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Long-Term Exposure Assessments for Cooking Workers Exposed to Polycyclic Aromatic Hydrocarbons and Aldehydes Containing in Cooking Fumes

Authors : Chun-Yu Chen, Kua-Rong Wu, Yu-Cheng Chen, Perng-Jy Tsai

Abstract : Cooking fumes are known containing polycyclic aromatic hydrocarbons (PAHs) and aldehydes, and some of them have been proven carcinogenic or possibly carcinogenic to humans. Considering their chronic health effects, long-term exposure data is required for assessing cooking workers' lifetime health risks. Previous exposure assessment studies, due to both time and cost constraints, mostly were based on the cross-sectional data. Therefore, establishing a long-term exposure data has become an important issue for conducting health risk assessment for cooking workers. An approach was proposed in this study. Here, the generation rates of both PAHs and aldehydes from a cooking process were determined by placing a sampling train exactly under the under the exhaust fan under the both the total enclosure condition and normal operating condition, respectively. Subtracting the concentration collected by the former (representing the total emitted concentration) from that of the latter (representing the hood collected concentration), the fugitive emitted concentration was determined. The above data was further converted to determine the generation rates based on the flow rates specified for the exhaust fan. The determinations of the above generation rates were conducted in a testing chamber with a selected cooking process (deep-frying chicken nuggets under 3 L peanut oil at 200°C). The sampling train installed under the exhaust fan consisted respectively an IOM inhalable sampler with a glass fiber filter for collecting particle-phase PAHs, followed by a XAD-2 tube for gas-phase PAHs. The above was also used to sample aldehydes, however, installed with a filter pre-coated with DNPH, and followed by a 2,4-DNPH-cartridge for collecting particle-phase and gas-phase aldehydes, respectively. PAHs and aldehydes samples were analyzed by GC/MS-MS (Agilent 7890B), and HPLC-UV (HITACHI L-7100), respectively. The obtained generation rates of both PAHs and aldehydes were applied to the near-field/ far-field exposure model to estimate the exposures of cooks (the estimated near-field concentration), and helpers (the estimated far-field concentration). For validating purposes, both PAHs and aldehydes samplings were conducted simultaneously using the same sampling train at both near-field and far-field sites of the testing chamber. The sampling results, together with the use of the mixed-effect model, were used to calibrate the estimated near-field/ far-field exposures. In the present study, the obtained emission rates were further converted to emission factor of both PAHs and aldehydes according to the amount of food oil consumed. Applying the long-term food oil consumption records, the emission rates for both PAHs and aldehydes were determined, and the long-term exposure databanks for cooks (the estimated near-field concentration), and helpers (the estimated far-field concentration) were then determined. Results show that the proposed approach was adequate to determine the generation rates of both PAHs and aldehydes under various fan exhaust flow rate conditions. The estimated near-field/ far-field exposures, though were significantly different from that obtained from the field, can be calibrated using the mixed effect model. Finally, the established long-term data bank could provide a useful basis for conducting long-term exposure assessments for cooking workers exposed to PAHs and aldehydes.

Keywords : aldehydes, cooking oil fumes, long-term exposure assessment, modeling, polycyclic aromatic hydrocarbons (PAHs)
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