OPENING MINDS:
RESEARCH FOR SUSTAINABLE
DEVELOPMENT

# Developing Sanitary Napkins Using Corn Husk Fibres

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## 1 INTRODUCTION

With 875 million tons cultivated worldwide in 2012, corn is the second largest agricultural crop grown in the world –. The cultivation of corn generates stover such as stalk, leaves and husk as by products. Cornhusk is the protective cover of the seeds. The United States produces about 20 million tons of cornhusks annually. (Reddy and Yang, 2015). In relation to the industry of developing sanitary napkins, there is now a necessity to develop a natural, super-absorbent layer due to the increased risk of cancer and other diseases caused by the use of tampons and napkins which are composed of super-absorbent gels and layers. The objective of this study is to replace a sanitary napkin with a natural waste product – corn husk fibres - which also has the quality of higher absorbency. Also, it resolves the day to day problem of the garbage produced by the boiling of corn by village sellers.

## 2 METHODOLOGY

First the fibres were extracted and the properties of the extracted fibres were checked according to the particular ASTM standards. Fibres were tested for their physical properties under the standard testing conditions, 65% ±2 Relative humidity 21° ±2 ºC temperature. Prior to test, samples were kept for 24 hours under standard conditions. The length was determined by the staple length, the average diameter value, the bundle strength separately for the short fibres and long fibres since the strength depends on the length, by Pressley Strength Testing - ASTM D 3822, and the Moisture Content of Fibres – ASTM D2495 – 07, and the microscopic appearance was checked. Then the sanitary napkin was developed with the extracted fibres. Finally, it was checked for the standards that have been given by the Sri Lanka Standards Institute for sanitary towels – SLS 111:2009. Under this standard, the checking of the Aerobic Plate Count of the developed sanitary napkin, the absorbency of the developed napkin and the testing for pH Value was carried out.

### 2.1 Designing the experiment

#### 2.1.1 Fibre Extraction

According to the literature survey, it was cleared that, better conditioned cornhusk fibres can be extracted from green immature cornhusks rather than dried mature ones. In case of fibre extraction, three natural methods and one chemical method was carried out. They are;

- Slow moving water retting
- Dew retting
- Stagnant water retting

- Heating with different percentage of NaOH solutions, temperatures and time

### 2.1.2 Developing the Sanitary Napkin Using Cornhusk Fibres

Extracted fibres were combed and pressed and stitched them together to become thinner and parallel. The napkin was composed of three layers, one polyethylene layer in the bottom as to prevent side leakages, and then the stitched fibre was laid on top of it and on top of that a cotton layer is laid for comfort. Finally, these layers were stitched together using a thinner, non-woven cotton layer on the top. Figure 01 shows the development of such a sanitary napkin.

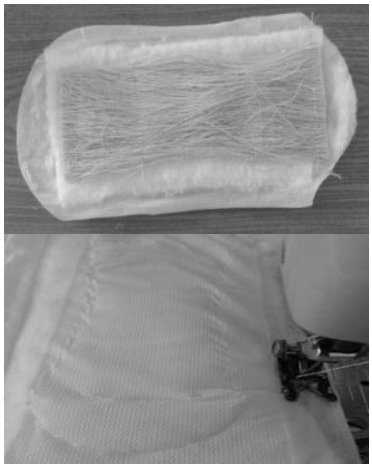

**Figure 1:** Developing sanitary napkins using Corn husk fibre.

### 2.1.3 Preparing the Solution for the Aerobic Plate Count Test – SLS 111:2009

A solution of 0.85% of NaCl was prepared and saline water was added to have a suspension of 100ml (assumption; 1ml = 1g.). So, in the case of the preparation of the NaCl solution, with 0.85g of solid NaCl three equal solutions were prepared. Here one sample is kept as a controlled solution and other two are used for the experiment. Then the mass of the sanitary towel was measured to the nearest 0.1g which resulted as 10g and autoclaved the samples to be tested and prepared solutions.

After autoclaving, all the testing equipment to be used such as tubes, bottles, beakers, pins etc. were securely covered with Aluminium paper in order to prevent moisture absorption and then sterilized. Temperature was controlled to be more than 800C and sterilization was done for 40 minutes as per the standard. Then, the sanitary napkin was cut into smaller pieces so that it would be easier to make the test suspension. The cut sanitary napkin was put into one solution, the lid was fitted and the contents were agitated well for 2 minutes with the use of an agitating machine. Then it was allowed to stand for 10 minutes. The process of agitating and standing was repeated twice more. Then the test suspension was removed for further testing.

From the initial suspension, further decimal dilutions were prepared by;

Removing 10ml from one of the remaining diluents and transferring 10ml of the previous dilution to the remaining 90ml of prepared diluents bottle. Shake well and this is 10-1 solution. Likewise, the 10-2 suspension was also prepared. Then a 1ml portion of the test suspension was distributed into duplicate sets of three Petri dishes using a pipette. 15ml of freshly melted, plate count agar that had been cooled to 450C was added to each dish. Then the suspension was smoothly mixed in order to have an even surface appearance. Finally, the suspension was incubated at 370C for 48 hours.

### 2.1.4 Preparing the Solution for Absorbency Test – SLS 111:2009

650 ml of boiling water and 0.4g of methyl paraben was added into a 1 litre capacity beaker and stirred until it dissolved. 80g of the gum acacia was


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added and stirred until it was dissolved completely. This made up about 870ml with water and the solution was then allowed to stand for at least 24 hours. The solution was then filtered through a 45-micron sieve. 1.0g of methyl orange, 160ml of glycerine and 90 ml of water was added to the filtrate and mixed. The final volume was 1 litre. It was then mixed thoroughly and allowed to rest for 24 hours the viscosity was then measured. It was measured as 5.5 milipascal. The solution must be shaken before use.

