the remaining water has been retained by both needle punched nonwovens and soil. It was observed that, water starts drained out after 25 minutes only. This indicates that it has reached the soil and from the soil it took some more time to drain out.

3.4 Effect of coir/cotton and coir/kenaf needlepuched nonwovens with soil on plant growth

The assistance of coir/cotton and coir/kenaf needle punched nonwovens with soil for plant growth was conducted. The growth of the plant was measured with respect to days. It was observed that, the height of the plant was very low for the plant without nonwoven bed. So, it was clear that the coir/cotton and coir/kenaf needlepuched nonwoven assists the plant growth by maintaining the microclimate between the top layer of the soil and the nonwoven bed.

The plant with coir/cotton needle punched nonwoven shows the better growth compared to that of other sample. It was observed that, the height of the plant with coir/cotton needle punched nonwoven bed is 19.6 cm and coir/kenaf needle punched nonwoven bed is 17.8 cm.

Table 4 Effect of coir/cotton and coir/kenaf needlepuched nonwovens with soil on plant growth (cm)

Days	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Coir / Cotton	0	1.3	2.65	3.9	5.3	6.6	7.9	9.25	10.5	11.8	13.2	14.5	15.85	17.2	18.5	19.6
Coir / Kenaf	0	1.2	2.6	3.6	4.8	6.1	7.2	8.4	9.5	10.7	12	13.2	14.5	15.6	16.7	17.8

3.5 Conclusions

The needle punched nonwoven beds was produced with coir/cotton and coir/kenaf using needle punching technology. It was observed that, needle punched nonwovens produced with 90%coir / 10% cotton shows better results in terms of water retention capacity and higher plant growth. The major outcome of this research work was, coir based needle punched nonwovens creates better microclimate, water retention bed reduces the water consumption and support the better plant growth.

4. References

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