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Application of Mathematical Models for Conducting Long-Term Metal Fume Exposure Assessments for Workers in a Shipbuilding Factory

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Abstract : To conduct long-term exposure assessments are important for workers exposed to chemicals with chronic effects. However, it usually encounters with several constrains, including cost, workers' willingness, and interference to work practice, etc., leading to inadequate long-term exposure data in the real world. In this study, an integrated approach was developed for conducting long-term exposure assessment for welding workers in a shipbuilding factory. A laboratory study was conducted to yield the fume generation rates under various operating conditions. The results and the measured environmental conditions were applied to the near field/far field (NF/FF) model for predicting long term fume exposures via the Monte Carlo simulation. Then, the predicted long-term concentrations were used to determine the prior distribution in Bayesian decision analysis (BDA). Finally, the resultant posterior distributions were used to assess the long-term exposure and serve as basis for initiating control strategies for shipbuilding workers. Results show that the NF/FF model was a suitable for predicting the exposures of metal contents containing in welding fume. The resultant posterior distributions could effectively assess the long-term exposures of shipbuilding welders. Welders' long-term Fe, Mn and Pb exposures were found with high possibilities to exceed the action level indicating preventive measures should be taken for reducing welders' exposures immediately. Though the resultant posterior distribution can only be regarded as the best solution based on the currently available predicting and monitoring data, the proposed integrated approach can be regarded as a possible solution for conducting long term exposure assessment in the field.

Keywords : Bayesian decision analysis, exposure assessment, near field and far field model, shipbuilding industry, welding fume
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