based printing inks, asphalt and tar, furniture stains, adhesives of various types, and so on. In some situations it maybe possible to wear protective equipment (PE), e.g., gloves, and avoid the soil. However, for many reasons, most workers choose not to wear PE and are faced with the task of removing these soils for both aesthetic and skin health reasons.

Selection and development of cleansers in the past has relied on one of the following methods:

1) Just try it, you'll like it
2) In use testing
3) Modified ASTM hard surface cleanser testing utilizing vinyl floor tiles
4) Ad hoc visual lab testing

Market research testing identified cleaning as the number one need-a must for industrial workers. The only available laboratory test for cleaning was a modified ASTM method for evaluating hard surface cleansers using vinyl floor tiles. However, vinyl floor tile and human skin are hardly the same. An in vivo method was developed utilizing a ChromaMeter to read skin color with a defined soiling and cleansing protocol. The ChromaMeter results were correlated to a visual grading scale and found to be statistically in agreement with the human eye. Subsequent end user testing validated the method as being predictive of end user perceptions. This test method is unique to the industrial cleansing market and provides a quantitative laboratory method for development and evaluation of cleansing formulations.

This paper discusses the basis for the testing procedure, correlation of the instrument measurements to the human eye, and finally validation with in use data.

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KEROSENE CLEANING DISTURBS THE BARRIER FUNCTION OF THE SKIN AND ALTERS THE ORGAN DISTRIBUTION OF BAP APPLIED TOPICALLY IN MICE. G. Talaska, C. LaDow, B. Schumann, N. Luce, D. Warshawsky, University of Cincinnati, Cincinnati, OH; B. Pickens, S. Hoath, Children"s Hospital, Cincinnati, OH.

Kerosene cleaning following treatment with used gasoline engine oil, a complex mixture containing polycyclic aromatic hydrocarbons, increased the relative and absolute levels of DNA adducts in the lungs of mice relative to animals treated with the used oil alone. To determine the mechanism for the effect we topically treated animals with 3H-BAP(100 nMol in 25 ul acetone) and washed ½ the animals with 25 ul kerosene 1 hour after the carcinogen application. Groups of 4 mice were sacrificed at 1, 4, 12, 24, 48 and 72 hours after the BAP treatment and lung, liver and skin were harvested. The levels of radioactivity were determined in each tissue and DNA was also isolated for determination of BAP-DNA adduct levels. The fraction of the radiolabel which remained in the skin of the animals treated with BAP but not washed with kerosene was 99.9 (std = 0.1), 98.1 (1.0), 91.6 (4.6), 99 (0.5), 98.6 (0.6) and 86.9% (7.4), respectively for each time point. In the animals that were washed with kerosene the comparative levels were 99.5 (0.1), 96.7 (1.3), 97.6 (1.0), 77.3 (9.2), 64.6 (9.1) and 69% (13.5). respectively. The relative fractions at 24 and 48, but not 72 hours were statistically significantly different at the 0.05 level between the two groups. At these same time points the fraction distribution to the lungs and livers of the kerosene washed animals were significantly elevated. In addition, we have found that kerosene increases the transdermal water loss following both single and multiple treatments. These data suggest that even a single small volume treatment with kerosene compromises the protective capabilities of the skin and enhances absorption topical carcinogens and alters their internal distribution. Work supported by NIOSH 1R01-oho-4124.

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CHEMICAL PROTECTIVE GLOVES — IN-USE PROTECTION TIME VS. STANDARD BREAKTHROUGH TIME. R. Oppl, MILJOE-CHEMIE, Hamburg, Germany.

