

Four volunteers were exposed on nine occasions. For eight of these exposures they wore air-fed half-masks to cut off the inhalation route. The "baseline" conditions were 25°C, 40% relative humidity, with volunteers wearing shorts and T-shirt. For each subsequent exposure, a single parameter was changed: humidity (60%, 30%), temperature (20°C, 30°C) and clothing (minimal, overalls). Finally, a "worst-case scenario" was conducted, combining the individual parameters that produced the highest dermal absorption.

Results show that baseline dermal absorption of 2-butoxyethanol vapor is, on average, 11% of the total absorbed dose. There is some indication that high temperature, high humidity, and minimal clothing might slightly increase absorption (means 14%, 13%, and 12%, respectively). The wearing of whole-body overalls did not attenuate absorption (mean 10%).

The work has shown that dermal absorption of vapors can be significant and that environmental conditions may possibly affect the absorption. Some types of protective clothing might not be suitable in significantly mitigating absorption. The possibility of dermal absorption of vapors should be considered particularly in high vapor concentration situations where control of exposure relies on respiratory protection.

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THE EFFECTS OF BENZO[A]PYRENE-INDUCED SKIN CYTOCHROME P450 ELEVATION ON 3,3',4,4'-TETRACHLOROBIPHENYL PERCUTANEOUS ABSORPTION AND TISSUE DISPOSITION. G. Qiao, NIOSH, Morgantown, WV; J. Riviere, North Carolina State University, Raleigh, NC

Skin metabolism has considerable impact on cutaneous and systemic risk of a topically exposed toxicant by changing its disposition and activity.

Workers could be exposed to both 3,3',4,4'-tetrachlorobiphenyl (TCB) and benzo[a]pyrene via the dermal route. To quantify skin cytochrome (Cyt) P450 induction effects on dermal absorption and local disposition, [¹⁴C]TCB was topically applied in vivo (n = 3), ex vivo (isolated perfused porcine skin flap, n = 4), and in vitro (flow-through diffusion cells, n = 6-9) to porcine models at 40 mg/cm² skin surface with or without Cyt P450 inducer benzo[a]pyrene pretreatment.

It was found that skin Cyt P450 induction enhanced ¹⁴C absorption in all models tested. Total 8-hour ex vivo (0.11%-0.46%) and in vitro (0.21%-0.48%) ¹⁴C absorption was increased 2-4 fold by skin P450 induction. The in vivo excretion via renal and fecal routes accounted for 5% and 9% of the doses. However, if the observation time was prolonged to 11 days as in the in vivo studies, the total absorption was 23%-30% regardless of skin Cyt P450 status, suggesting that the extended observation period may conceal the impact of modified skin metabolism on dermal absorption.

Skin Cyt P450 induction also changed label penetration depth and distribution pattern in local cutaneous tissues, suggesting that the enhanced cutaneous TCB metabolism may change the toxicity profile (cutaneous vs. systemic). On average, 82% of the topical doses were recovered.

It was concluded that the effects of cutaneous metabolism manipulation by pre-exposed or co-administered enzyme inducer(s) such as benzo[a]pyrene need to be taken into account for occupational and environmental dermal risk assessment. The mechanisms for such cutaneous Cyt P450

induction effects on total dermal absorption and disposition need to be further elucidated.

This study was supported by EPA CR 824007.

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A DERMAL SAMPLING METHOD FOR MEASURING SKIN EXPOSURE TO MULTIFUNCTIONAL ACRYLATES. L. Nylander-French, J. Surakka, University of North Carolina at Chapel Hill, Chapel Hill, NC

Dermal exposure to skin irritants and allergens, such as acrylates, is significant, but current methods for exposure assessment are insufficient. We have developed and tested a dermal sampling method for measuring skin exposure to a multifunctional acrylate using tape stripping of the nonviable epidermis (stratum corneum), extraction, and quantification by gas chromatography (GC).

We tested this method in 10 human volunteers exposed to 2.5 µL of neat tripropylene glycol diacrylate (TPGDA) or 2.5 µL of neat UV-curable acrylate coating containing TPGDA (UV-resin) at different sites on hands and arms. On average, the first tape stripping removed 94% of the theoretical quantity of TPGDA and 89% of the theoretical quantity of deposited TPGDA in the UV-resin after 30-minute exposures.

