

Assessing Occupational Health and Safety Risks of Nanomaterials in Functional Textile Manufacturing

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Abstract

Various nanomaterials, primarily silver, silica, nano-carbon, nano-titanium, and nano-clay, are utilized in the textile industry to impart functional properties such as antimicrobial, antistatic, UV-protective, electrically conductive, water-repellent, wrinkle-resistant, self-cleaning, and flame-retardant characteristics to textiles. Nanomaterials possess unique dimensions, shapes, surface areas, and physicochemical properties, with an external size of 100 nanometers (nm) or smaller. Owing to these distinctive attributes, their adoption in the textile sector is progressively increasing. Conversely, these inherent properties may induce toxic effects in workers, thereby posing severe occupational health and safety (OHS) risks. Measuring and managing these specific hazards necessitates a framework that extends beyond conventional risk assessment approaches and incorporates the monitoring of parameters such as nanoparticle-specific characteristics, environmental conditions, and operational parameters. This study presents a comprehensive framework, based on existing literature, aimed at identifying and managing the operational conditions and associated OHS risks of nanomaterials widely used in the textile sector. It is anticipated that the insights provided herein will mitigate the risks arising from nanomaterial utilization in functional textile manufacturing while concurrently enhancing awareness among industry stakeholders and employees.

Keywords

Textile industry, Functional textiles, Nanomaterials, Nanoparticle exposure, Occupational health and safety risks.

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Biographies

Nazli Gulum Mutlu received her B.Sc. (with honors) and M.Sc. in Chemical Engineering from Firat University, Turkey, in 2010 and 2013, respectively, and a second B.Sc. in Environmental Engineering in 2011. She began her Ph.D. in Occupational Health and Safety at Yildiz Technical University in 2015 and obtained a second M.Sc. in Business Administration from Anadolu University in 2020. Since 2025, she has been an Assistant Professor in the Department of Occupational Health and Safety at University of Health Sciences, Turkey. Her research focuses on occupational health and safety, operations research, risk analysis, and safety technologies. She has published over 15 papers in international journals and serves as the coordinator of TÜBİTAK-supported projects (2022–2023).

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