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DEVELOPMENT OF SCRUB PAD FROM NATURAL FIBRES

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Abstract

Scrub pads make it easy to clean kitchen utensils, tools, cooktops, and countertops. It is one of the most widely used cleansing solutions in the kitchen. They help remove even the toughest stains without causing damage to the items, and they are made to be quick to clean and rinse. Some scrubbers are hollow or flat, while others include sponges within. Some are constructed entirely of recyclable materials like twine or yarn, while others are made entirely of cloth. Ligno-cellulosic fibres such as coir, sisal, banana fibre, and banana bract fibre were mixed with cotton fibre and needle punched to make nonwovens, in this study. A variety of fibre blends are used: SP 1 (Coir 65%, Banana bract 13%, Sisal 13%, Cotton 7%) SP 2 (Sisal 53% ,Coir 26%, Banana bract fibre 13%, Cotton 7%) SP 3 (Coir 53%, Banana fibre 26%, Sisal 13%, Cotton 7%) SP 4 (Cotton 65%, Banana fibre 26%, Coir 7%). Banana bract fibre is extracted by water retting method. The physical properties of the nonwoven sheets are studied. Scrub pads supplied in stores are made of synthetic fibres that do not biodegrade, causing environmental pollution. These kind of scrub pads made of natural fibres would be a sustainable alternative.

Key words- Scrub pad, Natural fibres, Bio-degradable, Non-woven, Physical properties.

Introduction

Cotton is a soft, staple fibre that forms around the seeds of the cotton plant in a protective capsule known as a boll. The fibre is spun into yarn and used to create a soft, breathable textile, which is the most common type of garment textile. Cotton accounts for nearly half of the world's textile fibre. Cotton is farmed in 35 nations throughout the world, with 900 million metric tonnes produced annually. India, China, the United States, Pakistan, and Brazil are the world's largest cotton producers [1]. Sisal Fibre is a widely used natural fibre that is also very easy to cultivate. It comes from the sisal plant. Agave sisalana is the scientific name of the plant. These plants grow sword-shaped rosettes with toothed leaves that gradually remove their teeth as they grow. Decortication is a process that involves removing a number of long, straight fibres from each leaf. It is commonly used in the manufacture of cordage and ropes. Except for packing goods and carpets, it is rarely used for fabric [2]. Coconut fibre is one of the natural fibers abundantly available in tropical regions, and is extracted from the husk of coconut fruit. It is also called coir fiber. Coconut fibre is extracted from the outer shell of a coconut. Brown fibres are extracted from matured coconuts. Brown fibers are thick, strong and have high abrasion resistance [3]

Banana fibre is natural, ligno- cellulosic fibre obtained from the banana plant after harvest. Banana fibre is a bast fibre with generally good mechanical qualities that is derived from the pseudo-stem of the banana plant (Musa sepientum). The banana plant is found in Thailand and Southeast Asia, as well as India, Bangladesh, Indonesia, Malaysia, the Philippines, Hawaii, and a few Pacific islands [4]. Banana bract fibres are derived from the long fibres of the banana inflorescence, which have a higher moisture content and strength. The fibres have a high cellulose concentration and low wax content. Banana inflorescence bract fibres can be used in a variety of technical and apparel applications with a variety of natural and synthetic fibres. [5]. Ligno cellulosic fibres are extracted from some plants and agro waste. the most common method use for fibre extraction is the retting process also known as degumming. Several retting procedures have been employed to date, including the most conventional and still extensively used approaches, namely water retting and dew retting [6]. Nonwoven fabric technology is currently the most advanced method in the textile industry. Because of their simple production stages, high efficiency of production, lower cost, and disposability, nonwoven technology can approximate the appearance, texture, and strength of traditional woven and knitted fabrics. Nonwovens are one of the fastest-growing divisions of the textile business, accounting for nearly one-third of the whole fibre industry [7].

Nonwoven fabrics are sheet or web structures that are mechanically, thermally, or chemically bound together by entangling fibre or filaments (and by perforating films). They are porous flat or tufted sheets manufactured from individual fibres, molten plastic or plastic film. They are not woven or knitted,

and they do not involve the conversion of fibres to yarn [8]. Mechanical bonding is the oldest method of producing non- woven; it entangles fibres to impart strength to dry-laid webs. The most common mechanical methods are needle punching, spun lacing, and also called as hydro entangling and stitch bonding [9].

The nonwoven fabric properties depends on following particulars to an great extent,

The choice of fibre

Technology which determine show the fibres are to be arranged

The bonding process and the bonding agent

Fabric properties of nonwovens range from crisp to that of soft-to-touch to harsh, impossible-to-tear to extremely weak. This leads to a wide range of end products such as nappies, filters, teabags, geotextiles, etc. some of which are durable and others are disposable. The first stage in the manufacturing process of nonwoven fabrics is “production of web” and another is “bonding of web by using several methods”. Some of those (binding methods) are felting, adhesive bonding, thermal bonding, stitch bonding, needle punching, hydro-entanglement and spin lying [10]. Cleaning utensils with abrasive pads/scrubbers that usually include rubbing pad against the surface to be cleaned while also applying a detergent/cleaning chemical. Simple natural fibre-based abrasive pads with a long lifespan, as well as safe and hygienic handling conditions, are ideal for a variety of applications [11]. A scouring pad, also known as a scourer, is a small metal or plastic mesh pad that is used to scour a surface. One side of some scouring pads is made of a soft sponge-like material, while the other is comprised of the mesh. It can be used to clean most cooking utensils and equipment on a daily basis. It can be used in place of steel wool and metal sponges, and it won't leave any metal slivers on the hands or in the food [12].

