

Anti-Odour Finished Disposable Toilet Seat Cover: An Innovative Approach

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ABSTRACT: Intervention of effective sanitation and hygiene is much needed in India. Public toilets are a potential source of infection because they are contaminated with microbes from the gut every time they are used for defecation and microbes produce foul smell which causes odour pollution. To overcome the problem, disposable toilet seat cover of 100% polypropylene non-woven (32 GSM) finished with anti odour finish lavender oil in different concentration, which underwent drop penetration test, anti bacterial to optimize the recipe. Finished toilet seat cover was given to samples with feedback form. Overall positive responses were gathered. Toilet seat cover was highly appreciated by respondents.

KEYWORDS: Polypropylene, Lavender oil, Toilet seat cover, Sanitation & Hygiene.

I. INTRODUCTION

“Cleanliness is Godliness” is the mantra of Mahatma Gandhi, Father of Nation who is also known for “Gandhi’s Model Toilet”. He demonstrated, propagated and insisted for individual and community cleanliness throughout his life. Adequate drinking water, sanitation, and hygiene are all essential ingredients to ensure human health. Public toilets are a potential source of infection because they are contaminated with microbes from the gut every time they are used for defecation. Being wet provides ideal conditions for the survival and growth of microbes, these microbes produce foul smell which causes odour pollution. Such odour pollutants are obvious vectors for the transmission of disease. Public toilets are in worst conditions such as in trains, hotels, malls, aero planes, homes, cinema, colleges, hospitals, roadside etc. They are extremely stinky and full of bad odour.

1. Sanitation: Sanitation is hygienic means of promoting health through prevention of human contact with hazards of wastes as well as treatment and proper disposal sewage or wastewater.

Waste Management in Toilets

When human waste (feces) is not managed well, it pollutes water, food, and soil with germs, and leads to diarrhea and other serious health problems. Using toilets prevents germs from getting into the environment, and protects the health of the whole community.

Health is not the only reason to build and use toilets. People also want privacy, safety, comfort, cleanliness & respect.

2. Non-woven: Nonwovens are a sheet, web, or bat of natural and/or man-made fibers or filaments, excluding paper, that have not been converted into yarns, and that are bonded to each other by any of several means.

The various methods for bonding are:

- a) Adding an adhesive
- b) Thermally fusing the fibers or filaments to each other or to the other meltable fibers or powders.
- c) Fusing fibers by first dissolving, and then resolidifying their surfaces.
- d) Creating physical tangles or tuft among the fibers.
- e) Stitching the fibers or filaments in place.

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They are extensively used in the medical field and in protection against biological agents in other sectors. Nonwoven materials with improved finishes such as liquid repellent, virus proof and bacterial resistance have been developed for applications such as surgical masks, gowns, drapes etc. (ICRA Management Consulting Services Limited, 2009).

Polypropylene Non Woven: Polypropylene non-woven fabrics are commonly spun bonded, accounts for 63%, polyester fibre 23%, viscose rayon 8%, acrylic fibre 2%, polyamide fibre 1.5%, etc. Being synthetic in nature, it possesses anti-microbial property. PP nonwoven fabric is a thermoplastic material with excellent comprehensive performance; air permeable, it is small in density, easy to produce, has low production cost, dimensional stability, good strength and durability. These are used as interlinings, interfacings, filters, backings for tufted carpeting, reinforcement in needled fabrics, polypropylene bags and as a substrate for artificial leather.

3. Anti Odour Finish: Lavender Oil: The use of natural anti-odour materials, such as bamboo fiber, is rising at the expense of more established technologies, reflecting growing demand among consumers for eco-friendly products. Lavender oil is valued for its fragrance and versatility. It is extracted from flower spikes of lavender flower, *Lavandula*. High-quality lavender oil has a sweet, floral, herbaceous, and slightly woody scent. Its color can range from pale yellow to yellow-green, but it can also be colorless. According to Cavanagh and Wilkinson, 2005, various properties of lavender oil are: anti-bacterial property, anti-fungal property, anti microbial property, therapeutic benefits, pain relief.

4. Toilet seat covers: The change from open defecation to the use of an improvised latrine is a step forward, but is unlikely to offer health benefits unless the latrine provides an adequate barrier between the users and their excreta and is well maintained (Cairncross and Bartram, 2010).

