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## Design of low-cost high absorbency sanitary pads using core sheath yarns

Parth Dixit

[pd2916@gmail.com](mailto:pd2916@gmail.com)

Indian Institute of Technology Delhi, New Delhi, Delhi

Shubham Tambi

[shubhamtambi007@gmail.com](mailto:shubhamtambi007@gmail.com)

Indian Institute of Technology Delhi, New Delhi, Delhi

### ABSTRACT

*During menstruation pain, anxiety, menstrual hygiene, timely changing of sanitary pads and a lot of other problems have to be dealt with besides the gruelling everyday routines. We are looking into the details of pad related problem which have been gathered by a huge survey of girls within the age group 17-23. In particular, the low absorbency of the pad, itchiness, and rashes caused, and discomfort caused via current pads in an affordable range are some of the issues we have tried to focus upon for our design of the sanitary pad. State of the art core-sheath yarn technique using super-absorbing microfibers and biodegradable bamboo fibers are the major components of our re-designed pads – both of which are a major upgrade from the existing solutions while still being affordable.*

**Keywords**— High absorbency, Core-sheath, Pad

### 1. PROBLEM BEING ADDRESSED

Menstruation is a common phenomenon experienced by 3,764,360,787 females around the world once every month in other words for an average 35 years of their lives. According to Euromonitor survey [1], Indian sanitary napkin market was valued at \$236 in 2016 and is expected to grow at a very high rate. This huge growth has attracted a lot of foreign brands bringing new technology and products.

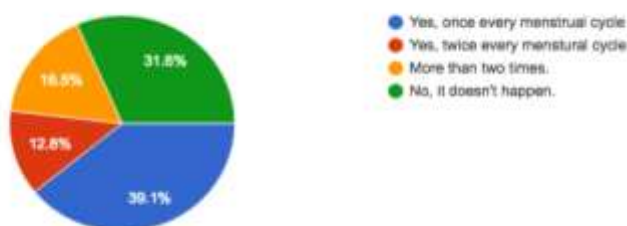
In order to get insights into how well current solutions are dealing with the issue and get better insights into the problem, we surveyed 133 women (residing in Delhi). Interestingly, the survey results indicated a huge dissatisfaction among the users.

The main problems highlighted by the survey are as follows:

1. The overflow of discharge out of sanitary pad (70%).
2. Harsh feel and rashes due to pad usage.
3. Use of plastics make the pads uncomfortable and noisy.

Further research revealed that current sanitary pads use non-biodegradable materials such as plastic sheet and hence aren't eco-friendly.

133 responses



**Fig. 1: The graph shows subjects with the problem of discharge**

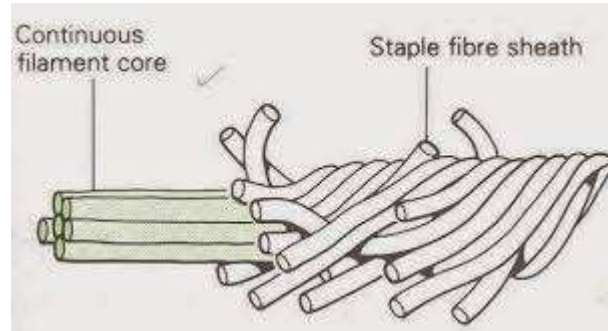
Pads of multiple sizes are available in the market yet problem of pad displacement while sleeping which results staining of the clothes is still common. 51% of subjects reported going to washroom multiple times to check off the pad highlighting the little trust users have in the existing product. Although few products exist in the market which solves some of these problems they are expensive hence out of the reach of many.

## 2. OUR SOLUTION – THE NEXT GEN PADS

Keeping the varied mentioned areas in mind and after understanding the various problems in the status quo, the proposed solution is an amalgamation of the desired properties while still keeping novelty at the heart of our innovation. The following areas are to be looked upon in order to provide better sanitary-pads:

### 2.1 Improved absorbency

We propose using a good antimicrobial property of Bamboo fibers and super-absorbing nature of microfibers by using a Core-Sheath yarn model, polyester microfibers forming the sheath while bamboo fibers being the core.



