

We-Po-04 Trisaminohexyl Isocyanurate, a Biomarker for HDI Isocyanurate Exposure

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Exposures to monomeric and polymeric 1,6-hexamethylene diisocyanate (HDI) in the automotive refinishing industry have been well characterized. However, biological monitoring is limited to a hydrolysis product of HDI monomer, 1,6-hexamethylene diamine (HDA). Further, inhalation and skin exposures to HDI monomer during painting operations are low compared to its oligomers. HDI isocyanurate constitutes the largest fraction of inhalation and skin exposures in automotive spray paints and has been shown to possess a greater sensitizing capacity than HDI monomer. Additionally, HDI isocyanurate penetrates the skin at a faster rate than HDI monomer, emphasizing the need to shift research focus towards the fate of HDI isocyanurate after exposure. We have developed a sensitive and specific method to quantify trisaminohexyl isocyanurate (TAHI), a hydrolysis product of HDI isocyanurate, in urine. Two end of day urine samples were collected from two spray painters exposed to HDI isocyanurate during automotive spray-painting operations. Urine samples were hydrolyzed with sulfuric acid, made basic with sodium hydroxide, and extracted with dichloromethane. The extracts were derivatized with acetic anhydride and excess reagent was removed with phosphate buffer and sodium sulfate before sample was dried and reconstituted with water for analysis. A calibration curve was created by spiking urine from non-exposed persons with the synthesized standard TAHI with a concentration range of 0.04-5.00 g/L and a synthesized internal standard trisaminoheptyl isocyanurate (TAHpl; 2.5 g/L). Samples were analyzed with nanoUPLC-ESI-MS/MS for the precursor ions m/z 553.3 (trisacetamidoheptyl isocyanurate, TAAHI) and m/z 595.3 (trisacetamidoheptyl isocyanurate, TAAHpl) using selected reaction monitoring. Urine samples collected from two workers with significant breathing-zone and skin exposure to HDI monomer (breathing zone: 216 and 79.5 g/m³; skin: 8.3 and 1.3 g/mm³) and HDI isocyanurate (breathing zone: 65432.3 and 20926.6 g/m³; skin: 3949.1 and 366.0 g/mm³) had TAHI levels of 0.43 and 2.29 g/L, respectively, while HDA concentrations in the same samples were 0.21 and 0.37 g/L, respectively. The results indicate that this method can be used to quantitate HDI isocyanurate biomarker TAHI in urine of exposed workers. Quantitation of HDI isocyanurate biomarker in urine in conjunction with HDI monomer biomarker from workers exposed to HDI-containing spray paints will aid in the investigation of the adverse effects of inhalation and skin exposure and individual susceptibility in exposed workers.