

Scaling up the graphene production from R&D to the pilot plant stage: implications for occupational exposure

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Graphene has a wide range of potential applications and uses due to its improved mechanical, electrical, and thermal properties. It has many applications in electronics, energy storage, sensors, coatings, composites, biomedical devices and other sectors; as consequence a growing number of workers is involved in different stages of graphene production and processing. The aim of this study is to evaluate the occupational exposure to airborne graphene by applying the Prevention-through-design (PtD) approach in the transition from the R&D laboratory production to the pilot plant scale. The exposure measurement strategy was based on the multimetric-tiered approach proposed by Organization for Economic Cooperation and Development (OECD) and ISO guidelines, considering both high frequency real-time measurements (particle number concentration, average diameter, lung deposition surface area and particle size distribution) and personal samplings for further off-line characterization (gravimetric analysis, chemical characterization and morphological characterization by electron microscopy).

Final products storage, in which graphene is handled in powder form, and cleaning activities of laboratory equipment, resulted the most critical phases due to the occurrence of airborne graphene emission in the workplace.

Based of the results of exposure assessment, recommendations are proposed for occupational safety and health risk mitigation strategies. These findings highlighted the importance of an effective PtD approach application of the in the production scale-up of graphene-based materials.