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Profiling of Sanitary Napkin Materials for Effective Menstrual Waste Management

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A B S T R A C T

Menstruation plays a crucial role in health and reproductive cycles of females. However, Menstrual Hygiene Management (MHM) poses significant challenges to many developing emerged in women's menstrual health and the environmental factors that influence it. This report represents the profiling of materials used during manufacturing of sanitary napkins to optimized practices required to manage and dispose menstrual waste effectively. Methodology: Various sanitary napkin brands were chosen based on popularity, affordability, and biodegradability. The selected brands were tested in accordance with the Bureau of Indian Standards (BIS) guidelines, using optimized procedures recommended by the textile committee. Around twenty-eight (n=28) napkins were tested for the same. Result: - The materials used for the top sheet, core absorbent material, and bottom sheet of each napkin were examined. Out of the 27 napkins tested, 12 napkins (35.71%) had natural fibre top sheets, 26 napkins (92.85%) had natural fiber absorbent materials, and all 27 napkins (100%) had synthetic bottoms. Conclusion: The majority of commonly used sanitary napkins are made of synthetic materials, and their absorbent gel components are not biodegradable. It is essential to explore alternative solutions for effectively managing this waste and promoting sustainable menstrual hygiene practices.

Introduction

Menstruation is a natural biological process that women go through that signals their reproductive health and fertility. However, inadequate menstrual hygiene management (MHM) practices pose significant challenges, particularly in developing countries, hindering progress toward sustainable development goals (Sommer *et al.*, 2015). One critical aspect of MHM is the selection and disposal of menstrual products, particularly sanitary napkins, which are widely used for convenience and accessibility (Lara Freidenfelds and Sharra Vostral, 2011). The proper management of menstrual waste, encompassing used sanitary products and associated materials, remains a significant challenge globally (Sommer *et al.*, 2013).

Menstrual waste contains various components that merit careful evaluation. Disposable sanitary napkins, for instance, typically comprise an absorbent core, top-sheet, back-sheet, adhesives,

fragrances, and packaging materials (Elledge *et al.*, 2018). Tampons, on the other hand, consist of absorbent fibres, applicators, and wrappers (Elledge *et al.*, 2018). These components, while essential for providing comfort and hygiene during menstruation, can pose challenges in terms of waste management and sustainability.

The disposal of menstrual waste raises concerns due to the potential for environmental pollution and the persistence of non-biodegradable materials. Traditional disposal methods, such as flushing sanitary products down toilets, can lead to clogged sewage systems and contribute to the accumulation of waste in water bodies (Rajanbir Kaur *et al.*, 2018). Improper disposal in landfills, where menstrual waste can end up due to lack of awareness or infrastructure, may result in long-term environmental consequences (Rajanbir Kaur *et al.*, 2018).

To address the growing concerns surrounding menstrual waste management and its impact on both women's health and the environment (Nepal *et al.*, 2021; Pednekar *et al.*, 2022; Harrison and Tyson, 2023), this paper presents a comprehensive profiling of materials used in the manufacturing of sanitary napkins (Pohlmann, 2016; Barman *et al.*, 2017). Understanding the contents of menstrual waste is essential for effective waste management and sustainable menstrual hygiene practices. By analysing the materials present in disposable menstrual products and exploring alternative solutions, we can work towards minimizing the environmental burden associated with menstruation. This paper serves as a foundation for further research, policy development, and collaborative efforts to promote sustainable menstrual waste management and safeguard the health of both women and the planet.

Materials and Methods

The textile analysis gives a brief idea about the fabric used in sanitary napkins. Textile analysis was carried out at the Textile committee, Worli (Resource Guide for Textile Testing, Textile Committee laboratories, Ministry of Textiles, Government of India). The 27 samples were tested for fabric used in different layers of sanitary napkins. The following tests were carried out.

Microscopic Test

Each textile fibre has its own distinctive structural shape and markings. Fibre can be identified when viewed through the microscope, longitudinally, and cross-section. The cross-section is only possible for cloth as fibres are present in a bunch or yarn.

