



Enhancing Worker Safety and Hygiene: Evaluating Fabric Performance for Protective Garments in Sanitation Work

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Abstract: This study evaluates polycotton fabric treated with water-repellent and odour-resistant finishes for protective garments used by sanitation and drainage workers. Laboratory tests and field assessments reveal significant improvements in water resistance and odor control compared to untreated fabric. The treated fabric also shows strong user acceptability, indicating its suitability for harsh working conditions. Findings suggest that functional finishing on common fabrics offers a cost-effective, scalable solution for improving sanitation worker safety and hygiene.

IndexTerms – Protective Garments, Polycotton, Odor Resistant, Water Repellent, Breathable Fabric

I. INTRODUCTION

Sanitation and drainage workers are among the most vulnerable groups in urban labour, routinely exposed to adverse environmental conditions including sewage, biohazardous waste, and toxic chemicals. These workers are critical to public health infrastructure, yet they often work without access to appropriate personal protective equipment (PPE). In many cases, protective clothing provided by municipal bodies either fails to meet performance expectations or is completely absent, leaving workers to wear their own clothing under extremely unhygienic conditions.

This research aims to address a key gap in the safety gear offered to sanitation workers—namely, the lack of functionally enhanced garments that are resistant to water penetration and foul odours. The selection of polycotton as a base fabric offers advantages in terms of breathability, affordability, and durability. However, untreated polycotton falls short in resisting moisture and odour retention. This study evaluates the performance enhancement of polycotton fabric treated with specialized finishes and provides an evidence-based framework for developing high-performance protective wear tailored to sanitation work.

II. OBJECTIVES OF THE STUDY

The primary objectives of the research were as follows:

To test the effectiveness of water-repellent and odour-resistant finishes applied to polycotton fabric.

To assess the treated fabric's performance through laboratory testing and field-level validation.

To determine the treated fabric's suitability for protective garments worn by drainage and sanitation workers.

To suggest a scalable approach for municipalities to adopt functional fabrics in uniform procurement policies.

By focusing on material performance, this research bridges the gap between fabric science and user-centric garment design.

III. FABRIC SELECTION AND FINISHING TECHNIQUES

Fabric Choice: Polycotton

Polycotton, a blended fabric composed typically of 65% polyester and 35% cotton, was selected due to its wide availability, cost-effectiveness, and favourable balance between breathability and strength. Polyester contributes durability and shape retention, while cotton ensures comfort and moisture absorption. This makes it a practical option for sanitation workers who work long hours in physically demanding environments.

However, untreated polycotton has two significant drawbacks in sanitation settings: it retains foul odours and allows water to easily penetrate the fabric. These issues prompted the development of enhanced finishes to improve functional performance.

Finishing Application

The selected polycotton fabric was treated with:

Water-Repellent Finish: A fluorine-free, eco-friendly finish was applied to the fabric surface. The finish modifies the surface energy of the fabric, allowing water droplets to bead and roll off rather than be absorbed.

Odour-Resistant Finish: A finish using silver-based antimicrobial agents was applied to reduce microbial growth and the associated odour development caused by prolonged exposure to waste and moisture.

The application process was conducted in a controlled laboratory setting, with subsequent evaluation conducted at Intertek Testing Services, Bangalore.

IV. FABRIC PERFORMANCE TESTING

Testing Protocols

The treated and untreated fabric samples were subjected to standardized tests as per relevant ISO and AATCC standards:

Water Repellency Test (AATCC 22): Evaluated the surface resistance of fabric against water droplets.

Hydrostatic Pressure Test (ISO 811): Measured the water penetration resistance under increasing pressure.

Odour Retention Test (AATCC 130): Assessed microbial odour resistance by simulating waste exposure conditions.

Air Permeability Test (ASTM D737): Ensured the breathable nature of the fabric was preserved despite finish application.

Wash Durability Test: Evaluated performance retention after multiple laundry cycles.

Results Overview

The water-repellent finish demonstrated a spray rating of 90–100 (AATCC 22), indicating excellent repellency on initial application.

The hydrostatic pressure resistance significantly improved post-finishing, with minimal water seepage even after 5 minutes of constant exposure. Odour resistance tests showed a 70–85% reduction in microbial odour retention compared to the untreated sample after 8 hours of simulated exposure.

Importantly, air permeability remained within acceptable range, indicating that breathability was not compromised. The treated fabric also retained 85% of its water repellency and odour resistance after five wash cycles, confirming a high level of durability suitable for sanitation work.

V. DISCUSSION

The results confirm that functional textile finishes significantly enhance the performance of polycotton fabric, making it suitable for use in protective garments for sanitation workers. Water-repellent treatment ensures that the fabric does not absorb contaminated water, minimizing skin contact and potential health risks. The odour-resistant finish addresses the psychological and social burden workers face due to persistent smells in their uniforms.