The sanitary towel was first laid on a flat, level, transparent surface. 30ml of the suspension, at the rate of 15ml per minute was then dripped on to the centre of the sanitary napkin from a height of 1mm to 2mm as in the image. After allowing 2 minutes for the napkin to absorb fluid from the surface a 1kg weight piece with the template was kept on the sanitary napkin. The template was removed after one minute and the weight piece as well as the underside and sides of the sanitary napkin was observed for leakages.

#### 2.1.5 Preparing the Solution for testing the pH Value – SLS 111:2009

Fibres were cut into pieces having approximately 5mm sides to allow the test samples to wet out rapidly. To avoid contamination, the materials were handled as little as possible. The samples were in between 2g – 2.5g. The test sample and 100ml of distilled water was placed in a polypropylene glass and the flask was agitated for a short period by hand to ensure that the materials were properly wetted out and then shaken mechanically for 2 hours.

## 3 RESULTS AND DISCUSSION

Quality corn husk fibres could be obtained by; Dew Retted for 2 days and then, Stagnant Water Retting for about 10 Days and after washing and Again Dew Retted for about 4 Days. Fibres were tested for their physical properties and table 01 shows the standard test and the obtained results.

**Table 01**: Results of tests on fibre properties

| Fibre Test | Results |
|---|---|
| Staple Length | 22.4cm |
| Average Diameter Value | 0.485mm |
| Average Tensile Strength (Short Fibres) ASTM D 3822 | 2.564 lb/g |
| Average Tensile Strength (Long Fibres) ASTM D 3822 | 1.738lb/g |
| Average Moisture Content ASTM D 2495 – 07 | 7.221% |

### 3.1 Microscopic Appearance

According to the microscope view obtained, the cross-sectional view of the fibre structure is heavily porous. It has a shape which is in between an oval shape and is somewhat similar to a kidney shape but it does not have as much of a kidney shape as a cross-section of cotton fibre. So, it was assumed that this fibre should have a high absorbency rate and it is tested further. The longitudinal view can be seen as a straight fibre. These views are shown in the figures 2.

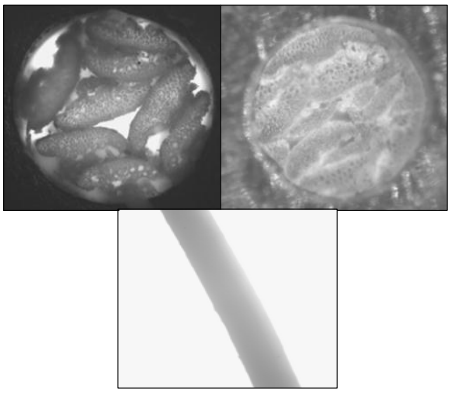

**Figure 2:** Cross-Sectional view 100 x magnified lighting from the (a) underside (b) upper side of the microscope (c) Longitudinal View in white background

### 3.2 Aerobic plate count of the developed sanitary napkin – SLS 111:2009

No microbes had grown on the controlled sample. But the other samples had grown colonies. The average colony count was 92. The grown colonies are shown in figure 3.

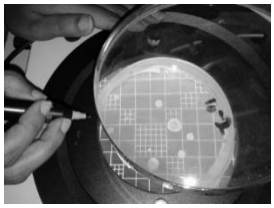

**Figure 3:** Grown colonies of the uncontrolled sample of the $10\text{-}_2$ solution.

### 3.3 Calculation

Aerobic Plate Count

$$=\left(\frac{\text{No. of Colonies x Total Dilution Factor}}{\text{Volume Plated}}\right)$$

$$= \frac{92 \times 1/10^{-2}}{10}$$

$$= 920$$

According to the SLS 111:2009; the aerobic plate count per g, should be lower than 1000 for sanitary towels. According to that standard, this napkin has achieved the suitability in case microbes test.

### 3.4 Observations regarding absorbency of the developed sanitary napkin – SLS 111:2009

No leakage of test fluid was found on the underside or the sides of the napkin. So, the assumption is that the sanitary napkin was produced up to the satisfactory requirement.

### 3.5 Testing for pH Value – SLS 111:2009

After 2 hours, the pH value of the material was read as 6.1. So, it can be considered a hygienic product that can be applied further without causing negative effects to the skin of the wearer.

## 4 CONCLUSIONS

Today, many of the commercial products use high absorbency gels as the absorbency agent on the interior of the sanitary napkins, which is harmful to the wearer and carries the risk of cancer. As a solution, the production of a sanitary napkin which highly absorbent but composed of completely natural interior layers using a combination of cotton and developed cornhusk fibres is possible as this this project demonstrates.

## Acknowledgments

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## REFERENCES

Reddy, N., Yang, Y. (2015). Innovative Bio fibres from Renewable Resources. Retrieved from http://www.springer.com/br/book/9783662451359

Nazire, D. Y. (2013). Effect of chemical extraction parameters on corn husk fibres characteristics. Indian Journal of fibre and textile research, (38) 2934.

Kalia, S., Avérous, L., Njuguna, J., Dufresne, A. and Cherian, B. M. (2011). Natural fibers, bio- and nanocomposites. International Journal of Polymer Science, (2011), 735932

Williams, T., Hosur, M., Theodore, M., Netravali, A., Rangari, V. and Jeelani, S. (2011).

Time effects on morphology and bonding ability in mercerized natural fibers for composite reinforcement. International Journal of Polymer Science, (2011), 192865.



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