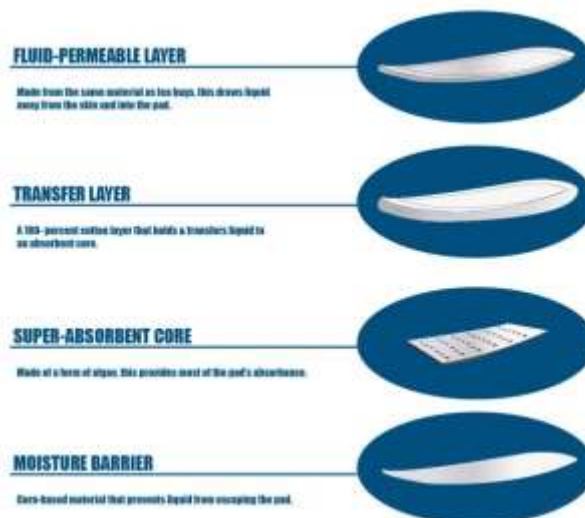
**Fig. 2: Core-sheath yarn model - Bamboo fibers core & Polyester microfibers sheath**

The current technology comprises of a soft upper layer close to the skin for comfort purpose, mainly made of organic cotton since it is highly porous and dries instantaneously. This layer is also made of a non-woven material which helps in the easy drawing of the fluid into the pad due to its reduced surface energy and high permeability.

In such a case, this layer is made of bamboo needle-punched non-woven structure provides a better case for both comfort and permeability while at the same time bamboo being antimicrobial in nature reduces the chances of microbial growth.

The second layer beneath it is again a 100% cotton layer which transfers the liquid to the next layer due to its high porosity. This layer can be made of a more porous non-woven bamboo structure thus inheriting all the properties from the first layer and providing better transfer of fluids.

The third and important layer is the absorbing layer made up of super-absorbent material - usually derivatives of polyacrylates works on gel-based absorption and swells up as more fluid gets absorbed. Rayon fibers are also used as an absorbing material in some pads. This layer needs major re-working and our solution of using the core-sheath yarn model to make a woven layer increases the absorbency by a factor of 3. Polyester microfibers provide the superabsorbent property [3]. Thus instead of using a non-woven/woven layer of just microfiber made yarns, we can use the core-sheath yarn wherein due to the spiral winding structure of sheath microfibers, we can achieve an effective increase in the length of the microfibers and hence increasing the absorbing capacity by more than a factor of 3. Thus, in turn, increasing the durability for which a pad can be used which helps in taking care of the problem of overflowing of discharge and even reducing the number of times the pad needs to be changed.



**Fig. 3: Layers in a pad**

The last layer is made of plastic so that the liquid does not seep from the third layer to outside the pad. The plastic used right now, though is impermeable but at the same time causes a lot of discomfort to people. A micro patterned superhydrophobic textile (MST) which has superhydrophobic yarns as well as a coating using fluoro-microparticles as in a Teflon surface [4].

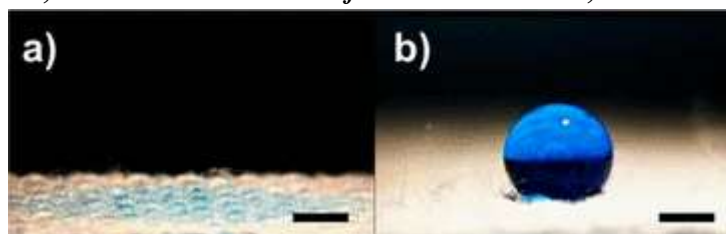


Fig. 3: a) Original hydrophilic stitching substrate, b) Superhydrophobic treated substrate and (scale bars: 1mm)

## 2.2 Pads don't cause rashes and itching

The rashes are mainly due to rubbing action of the pad against the skin and damp skin leading to microbial growth. Thus our choice of bamboo fibers. The excellent antimicrobial property of bamboo fibers coupled with the comfort provides the best solution for taking care of the rashes and itching. The bamboo fibers are softer than cotton fibers being used right now and thus a better prospect for reducing the friction between skin and pad. Along with using bamboo fibers, microencapsulation of antimicrobial agents can be easily done using many natural compounds.