Methodology

Selection of fibres

The following fibre has been chosen for the current study to make needle-punched nonwovens to be used as scrub/ scouring pads.

- Sisal
- Banana
- Coir
- Cotton
- Banana bract fiber

Collection of fibres

The Agave Americana plant is abundantly available in nature. The leaves are collected from Kunnathur, Tirupur,Tamilnadu, India. Matured leaves are cut away from plant with sharp knife and taken for fibre extraction. The extracted banana fibre purchased from Eco-Green unit, Agricultural service in Coimbatore, Tamilnadu, India. The coir fibres purchased from Gokulay Global Services, Pollachi, Tamilnadu, India. Cleaned cotton fibre purchased from RRR Spinning Mills Pvt Ltd, in Malumichampatti, Coimbatore, Tamilnadu, India. The banana bracts were collected from a farm in Vadavalli, Coimbatore region of Tamilnadu, India.

Fibre extraction

Sharp knife is used to remove the thorns on the leaf margins and the spine at the leaf tip of the sisal plant. After retting the fibre was washed 15 to 20 times frequently, the leaves were soaked in water bath for 5 to 6 days constantly. The fibre is then extracted and exposed to the sun to dry. The collected banana bracts are dried at room temperature. In a bath 5 litres of water and 500g ash is added and brought to boil. The banana bracts are boiled in if for 30 minutes. The bracts are thoroughly rinsed with tap water after boiling. The wet bracts are gently combed and dried on a flat surface using a steel comb. After drying, the fibre is processed again to eliminate any remaining waste and the fibres are extracted. Natural fibres such as sisal, banana fibre, cotton fibre, coir fibre, and banana bract fibres are shown in Fig. 1.

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Fig 1: Natural fibres
a) Sisal fibre b) Banana fibre c) Cotton d) Coir fibre e) Banana bract fibre

Fibre softening

Chemicals were used to soften sisal fibre

Name of the chemical: Urea
Concentration: 25g/l
Time: 1 hr
Temperature: Room Temperature

After urea treatment the fibres are washed and then dried

Blending of selected fibres

The process of blending in different fibres into a single fabric is made to improve the quality of the fabric and to give the desired properties. But, long fibres cannot be used in this process. So, Banana fibre, sisal fibre, coir fibre, and banana bract fibres were manually chopped into small pieces and mixed. The fibres were about 2-3 inches long.

Fibres used for non-woven preparation

Tables 1 show the sample, quantity, and percentages of the most regularly used natural fibres in nonwoven preparation.

Table 1: Fibres used for non-woven preparation

Sample	Fiber	Quantity (gm)	Percentage %
SP 1	Coir	125	66
	Banana Bract	25	13
	Sisal	25	13
	Cotton	15	8
SP 2	Sisal	100	53
	Coir	50	26
	Banana Bract	25	13
	Cotton	15	8
SP 3	Coir	100	53
	Banana	50	26
	Sisal	25	13
	Cotton	15	8
SP 4	Coir	125	66
	Banana	50	26
	Cotton	15	8

Web Formation

Web formation is the process that arranges the fibres or filament into a sheet or web form. The carding method was used to develop the web under the scope of this study.

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Carding

The principle of carding is a mechanical action in which the fibres are held by one surface while the other surface combs the fibres, causing individual fibre separation. The static electricity is applied to the worker-roller to improve the fibre web uniformity of the fibre web made by the carding process [13]. In this study the strength ratio of machine direction cross direction is 1:1 hence the web formed is condensed web. The condensed web will have even strength in all the directions. Figure 2 shows the carding process of natural fibres.

Fig 2: Carding process

Non-woven making by needle punching

The sheet is formed by a process called needle punching where the web structures bonded mechanically by the interlocking of fibres. The lap is fed into the needle punching machine for the formation of needle-punched non-woven sheet. DILO needle punching machine of model OD-1 1/6 is used for the preparation of the sheet. Single board downward punching loom is used. Punching of the web is done using barbed needles. The needles are spaced in a non-aligned arrangement and designed to release the fibre as the needle board was withdrawn. The effective operation width is 700 mm. The sheet thickness ranged from 1.5 mm to 3 mm. The fabric weight of 250 to 350 GSM could be produced in the machine. The needle loom is basically a very simple piece of machinery. The most common mode of operation is one in which the needles oscillate vertically on a fixed stroke through web material supported between two plates. The plates are drilled with holes to match the pattern of needles in the needle board. The web is supported until it passes into the inlet gap between the two plates. The rollers aid the web to pass into the needling zone. Around 1200 needles are used. The top plate (the stripper) will be inclined so that there is more room at the entry side for the passage of bulky web prior to needling. The bottom plate (the bed) supports these webs during needling. The gap between these plates is adjusted depending on the thickness of the web. The web is made to pass through without any hindrance. The needle punched fabric is drawn away from the needling zone by take-up rollers. The sheet is needle punched on the reverse side also to add strength and to increase the penetration of the needles. The nonwoven sheet is shown in Figure 3.

