An Evaluation of Two Toluene Diisocyanate Sampling Methods

Worker exposure to airborne isocyanates can cause serious health effects, such as occupational asthma, airway irritation, and hypersensitivity pneumonitis. An occupational asthma prevalence rate of 5-10% has been estimated for isocyanate-exposed workers, and more than 40,000 workers were potentially exposed to TDI in the 1980s when a national occupational survey was conducted. Thus, accuracy is critical in estimating worker exposures to isocyanates. However, two commonly used field-sampling methods to estimate tolune diisocyanate (TDI) exposures have not been evaluated against each other to determine if the difference in TDI yield is significant nor which sampling method is most accurate in estimating TDI. The methods rely on the retention and extraction efficiency of TDI from a glass-fiber sampling filter in the form of TDI aerosol or TDI-coated particulates. TDI existing in these two forms will obstruct/interrupt the necessary contact with the derivatizing agent on the filter media, in turn causing a hindrance in the TDI-derivatizing agent reaction. One of the two methods requires desorption of TDI immediately after sampling and the other requires desorption of TDI after the sample is shipped to the analytical laboratory. The time delay in desorption for samples desorbed in the analytical laboratory may result in lower TDI yield. Thus, worker exposure may be under estimated for these laboratory-desorbed samples. The Occupational Safety and Health Administration (OSHA) requires that its compliance officers use the laboratory-desorbed method. Given that the OSHA Permissible Exposure Limit (PEL) for TDI is set at such a small concentration at 5 parts per billion (8-hour time-weighted average), these differences in desorption methods may significantly impact exposure estimates.

In this study, we propose to determine if the OSHA Sampling Method 42 and the Wisconsin Occupational Health Laboratory (WOHL) Sampling Method LC 48 result in significantly different TDI yields by collecting side-by-side airborne samples in the auto-body industry. In addition, we propose to determine which of the two methods is more accurate in estimating TDI exposures by collecting laboratory-controlled sample concentrations using the two sampling methods. Last, we propose to develop a predictive model so that the TDI sample concentration for one method can be predicted when provided the TDI sample concentration from the second method. The results of this research will allow the occupational health community to choose the most accurate TDI sampling method to help assure worker health and prevent the development of isocyanate-related occupational diseases.