Avoiding chemical skin contact is the best way to control dermal exposure and skin disease. Protective gloves can reduce the residual risk. Protection time is determined by the glove permeability. A research project on the significance of permeation testing standards for in-use conditions was funded by the German Work Insurance with additional support by the German Chemical Industry and a glove manufacturer. A test procedure was developed using the standard test cell but with simulation of in-use conditions (35°C inside glove temperature and 20 % length stretching), and of short-term exposure and re-use if relevant. The procedure was applied to 5 chemical products containing volatile organic solvents. A total of 19 gloves were tested. Testing with in-use simulation gave protection times of only 1/2 or even 1/3 when compared to standard test results. ASTM 739 or EN 374-3 testing standards proved to be insufficient for in-use conditions. Elevated temperature inside glove due to body heat was the most important factor. Short-term or occasional exposure was also important. Mechanical stretching due to hand moving showed to be of minor importance. Glove selection based on polymer type (e.g., "nitrile glove") showed to be misleading as there are huge differences of barrier properties within these categories depending on raw material, production technique (e.g., cross-bonding) and glove thickness. Compared to information available in databases on protective gloves, the test results in many cases allowed a more specific glove selection — particularly if the use pattern included short time exposure only. Based on the reported findings, there are considerations in Europe on establishment of a legal claim to recommend gloves with their brand names within Safety Data Sheets. A guidance on selection of gloves with sufficient barrier properties in use was developed for uses in the field.

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A COMPARATIVE ANALYSIS OF GLOVE PERMEATION RESISTANCE TO PAINT STRIPPING FORMULATIONS. J. Stull, International Personnel Protection, Inc., Austin, TX; L. James, BASF Corporation, Wyandotte, MI.

Although there are a wide variety of work gloves available to users of commercial paint stripping products, there are no published studies examining which type of gloves provide the best protection. To address this need, a multiphase study was undertaken to evaluate how several types of gloves resist multi-chemical based paint stripping formulations. A unique feature of the study was its focus on identifying acceptable gloves easily available to the average customer. Due to the wide range of commercial paint stripping formulations available, seven categories of analog paint stripper formulations were created to evaluate glove performance initially. Twenty different glove types were identified for initial evaluation. Degradation resistance screening was carried out for each glove style and paint stripping formulation. Screening results were used to identify those glove styles least affected by the analog paint strippers. Those gloves were then evaluated for their resistance to permeation using continuous contact testing. Glove styles showing extensive permeation with early breakthrough were then evaluated to see how they performed with only intermittent contact with the analog paint strippers. These results were used to select glove styles to be tested using commercially available paint stripping products. Gloves made of plastic laminate and butyl rubber were the most effective against the majority of paint strippers. More glove styles resisted permeation by N-methylpyrrolidone and dibasic ester-based paint strippers than conventional solvent products such as methylene chloride, methanol, isopropanol, acetone, and toluene. The study also found that decreased contact time caused relatively little change in permeation resistance and that the analog paint stripper data did not always accurately predict resistance to the commercial paint stripper formulations.

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THE FINNISH SCHOOL KITCHEN STUDY — QUESTIONNAIRE AND OCCUPATIONAL HYGIENE SURVEYS. P. Kalliokoski, University of Kuopio/University of Michigan, Kuopio/Ann Arbor, MI; T. Husman, A. Vepsalainen, A. Nevalainen, U. Lignell, National Public Health Institute, Kuopio, Finland.

Large quantities of water are used daily in the institutional kitchens to wash various surfaces. This study was conducted to investigate whether this will promote microbial growth and cause adverse health effects among the kitchen workers. Occupational hygiene surveys were carried out in eight school kitchens. In addition, questionnaires on the health status and symptoms of kitchen workers and indoor climate conditions were sent to 360 randomly selected schools in Finland. The answers were received from 175 (48.6%) schools. The office personnel of the same schools were used as references. The measurements revealed that fungal counts were low both in the air and on surfaces whereas some high bacterial counts were encountered. In addition, the presence of potentially toxic Bacillus cereus and mycobacteria were detected. Storage mites were also found in the kitchens. Perceived air quality was poorer and more moldy odors were reported in the kitchens than in the offices. Slightly more than half of the kitchen workers had noticed visible signs of moisture damages. The differences between the groups were small as far as the respiratory symptoms are concerned. Nose bleeding was the only respiratory symptom that was significantly more common among the kitchen workers. On the other hand, kitchen workers had significantly more vertigo, memory disturbances, excessive sweating, irritativeness, nightmares, muscle and low back pain, joint aches, and skin symptoms than the office personnel. Some of these differences are expected and explained by the differences in work, e.g., sweating and skin irritation. However, visible signs of moisaihce

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ABSTRACTS