

Toxicological Exposure Assessment of Carpet Manufacturing with ProScale Method

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The long-term exposures to toxic substances and environmental pollutants in living and working environments have adverse effects on human health. Currently, all assessment methods work based on hazard performance. None of these methods compare hazard and exposure performance along the life cycle of products (from raw material extraction, production, and use phase to the end of a product's life). To bridge this gap, ProScale method is developed to assess the toxicological potential of products along their life cycle. The aim of this thesis project was to investigate the applicability of the ProScale method to the entire production cycle of a synthetic fiber carpet concerning inhalation and dermal routes. To conduct ProScale assessment, hazard factor (HF) was calculated at the very beginning for each and every substance integrated in the entire production cycle of the carpet (for inhalation and dermal routes). In addition to HFs, three other parameters, namely, exposure concentration factor (ECF), time factor (TF), and mass flow (MF) were calculated for all the substances. Using these four parameters, toxicological exposure potential (ProScale score) of all substances that existed in each unit process of the carpet production were calculated.

Results showed that in the inhalation route, blending unit process has the highest exposure to the workers. Moreover, Butadiene turned out to have the highest inhalative exposure to the workers in this unit process. Regarding dermal route, the highest score was assigned to the blending unit process and it was shown that Tetrakis (dimethylamino) ethylene (TDAE) in the blending unit process had the highest dermal exposure to the workers. Later, toxicological exposure potential of the carpet (product) was calculated. The result showed that carpet production has toxic exposure potentials on workers. However, workers are more exposed to the toxic chemicals through inhalation than dermal route. Furthermore, it was found that Butadiene (through the inhalation route) and TDAE (via dermal route) have the highest toxic exposure potentials to workers along the entire life cycle production of the carpet. These demonstrate that ProScale is perfectly capable of assessing toxicological exposure potentials for different chemicals, unit processes, and exposure routes in the entire life cycle of a product.