## 2.3 Comfort

The last plastic layer is the main cause of the discomfort with the existing pads which can be replaced by using superhydrophobic fibers' tight woven structure so as to provide the required permeability while at the same time not compromising with the comfort of users. Softness provided by first and second layers of bamboo fibers improves the feel and comfort.

## 2.4 Cost-effective

Bamboo fibers and non-woven technology both make the pad cheaper. While the super absorbing polyester microfibers are already being used so no cost alteration there.

## 2.5 Biodegradable

The entire product is biodegradable except for the polyester-based microfibers. Our solution tries to make most of the pad biodegradable by removing the plastic layer. However, the microfibers stand can well be re-used if the used pads are recycled.

## 3. CURRENT STATUS OF THE PROBLEMS

In general, the main constituents for making sanitary napkins are cotton, bleached rayon, and plastics. Plastics helps in reducing cost but have been rated uncomfortable by users and are not environment-friendly.

Although new materials are also coming up like Procter and Gamble have been marketing their sanitary pads with a technology called *Infinicel* [2] but as the survey highlights, major problems still remain unsolved. Cloth based menstrual pads made out of hemp and cotton are popular in the semi-urban and rural areas because of their reusability and cheaper cost but they present issues in terms of hygiene and poor absorbency.

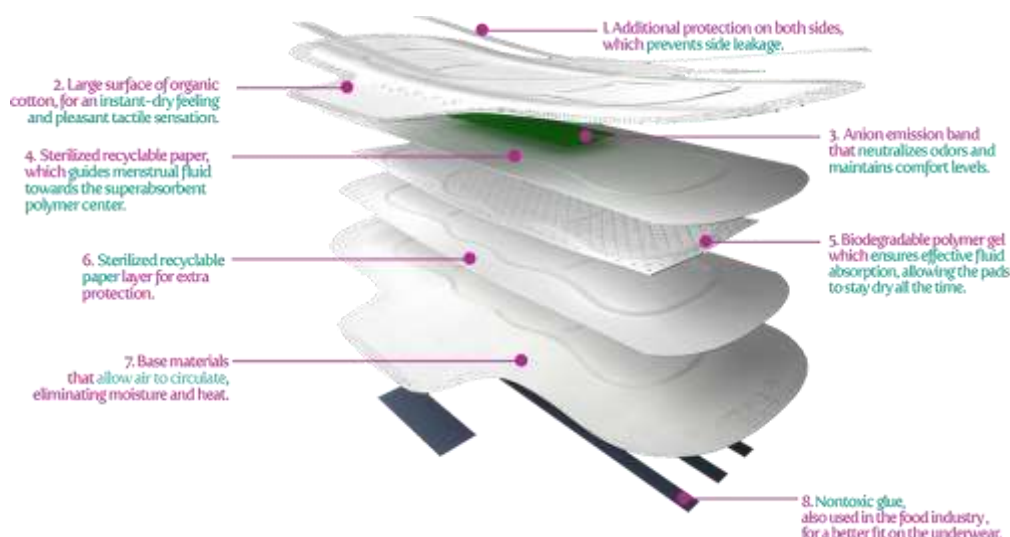


Fig. 4: Properties of layers

A lot of new products have been trying to harness the gel-based technology to increase absorbency. Companies have been trying to use super absorbable polymers to tackle the issue of incomplete absorption.

A lot of new technologies have focussed on adding multiple layers this helps in increasing comfort and antimicrobial properties but eventually raises the cost of product making it unaffordable for a large segment.

We have used material and textile-based innovations to propose a simpler, more absorbent and cheaper solution that is biodegradable as well-an attribute lacking in most of the commercially available product.

#### **4. FUTURE SCOPE AND IMPROVEMENTS**

One of the major areas to be worked upon is absorbency of the cloths that is by far, the biggest issue primarily unsolved.

Another improvement needs to be done for decreasing the contact angle of the discharge fluid with the first layer for facilitating quick absorption.

#### **5. REFERENCES**

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