Burning Test

Different fibres have distinct odours and appearances when they are burned. With this test, we can identify one of three categories: cellulose, protein, or synthetic.

Chemical Test

The solubility of the fibre in a particular reagent is a means of identification. The fibre is placed in a chemical at a particular temperature and the solubility confirms the type of fibre.

Results and Discussion

3 different types tests carried out to confirmed the material used in the sanitary napkins.

In Microscopic fibre testing Out of 27 napkins, 2 core and 11 top sheets are made up of polypropylene, 18 core and 9 top sheets are made up of cellulose, 6 core and 4 top sheets are made of natural cotton, 1 core and 1 top sheet is made up pf mixed fibre and 2 top sheets are made up of nonwoven fibre. The following is the graphical representation of the same.

In burning test, 3 core and 14 top sheets turn in to Bead and 25 core and 13 top sheets turn ashy. Following is the graphical representation of the same.

In Chemical test, 14 core and 1 top sheet soluble in boiling xylene indicating Polyolefin fibre, 10 core and 24 top sheets soluble in 75% H_2SO_4 indicating cellulosic, cotton, flax fibre and 2 core and 3 top sheets are insoluble in 75% H_2SO_4 indicating some more tests to be performed to identify the fibre.

If the fibre is insoluble in 75% H_2SO_4 then it is tested for its melting point for distinguishing between polypropylene and polyethylene. However during melting point test, fibres didn't melt instead turn into ash indicating it might be the mixer of many fibres. Based on the analysis conducted on the sanitary napkins, it has been determined that out of the 27 tested napkins, only 8 are entirely composed of organic materials, excluding the leak-proof back sheet. They are S3, S8, S10, S11, S13, S20, S21 & S25. It is concerning to note that the majority of the sanitary napkins available in the market are made from inorganic and non-biodegradable materials. This finding raises significant concerns regarding both human health and environmental impact. The usage of inorganic and non-biodegradable materials in sanitary napkins can have adverse effects on the environment. These materials are not easily biodegradable, meaning they persist in landfills for long periods, contributing to waste accumulation and potential pollution.

Table.1 Results of various tests of Sanitary Napkins.

