ABSTRACT

Title: Prediction of Nanomaterials Risk using Bayesian Network
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Abstract:

Nanomaterials have been widely used in various applications such as medical, agriculture and chemical industries due to benefits influenced by their surface area. Nanoparticles are special and interesting because their chemical and physical properties are different from their macro counterparts. However, due to the rapid diversification of nanomaterials in industries, the scarce information on nanomaterials' safety properties lead to poor understanding of their hazards. It contributes to the negligence towards safe work practices, hence exposing workers to danger. Therefore, an integrated framework, namely Nanomaterial Risk (NanoRisk), is developed which incorporates Bayesian Network (BN) model, a control banding and process parameters focusing on humidity, mass of nanomaterial, and operating temperature is developed to assess health hazards due to nanomaterial exposure at workplace that caused potential biological effects to human health. The developed assessment is then applied to the nanomaterials used in the paint and coating industry; nano-silica, nano-titanium, and nano-silver. The BN model characterized the relationship between the physicochemical properties of nanoparticles and the resultant biological effects on the human body based on expert elicitation and available data from scientific publications and independent results of various published studies. The flexible analytic approach of BN allows valuable prediction of hazard exposure towards nanomaterials in supporting human decision-making and closing the gaps of missing nanomaterials data that are crucial for nano-safety assessment. The impact of these modifications leads to positive safety improvement. With 89.60% accuracy, the prediction of health hazard using BN model were consistent and comparable with the published literature and experimental studies. It shows that the potential of health hazard is highly dependent on the physicochemical properties and operating conditions when using the nanomaterials. It is proven that the developed BN model is able to learn from the data provided and the accuracy could be further improved if more information is supplied. The outcome of this project is very useful in supporting the improvement of occupational safety and health performance in the industry especially in handling nanomaterials. Furthermore, the integrated framework proposes suitable control measures to reduce the hazard exposure according to the hazard level at different scales of operation. The distinctive feature of NanoRisk demonstrates comprehensive analysis and accuracy in comparison with previously developed methods.

Keywords: Occupational Safety and Health, Health Hazard, Nanomaterials Exposure, Prediction of Health Hazard, Workplace