
Letter to the Editor

Styrene oxide in the manufacture of reinforced polyester plastics

Many studies are currently being aimed at the evaluation of the potential carcinogenicity of styrene and the risk that styrene production and use may carry for exposed workers.

The presumed cancer risk has been related to styrene oxide, a metabolic intermediate of styrene biotransformation. Styrene oxide — contrary to styrene — is mutagenic in various test systems without metabolic activation (4, 6). It was tested to some extent by application to the skin of mice in the beginning of the sixties (5), and van Duuren (1, 2), has concluded that it is a weak carcinogen in this respect. However, an IARC monograph (3) does not agree with this conclusion.

The lack of carcinogenicity studies with styrene oxide may be the result of the fact that few have realized that workers may be directly exposed to styrene oxide rather than only indirectly as a metabolite of styrene.

In the production of reinforced plastics a curing agent (peroxides) is added to polyester (containing about 40 % styrene) to start the polymerization process. Mixing styrene and peroxides should lead to the formation of styrene oxide, and we have identified and quantified this compound in the workroom atmosphere. Thus workers in the reinforced plastics industry are exposed directly to both styrene and styrene oxide. Until now, the search for increased cancer risk from styrene exposure has been carried out primarily among workers producing mono- and poly-

styrene. These workers are not exposed to styrene oxide.

The samples analyzed in this study were collected in a factory producing car parts, biological toilets and radar antenna protection shields from reinforced polyester plastics. Styrene was used both as a solvent and as a monomer, and it was polymerized by means of methyl ethyl ketone peroxide, methylcyclohexanone peroxide or acetylacetone peroxide.

Samples were collected by personal samplers consisting of a small battery-driven (air) pump and a charcoal sampling tube. The tubes were located in the breathing zone of the worker during the sampling period (2 h). The samples were eluted with 5 ml of carbon disulfide and analyzed on a Carlo Erba Fractovap 2151 gas chromatograph with a flame ionization detector (FID). A glass column (length 2 m, internal diameter 4 mm), packed with 3 % OV-17 on Supelcoport (80/100 mesh), was used. The column temperature was 100°C, and the nitrogen flow 35 ml/min. The detection limit for styrene oxide by this procedure is 0.003 ppm.

A further identification of styrene oxide was achieved also by means of high performance liquid chromatographic analyses (column 250 mm, Nucleosil 100 — 5, internal diameter 4.6 mm, eluted with isooctane 1.4 ml/min, sample vol. 50 µl, UV detector at 225 nm).

The values found ranged from about 30 to 300 ppm for styrene and from not detectable to 0.12 ppm for styrene oxide. The relative styrene oxide content in styrene varied between about 0.001 % to 0.13 %; the production of biological toilets

Table 1. Atmospheric styrene oxide concentrations measured during the manufacture of reinforced polyester plastics (mainly personal samples).^a

Type of production	Number of samples	Styrene (ppm)		Styrene oxide (ppm $\times 10^{-3}$)		Styrene oxide relative to styrene (%)	
		Median	Range	Median	Range	Median	Range
Mudguards	5	54	28—170	38	28—86	0.083	0.022—0.103
Car bodies	6	108	65—278	48	12—71	0.036	0.018—0.055
Other car parts	2		31—51		29—64		0.094—0.125
Fiber machines	2		17—46		< 3—4		0.009—0.018
Antenna elements	2		89—102		41—65		0.046—0.064
Biological toilets	4	147	83—289	19	16—28	0.011	0.008—0.034

^a One single stationary sample, not analyzed on styrene, showed 0.12 ppm styrene oxide.

produced smaller concentrations (0.001 to 0.034 %) than the other production types (table 1).

These results indicate that, in addition to styrene exposure, direct exposure to styrene oxide may constitute a risk in the reinforced polyester plastics industry.

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P. E. Fjeldstad, S. Thorud and A. Wannag
Institute of Occupational Health
Oslo
Norway