

Air exposure assessment of TDI and biological monitoring of TDA in urine in workers in polyurethane foam industry

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ABSTRACT

Objectives. Toluene diisocyanate (TDI) is used in the manufacturing process of polyurethane foams and is a potent inducer of occupational asthma. The objective of this study was to evaluate the correlation between the exposure to total TDI (2,4- and 2,6-TDI) in air and the corresponding biomarker concentration of total TDA (2,4- and 2,6-TDA) in hydrolyzed urine. The aim also is to propose an appropriate biological exposure limit for total TDA in urine.

Methods. Nine workers from two production lines in a foam producing plant were studied. Personal exposure to TDI during four representative full-shifts was monitored by an active air sampling method (filter impregnated with 1-(2-methoxyphenyl)piperazine) and quantified by high-performance liquid chromatography (HPLC) and diode array detection (NIOSH n° 2535, 5521). In parallel, pre-shift and post-shift urinary samples were collected from the exposed workers and TDA concentrations were determined by gas chromatography-mass spectrometry (GC-MS). All these samples were collected on four measuring days: two Fridays (end of workweek) and two Mondays (start of workweek) both separated by a weekend without exposure.

Results. Strong correlations between the personal air concentrations of total TDI and the corresponding biomarker levels of total TDA in urine ($r=0.816$) were observed. An increase of $18.12 \mu\text{g TDA/l}$ (post- minus pre-shift concentration) corresponds to an exposure of 5 ppb ($37 \mu\text{g/m}^3$, the current ACGIH TLV) during the shift.

Conclusions. The increase in TDA during the shift is a suitable biomarker for exposure to TDI during the same shift. Further research is needed to evaluate the use of end of week post-shift TDA in urine as biomarker since TDA was found to accumulate during the working week.