A Method for the Determination of Metalworking Fluids in Workplaces

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Metalworking fluids(MWFs) are used in grinding and machining operations involving products from metal and metal substitutes, cause the asthma, hypersensitivity pneumonitis, other adverse respiratory effects, or allergic and irritant skin disorders. Some epidemiological and toxicological data provided evidence for carcinogenicity of MWFs. The purpose of this study was to develop a new analytical method for measuring the airborne MWFs concentrations in workplaces, and to develop the sample preparation method for separating the components of MWFs, and to evaluate the performance of these methods. MWF is new substance to be measured in workplaces by amended Industrial Safety and Health Act in 2003. In laboratory tests, the newly developed method of analyzing MWFs, referred to as the Solvent Extraction Gravimetric Method, showed 0.05 ㎎/sample as LOD, and 0.15 ㎎/sample as LOQ. This level is sufficient to evaluate compliance to the 5 ㎎/㎥ oil mist-TWA recommended by the MOL in Korea, and also the REL-TWA (0.5 ㎎/㎥) for the MWFs recommended by the NIOSH. The total analytical precision and 95% confidence limit of the estimated total standard error for the Solvent Extraction Gravimetric Method were 1.2～2.2% and ±13.9～±14.6%, respectively, which satisfied the OSHA sampling and analytical criteria. The Solvent Extraction Gravimetric Method for the determination of airborne MWFs concentration showed good performance with acceptable accuracy and precision.

The technique for separating the complex mixture into the manageable sub-mixtures by SPE column was sufficiently useful for analyzing the major components of MWFs. Cationic compounds like ethanol amine and triethanol amine were selectively separated from the complex mixture by using mixed cationic exchange(MCX) SPE column, anionic compounds like octanoic acid and nonanoic acid were selectively separated from the complex mixture by using mixed anionic exchange(MAX) SPE column, and mineral oil also was selectively separated from the complex mixture by MAX SPE column. The recovery of this sample preparation method was 96.8%(CV 2.5%) for ethanol amine, 97.1%(CV 2.2%) for triethanol amine, 96.6%(CV 1.8%) for octanoic acid, 99.6%(CV 2.0%) for nonanoic acid, and 96.3%(CV 2.0%) for mineral oil. Overall uncertainty for the sample preparation procedure by SPE columns was 8.0% for ethanol amine, 7.3% for triethanol amine, 6.8% for octanoic acid, 4.4% for nonanoic acid, and 7.5% for mineral oil.

In conclusion the sample preparation methods by SPE columns for separating the complex mixtures into the manageable sub-mixtures of physically & chemically similar property such as cationic, anionic, polar, and non-polar compounds showed the good performance for the sample preparation for screening hazardous substances in MWFs.