Textile Analysis of Sanitary Napkins							
Sample No.	L.S		Burning Test		Solubility Test		Gel Sheet
	Top sheet of Napkin	Core absorbent Napkin	Top sheet of Napkin	Core absorbent Napkin	Top sheet of Napkin	Core absorbent Napkin	
S1	Polypropylene	Cellulose	Beaded	Ashy	Soluble in xylene	soluble in 75% of H2SO4	present
S2	Non-woven (Synthetic)	Mixed Fibre	Beaded	Beaded	Soluble in xylene	Soluble in 75% H2SO4	present
S3	Cellulose	Cellulose	ashy	Ashy	Soluble in xylene	Soluble in 75% H2SO4	absent
S4	Non-woven (Synthetic)	Natural cotton	Beaded	Ashy	Soluble in xylene	Soluble in 75% H2SO4	present
S5	Polypropylene	cellulose	Beaded	Ashy	Soluble in xylene	Insoluble in 75% H2SO4	present
S6	Polypropylene	Cellulose	Beaded	Ashy	Soluble in 75% of H2SO4	Soluble in 75% H2SO4	present
S7	Polypropylene	cellulose	beaded	Ashy	Insoluble in 75% of H2SO4	Soluble in 75% H2SO4	absent
S8	Cellulose	cellulose	Ashy	Ashy	Soluble in 75% of H2SO4	Soluble in 75% H2SO4	absent
S9	Polypropylene	Polypropylene	Beaded	Beaded	Soluble in xylene	Soluble in xylene	absent
S10	Natural cotton	Cellulose	ashy	Ashy	Soluble in 75% of H2SO4	Soluble in 75% H2SO4	present
S11	Natural cotton	cellulose	Ashy	Ashy	Soluble in 75% of H2SO4	Soluble in 75% of H2SO4	present
S12	Cellulose	Natural cotton	Beaded	Ashy	Soluble in xylene	Soluble in 75% of H2SO4	absent
S13	Cellulose	cellulose	Ashy	Ashy	Soluble in 75% of H2SO4	Soluble in 75% H2SO4	present
S14	polypropylene	Cellulose	ashy	Ashy	Soluble in xylene	Soluble in 75% H2SO4	absent
S15	Cellulose	Natural cotton	Ashy	Ashy	Soluble in 75% of H2SO4	Soluble in 75% of H2SO4	absent
S16	Mixed fibre	Cellulose	ashy	Beaded	Soluble in 75% of H2SO4	Soluble in 75% H2SO4	present
S17	Natural cotton	cellulose	Ashy	Ashy	Insoluble in 75% of H2SO4	Soluble in 75% H2SO4	absent
S18	Polypropylene	Natural cotton	Beaded	Ashy	Soluble in xylene	Soluble in 75% H2SO4	present
S19	Polypropylene	Cellulose	Beaded	Ashy	Soluble in xylene	Soluble in 75% of H2SO4	absent
S20	Cellulose	Natural cotton	Ashy	Ashy	Insoluble in 75% of H2SO4	Soluble in 75% H2SO4	present
S21	Cellulose	Cellulose	Ashy	Ashy	Soluble in 75% of H2SO4	Soluble in 75% H2SO4	absent
S22	polypropylene	cellulose	Beaded	Ashy	Soluble in Xylene	Soluble in 75% H2SO4	absent
S23	polypropylene	Natural cotton	Beaded	Ashy	Soluble in Xylene	Insoluble in 75% H2SO4	absent
S24	Cellulose	Polypropylene	Beaded	Ashy	Soluble in 75% of H2SO4	Soluble in 75% H2SO4	present
S25	Natural cotton	cellulose	Ashy	Ashy	Soluble in xylene	Soluble in 75% H2SO4	present
S26	Cellulose	cellulose	Ashy	Ashy	Soluble in 75% of H2SO4	Soluble in 75% H2SO4	present
S27	polypropylene	cellulose	Beaded	Ashy	soluble in xylene	Soluble in 75% H2SO4	present