Toilet seat covers are not available in market and even if there is availability, they are made up of too thin paper which degrades easily in liquids. Various germs and bacteria like *E.coli*, syphilis, *staphylococcus aureus* etc survive on toilet seats and transfer from person's skin to toilet seats, therefore harming the health of toilet user. Hence, in order to overcome above problems there is a need to design disposable seat covers with an anti-odour finish of essential oil of lavender through this study, which provides hygiene comfort to people especially women whenever and wherever they want to use toilets. The study was undertaken to provide health and hygiene comfort to toilet users using western toilet seats.

II. RELATED WORK

- Gandhi ji was known for his attention to personal health and hygiene. He also believed in the "responsible" disposal of human excrement to avoid disease. "Our Indian toilets bring our civilization into discredit. They violate the rules of hygiene," Gandhi wrote in 1925. Following his footprints, Government of Gujarat launched Nirmal Gujarat Abhiyan from the year 2005. The campaign achieved encouraging results.
- A newly published research study by the India WASH Forum that took place in rural Indian villages has identified and analysed key barriers and motivators of change in sanitation and hygiene behaviour. The WHO funded study entitled "Formative Research to Develop Appropriate Participatory Approaches towards Water, Sanitation and Hygiene in Rural Areas" was conducted in the states of Gujarat, Telangana, and Jharkhand in India in 2015 and 2016.

III. METHODOLOGY

The present study was conducted to develop non-woven toilet seat covers with an anti-odour finish of essential oils of lavender. Keeping in mind the objectives of the study, a plan of work was formulated.

PHASE-1: Experimental Study

a) Test performance on non-treated non woven fabric: After the selection of polypropylene non woven fabric, test was performed over different GSM's of nonwoven. According to BIS standards, all the test were performed under standard atmospheric condition of $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and 65% R.H. $\pm 2\%$ R.H.

- Weight (gsm): To check the weight of non-woven fabric, GSM (mass per unit area of fabric) test was performed. ASTM D3776 standard is followed. Fabric weight is determined using GSM sample cutter and a digital weighing balance. .

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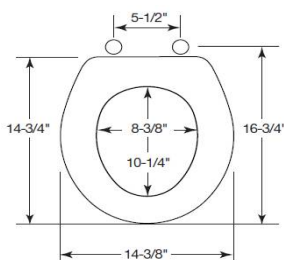
b) Preparation of suitable finish, method of application and optimization of finish: Four beakers of different concentrations (4%, 6%, 8% and 10%) were prepared. Essential oil with water mixture was stirred at 800-1000 rpm for 10 minutes; the oil in water solution was ready for application on the fabric. The above finish was applied on the non-woven fabric by dipping the fabric in above solution for 10 minutes. For uniform finishing, it is taken to padding mangle (3 nips-3 dips) under 1.5 kg/m². After finish application, sample was dried at 100°C for 3 minutes.

Optimization is done by performing following test:

- Anti-bacterial assessment: Preparation of nutrient for bacterial culture, the solution is autoclaved for 15 minutes at 121°C and cooled. After sterilisation of the nutrient broth, using 4mm loop/ inoculums fresh culture of Escherichia. Coli (e.coli) is taken and is inoculated in the broth solution and incubated at 37°C. Agar diffusion test in which antibacterial activity of herbal oils was screened by disc diffusion method (modified Kirby Bauer method) and the efficiency of finished fabric was tested by AATCC- 147 (Geethadevi and Maheshwari, 2013).

PHASE-2: Product development and evaluation

Based on the fragrance test and anti-bacterial assessment, non woven finished with optimizes finish cut in the shape of standard toilet seat cover (83/8"×101/4").



After the construction of disposable toilet seat covers, it was given to the 25 respondents to use the product. Out of 25 respondents, 10 were teachers while 15 were students. Questionnaire was prepared which includes questions like-problems faced in using western toilet seats at public toilets, preference and acceptability of toilet seat cover, checklist based on parameters like comfort, durability, and hygiene, feel

IV. EXPERIMENTAL RESULTS

Phase 1- Experimental

A) PHYSICAL TEST OF NON-TREATED NONWOVEN FABRIC (GSM)

Table 1 GSM of Nonwoven Fabrics

Test	Fabric A	Fabric B	Fabric C	Fabric D	Fabric E
Weight (GSM) (gm/sq.mt.)	15	32	50	70	100

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Table.1 shows weight of five different nonwoven fabrics sourced from the market. Fabric B of 32 GSM was finally selected for application of finish. It was chosen because after this all fabrics possessed similar wet ability properties which is desired for the development of toilet seat covers, and also keeping in mind the disposability as a major factor of the product, Fabric B was economical and light weight than Fabric C, Fabric D and Fabric E. Hence, Fabric B was selected for finished disposable toilet seat covers.

B) OPTIMIZATION OF FINISH.