Two consecutive tape strippings removed 102% and 113%, of TPGDA or TPGDA in UV-resin, respectively. Coefficient of variation varied between 11% and 16% for all the sites and between 5% and 24% for the individual sites.

In general, recoveries for the first tape stripping were 10%-15% higher for TPGDA than for UV-resin, while the second tape stripping was 10%-15% lower for TPGDA than for UV-resin. However, when the average recoveries in the first tape stripping for TPGDA or TPGDA in UV-resin from the five different individual sites were compared, no significant difference was observed (p = 0.111 and p = 0.893, respectively).

No significant difference was observed in recovery between TPGDA and UV-resin for the first tape stripping when calculated as of percentage of the theoretical amount (p = 0.262). This tape-stripping method provides a simple and affordable noninvasive method for quantifying recent dermal exposures to multifunctional acrylates for exposure assessment.

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PREDICTING DERMAL EXPOSURE TO JET FUEL (NAPHTHALENE) USING AN ADHESIVE TAPE-STRIPPING METHOD. D. Mattorano, L. Nylander-French, University of North Carolina, Department of Environmental Sciences and Engineering, School of Public Health, Chapel Hill, NC

A noninvasive dermal sampling procedure was developed and tested to predict dermal exposure to jet fuel using tape-stripping of the nonviable epidermis (stratum corneum), extraction, and quantification by gas chromatography/mass spectrometry (GC/MS). Naphthalene was used as a marker for jet fuel (JP-8) exposure.

The method was tested in 20 human volunteers (10 male and 10 female) exposed to 25 µL of jet fuel (neat) at two sites on the ventral surface of each arm (four sites total). One additional site per arm was selected as an unexposed control area.

Jet fuel was applied by using an aluminum application chamber and a calibrated micropipette. Cover-Rollâ adhesive tape (BeiERSdorf AG, Germany), pre-cut in size to 2.5 cm × 4 cm, was applied to the exposed or unexposed site. After two minutes, the

Cover-Rollâ tape was removed carefully by pulling at an angle of 45° using clean forceps.

The samples were collected 5, 10, 15, or 20 minutes after fuel application. The tape-stripping samples were placed in vials containing 5 mL acetone and sealed for storage until analyzed. The data collected were fit to a second-order polynomial model. This model was able to predict the amount of jet fuel initially applied to skin when taking into account evaporation, perfusion away from the application site, and loss due to residual agent remaining on chamber walls after removal from the skin.

These results indicate that the tape-stripping technique developed can be used to predict dermal exposure to jet fuel.

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FACTORS INFLUENCING FILTER PENETRATION AND QUALITY. C. Chen, S. Huang, National Taiwan University, Taipei, Taiwan Republic of China; C. Chen, Institute of Occupational Safety and Health, CLA, Taipei, Taiwan Republic of China; Y. Huang, Center for Industrial Safety and Health Technology, ITRI, Hsinchu, Taiwan Republic of China

Air filtration is a complex process, so the establishment of an effectual filter test protocol is never an easy task. In the present study, a theoretical model is used to examine the factors that might affect the filtration characteristics of filters for respiratory protection.

The major operational parameters included face velocity, fiber diameter, packing density, filter thickness, and fiber charge density. The characteristics of the most penetrating size were demonstrated under the same ranges of operational parameters.

The results show that aerosol penetration through filter media increases with increasing face velocity or fiber diameter, and decreases as packing density, thickness, or fiber charge density decrease. The face velocity and fiber charge density have more significant effects on the filter quality than the other factors. The filter quality increases with decreasing face velocity or increasing fiber charge density.