Flow chart.1 Textile Analysis Process of Sanitary Napkins

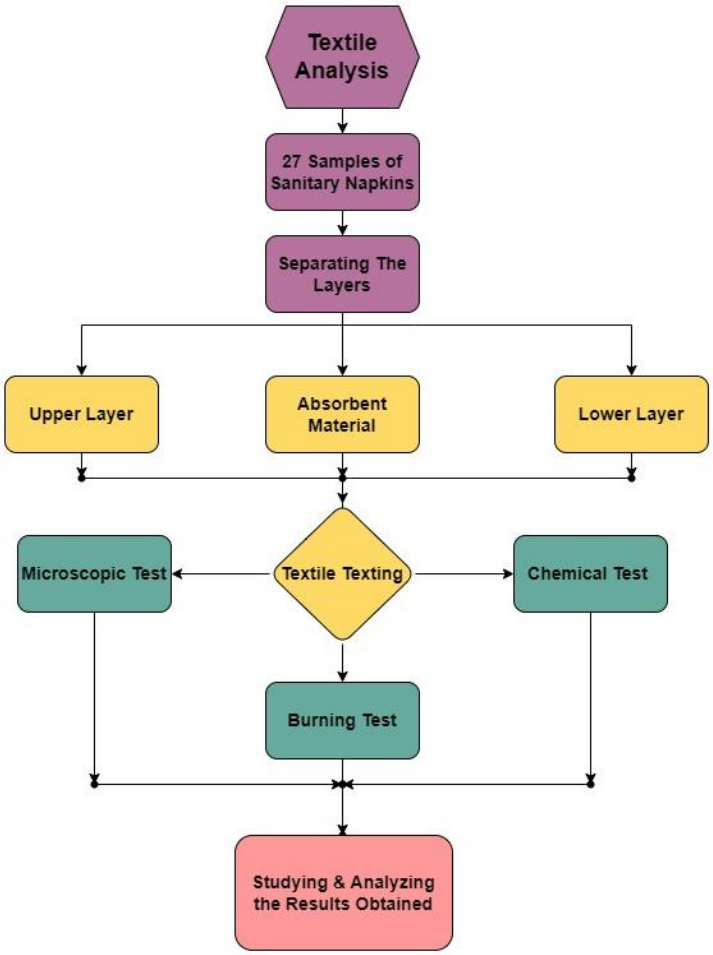


Fig.1

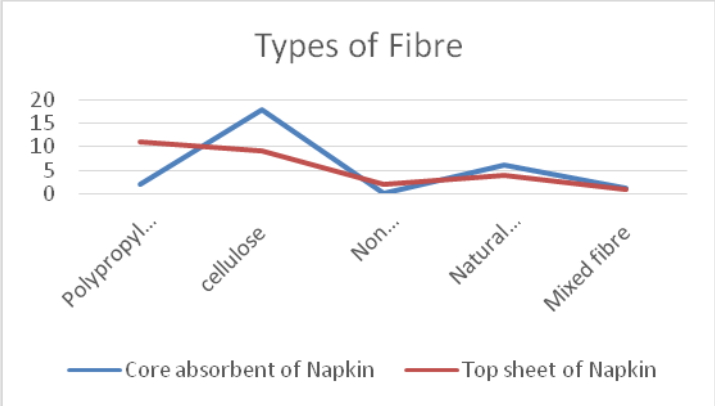


Fig.2

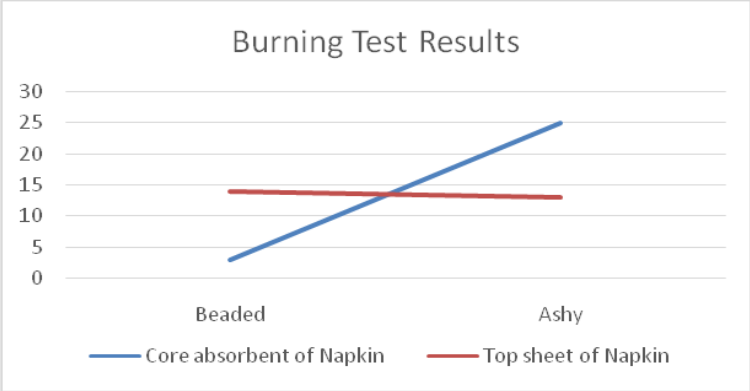
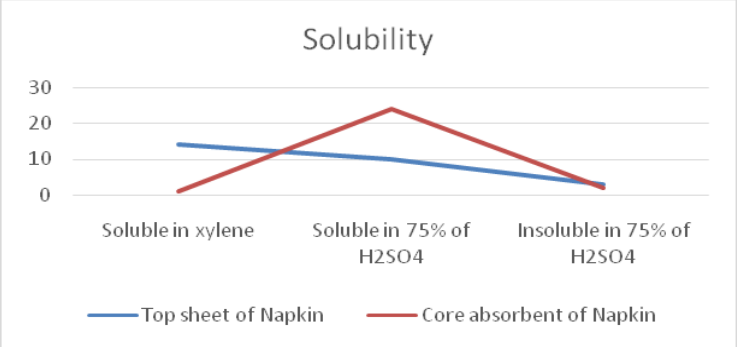


Fig.3



Furthermore, the potential impact on human health is a concern. The usage of inorganic materials in direct contact with the body, especially in sensitive areas, raises questions about the potential risks and discomfort that may arise from prolonged exposure to such materials.

Given these concerns, it is important to promote the development and use of eco-friendly and biodegradable materials in sanitary napkins. This would help mitigate environmental issues associated with waste management and reduce potential health risks to individuals.

Future Scope

As the some fibres are remained unidentified there is lot of scope for development of new methodology for the same like fibre identification techniques and material science innovation for eco-friendly options. It is important to create awareness among the people about used of biodegradable napkins and promote use and production for the same and this can be achieved by consumer awareness program and social media initiative.

Conflict of Interest

Authors have declared that no competing interests exist.

Author contributions

First author have performed all the experiments and second author is a guide who guided all the experiments.

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