- Antibacterial test by Agar diffusion method (AATCC 147): To check antibacterial activity of the treated fabric, agar diffusion test was done against bacterial E.coli.. A clear zone of inhibition ensures anti bacterial activity of the finish since zone of inhibition occurs as a result of diffusion of an antimicrobial agent.

Table 2 Antibacterial effect of lavender oil finish at various concentrations

S.No.	Concentration of Lavender Oil	E.Coli Width of Inhibition In Mm
1	4%	-
2	6%	1.5
3	8%	4
4	10%	4.5

Table 2 shows width of inhibition by E.coli bacteria at different concentration of anti odour lavender oil finish. There was no result in 4% concentration while there were quite a similar result between 8% and 10% concentration with the difference of only 0.5mm. It was also noticed that as the concentration of lavender oil increases, the zone of inhibition also increases (Chinta et al, 2012). 8% concentration of anti odour finish was finalized for application on nonwoven fabric.

Table.3 Antibacterial effect of optimised finished fabric

Weeks	Diameter of Zone of inhibition in mm in finished sample
First week	38
After 4 weeks	26

Table 3 shows diameter of zone of inhibition (in mm) against E.coli bacteria at 8% concentration of anti odour finish of lavender oil on non woven fabric. It was observed that zone of inhibition decreased after 4 weeks as fragrance or anti odour property of lavender oil diminished. The finish that prevents the growth of bacteria and products finished in it have been proved environment friendly, health protecting, preventing diseases and also prevents unpleasant odour

Phase 2- Product Development and Evaluation

Evaluation of disposable toilet seat covers: Questionnaire was prepared to collect the responses in form of acceptability and preference of the final disposable toilet seat covers among 25 respondents and also to know whether they would like to use the product in the future.

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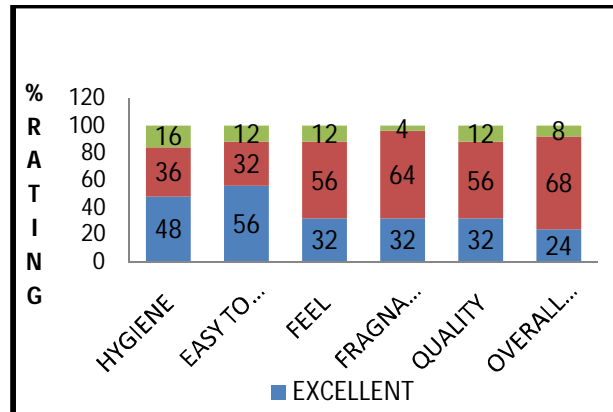


Figure 1 Product evaluation checklists

After using the disposable toilet seat cover, respondents were asked to evaluate the product based on few important parameters. Figure 1 shows percentage of respondents who rated the product excellent, good, average, below average or poor on the basis of six parameters like hygiene, easy to use, feel of the product on body, fragrance, quality and overall performance of the product. Majority of respondents rated it as a good and satisfied product. In all the above parameters, none of the respondents rated below average or poor.

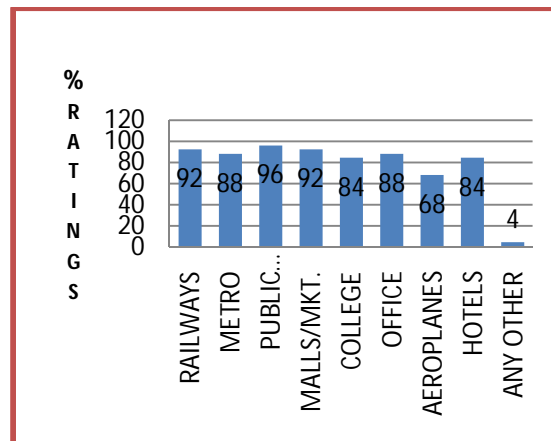


Figure 2 Places to use disposable toilet seat covers

Figure 2 represents percentage of places where respondent would like to use disposable toilet seat covers. 96% of respondents preferred to use disposable toilet seat covers in public convenience or public toilets while 92% would like to use in railways and malls/markets.

V. CONCLUSION

Sanitation and hygiene is most important concern today especially in country like India. Public toilets are in worst conditions such as in trains, hotels, malls, aero planes, homes, cinema, colleges, hospitals, roadside etc. Hence, disposable toilet seat covers of polypropylene non woven fabric with anti odour finish of essential oil of lavender were made which was testing for GSM & anti bacterial. Finished products were given with a questionnaire to the samples and thereby, overall positive responses were gathered. Toilet seat cover was highly appreciated by respondents.

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