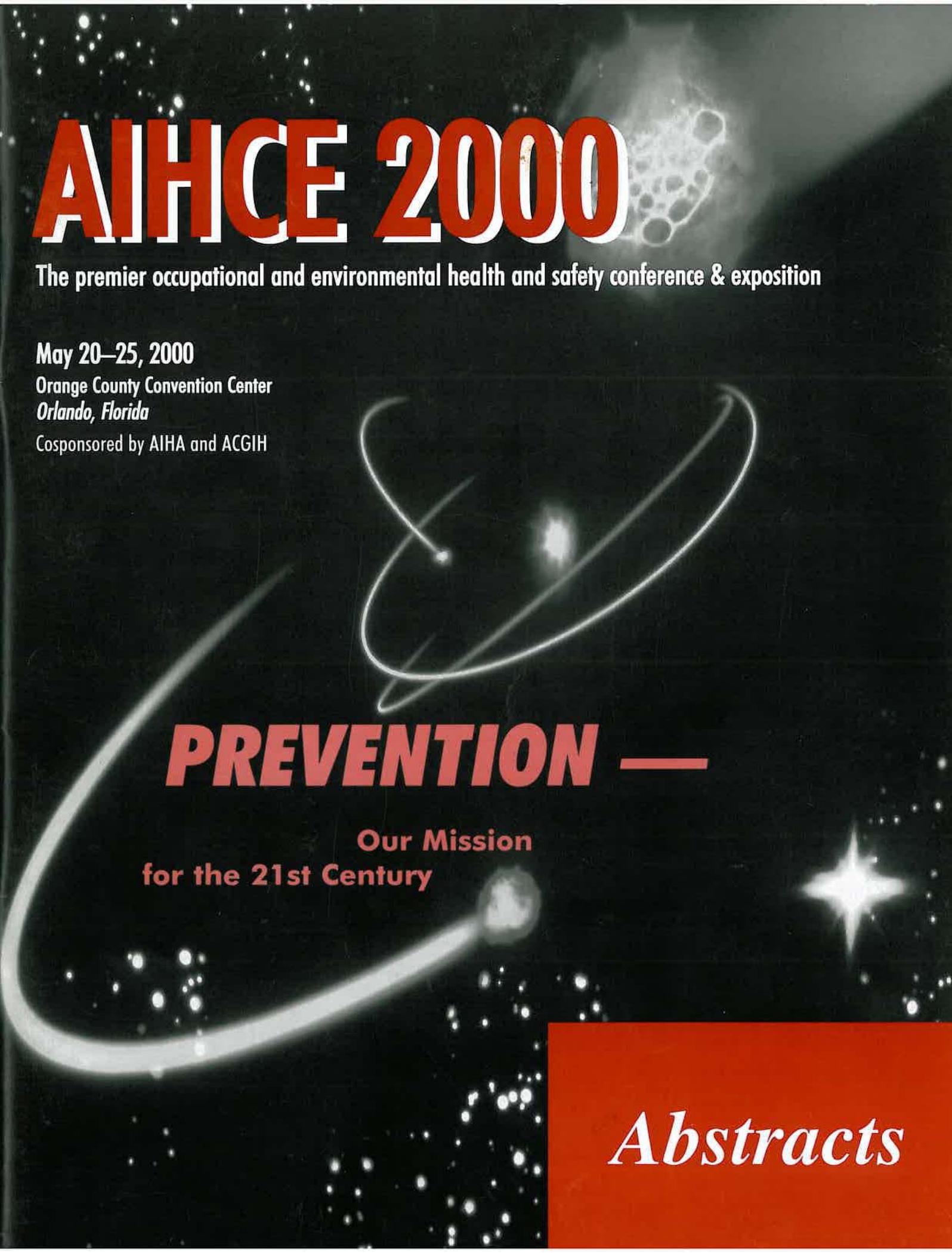
For electret filters, the most penetrating size increases with increasing fiber diameter. The increase in packing density, thickness, and fiber charge density would cause the most penetrating size to decrease. The most penetrating size through electret filters increases with increasing filtration velocity or decreasing filter thickness, whereas for non-electret filter media the most penetrating size increases with decreasing face velocity and is not affected by the filter thickness.

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POWERED AIR-PURIFYING PARTICULATE RESPIRATOR FILTER PENETRATION BY DOP AEROSOL. S. Martin, E. Moyer, NIOSH, Morgantown, WV

With the inception of 42 CFR 84, the old 30 CFR 11 regulations for nonpowered, air-purifying particulate respirators were replaced with new, more demanding certification requirements. However, the updated 42 CFR 84 regulations only changed the requirements for negative-pressure particulate respirators. The certification requirements for powered air-purifying respirators (PAPRs), were copied directly from 30 CFR 11 without any major changes. PAPR filters are still certified based on their performance using the silica dust test.

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