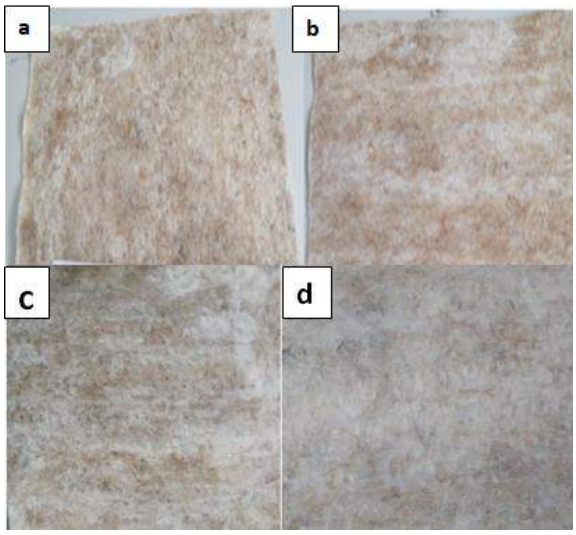

Fig 3: Non-Woven Sheet
a) (Coir 65%, Banana bract 13%, Sisal 13%,Cotton 7%) b) (Sisal 53% ,Coir 26%, Banana bract fibre 13%, Cotton 7%) c) (Coir 53%, Banana fibre 26%, Sisal 13% ,Cotton 7%) d) (Cotton 65%, Banana fibre 26%,Coir 7%)

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Scrub pad making

The nonwoven sheet is cut into various shapes to make scrub pads. Then the sample's edges are finished by hand sewing with long sisal fibre. The product is now ready to use. Fig 4 shows the process of creating scrub pads.

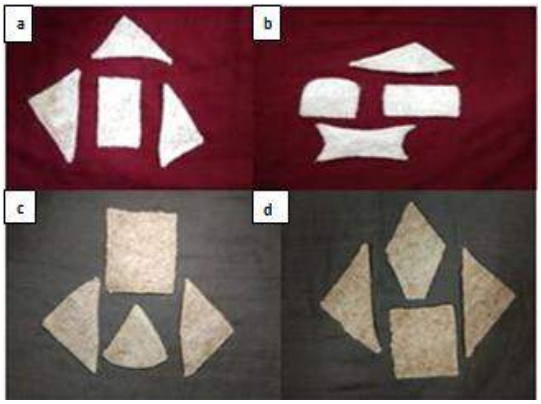

Fig 4: Scrub pad making
a) (Coir 65%, Banana bract 13%, Sisal 13%,Cotton 7%) b) (Sisal 53% ,Coir 26%, Banana bract fibre 13%, Cotton 7%) c) (Coir 53%, Banana fibre 26%, Sisal 13% ,Cotton 7%) d) (Cotton 65%, Banana fibre 26%,Coir 7%)

Results and Discussion

Table 2 GSM, Thickness, and Abrasion

S.No	Sample Code	GSM ASTM D3776	Thickness (mm) ASTM D1777	Abrasion (no.of cycles) ASTM D4966
1	SP 1	1119	7.69	755
2	SP 2	1232	5.87	553
3	SP 3	1051	7.65	623
4	SP 4	826	6.5	840

While analyzing the nonwoven sheet, it was discovered that the scrubber formed from SP 1 (coir, banana bract, sisal, cotton) has an average GSM of 1119. 7.69 mm is the average thickness. SP1 can withstand 755 abrasion cycles without tearing. The scrubber made with SP 2 (coir, banana bract, sisal, cotton) non-woven preparation has an average GSM of 1232. The average thickness is 8.7 millimetres. SP2 can withstand 553 abrasion cycles without tearing. Sp 3 non-woven preparation (Coir fibre, Banana fibre, Sisal fibre, Cotton fibre) has an average GSM of 1051. The average thickness 7.65mm. SP3 can withstand 623 abrasion cycles without tearing. The scrubber constructed with SP 4 (Coir fibre, Banana fibre, Cotton fibre) non-woven preparation has an average GSM of 826. The average thicknesses are 6.5mm thick. SP4 can withstand 840 abrasion cycles without tearing. Table 2 summarizes the sample's gsm, thickness, and abrasion.

Conclusion

The study used natural fibres for development of scrub pads in four different ratios. It is concluded that nonwoven sheets formed from different percentage of fibres used in sample 1, 3, 4 have a higher abrasion resistance than sample 2. Nonwovens made with sample 2, 3, 4 have a greater GSM and thickness than those made with sample 1. This research developed a biodegradable utensil scrubber that can be used in place of non-biodegradable synthetic scrubbers available commercially.

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