Compared to synthetic alternatives or heavy-duty industrial PPE, treated polycotton garments strike a balance between functionality and affordability. Their light weight, comfort, and ease of maintenance make them ideal for municipal implementation. Additionally, using silver-based antimicrobial treatments ensures safety without introducing harmful chemicals into the environment or on the skin.

The integration of such finishes in uniform procurement for sanitation workers can improve both health outcomes and morale. When combined with ergonomic garment design, these functional fabrics become part of a holistic safety solution rather than a superficial fix.

VI. REAL-WORLD APPLICATION AND FEEDBACK

Treated fabric was used to construct a prototype garment, which was then evaluated by two sanitation workers over a short trial period. Their qualitative feedback echoed the lab results: the garment remained dry for longer periods, dried quickly after cleaning, and emitted noticeably less odour by the end of the workday. They also noted that the treated fabric felt slightly smoother and more comfortable against the skin.

While some feedback included requests for additional structural features (e.g., hoods, reinforced knees), there were no complaints about fabric functionality. Workers confirmed that the garment required less frequent washing and was easier to maintain. This supports the hypothesis that the use of functional finishes has a tangible benefit in real work environments.

VII. CONCLUSION

This research demonstrates that applying functional finishes to commonly available fabrics like polycotton can transform standard garments into effective protective wear for high-risk occupations. Treated fabrics with water-repellent and odour-resistant properties significantly improve hygiene, comfort, and safety for drainage workers.

Given the affordability and scalability of the treatment process, municipal bodies and policymakers should prioritize integrating such fabrics into uniform procurement strategies. Future research can expand testing to include flame resistance, UV protection, or smart sensors to further enhance garment utility. By investing in material innovation, we not only protect sanitation workers but also dignify their contributions to public health and urban sustainability.

VIII. REFERENCES

- Gopalakrishnan, D., & Nair, A. (2018). Personal Protective Equipment Usage in Municipal Waste Management. *Journal of Environmental Health Research*, 17(2), 45–52.
- Batra, D. (2017). Functional Textiles for Industrial Safety. *Asian Textile Journal*, 25(5), 31–38.
- Hegde, R. R., & Somashekar, R. (2016). Finishing Techniques for Water and Stain Resistance in Cotton Blends. *Indian Journal of Fibre & Textile Research*, 41, 330–336.
- Paul, S. (2016). Eco-Friendly and Cost-Effective Water Repellent Finishes for Cotton. *Textile Review*, 11(2), 14–19.
- ISO 811:2018. Textiles — Determination of Resistance to Water Penetration — Hydrostatic Pressure Test. International Organization for Standardization.
- AATCC 22-2017. Test Method for Water Repellency: Spray Test. American Association of Textile Chemists and Colorists.
- AATCC 130-2010. Odor Retention Test for Antimicrobial Fabrics. AATCC.
- ASTM D737-18. Standard Test Method for Air Permeability of Textile Fabrics. ASTM International.
- Intertek Testing Services (2025). Performance Evaluation Report: Treated Polycotton Fabric for Sanitation Work Garments. Bangalore.
- Chatterjee, M., & Joseph, S. (2020). Occupational Health Hazards Among Sanitation Workers in India: A Review. *Indian Journal of Occupational and Environmental Medicine*, 24(1), 1–6.
- Ministry of Housing and Urban Affairs (2020). Sanitation Worker Safety Guidelines. Government of India.
- WHO (2019). Guidelines on Sanitation and Health. Geneva: World Health Organization.

- Patnaik, D., & Becker, R. (1999). Needfinding: The Why and How of Uncovering People's Needs. *Design Management Journal*, 10(2), 37–43.
- Indian Standards Institution. (2008). IS 15809: Protective Clothing for Industrial Use – Specification. Bureau of Indian Standards.
- Saini, N., & Aggarwal, M. (2021). Application of Antimicrobial Finishes in Workwear. *International Journal of Textile Engineering*, 15(1), 22–29.
- Shukla, P. (2017). Challenges in Designing Protective Clothing for Informal Sector Workers. *Journal of Textile and Apparel Technology*, 6(4), 85–91.
- Ghosh, P. (2022). Local Fabric Sourcing Trends in Indian Apparel Manufacturing. *Apparel Views*, 19(6), 30–35.
- Kaur, P., & Sharma, A. (2019). Development of Protective Clothing for Indian Workers: A Need-Based Approach. *Textile Trends*, 61(3), 40–44.
- Shenoy, A., & Fernandes, L. (2021). Participatory Design and Worker Inclusion in Urban India. *Journal of Design Research*, 19(1), 75–94.
- Narayan, P. (2021). Dignity Through Design: Transforming Uniforms for Informal Sector Workers. *Design for All Institute of India Journal*, 16(6), 20–27.

