measurements in the field: the Dräger CMS and the UltraRAE specific vapor monitor. The former is essentially an automated tube reader and the latter a photoionization detector with a pre-tube that removes interferences. In a series of tests at oil refineries, these two methods were compared with established methods including the Photovac Snapshot portable GC, and laboratory GC analysis.

All the field instruments gave detection limits of 0.1 ppm and were relatively unaffected by humidity. The advantages of the CMS included small size, simple operation, and no calibration requirements; its range was up to 10 ppm benzene. The UltraRAE had rapid response time (<2 min.), small size, simple operation, and good accuracy; its range was up to about 100 ppm benzene and 500 ppm total hydrocarbons. The Snapshot gave good accuracy in the presence of at least 1000 ppm total hydrocarbons. The field methods gave enough accuracy to make them useful for personal protective equipment decisions.

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A COMPARISON OF TRACER GAS ANALYTICAL TECHNIQUES: INFRARED ABSORPTION AND GAS CHROMATOGRAPHY-ELECTRON CAPTURE DETECTION. C.B. Keil, Bowling Green State University, Bowling Green, OH

Sulfur hexafluoride (SF6) is commonly used as a tracer gas for a variety of occupational health applications. SF6 has been used in evaluating general ventilation and air mixing indoors, testing the effectiveness of local exhaust ventilation, and checking for the recirculation of exhaust air.

Two common methods of analyzing air samples for SF6 concentrations are the use of infrared absorption and gas chromatography. These methods were compared under both laboratory and field conditions. One method was a factory calibrated Foxboro Miran 1B portable infrared analyzer. The other method consisted of whole air syringe sampling with subsequent analysis on a calibrated bench-top gas chromatograph equipped with an electron capture detector (GC-ECD).

Comparison tests were done for four scenarios. The first was the analysis of a known concentration lab standard. Next, SF6 was released at a known rate in a room that approached well-mixed conditions due to the use of fans to mix the air in the room. The last scenario consisted of known SF6 release rates in two rooms under normal ventilation conditions. When room sampling was done, syringe samples were taken immediately adjacent to the Miran inlet.

For well-mixed situations the two methods were in good agreement at concentrations greater than 3 ppm ($p<0.05$). In situations where the air was less than well-mixed and may have had concentration gradients, the Miran results were significantly lower than the GC-ECD results ($p<0.05$). This may be the result of the flow field induced by the Miran sampling, but requires further study. Additional investigation of these tracer gas analysis techniques is needed to ensure their appropriate use in industrial hygiene investigations.

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PERFORMANCE COMPARISON OF RESPIRABLE SAMPLERS. C-C. Chen, C. Lai, National Taiwan University, Taipei, Taiwan; T. Shih, Institute of Occupational Safety and Health, Council of Labor Affairs, Taipei, Taiwan

Three products of respirable samplers (nylon cyclone, SKC cyclone, and foam sampler) were tested for aerosol penetration as a function of aerosol size, to examine the precision and the accuracy with respect to the newly defined respirable convention. An ultrasonic atomizing nozzle was used to generate micrometer-sized liquid DOP or solid potassium sodium tartrate aerosol particles, with count median diameters of 3 to 8 mm, and geometric standard deviation of 1.65. The aerosol number concentration and size distribution upstream and downstream of the sampler were measured by using an Aerodynamic Particle Sizer.

The newly designed foam sampler was found to be ideal for sampling liquid aerosols, provided the airborne pollutants do not react chemically with the foam, as this may result in change in foam filtration properties, such as packing density and foam thickness. Foam samplers had a better fit to the ISO respirable convention and, therefore, the bias caused by the foam sample was less. Extra attention was paid to the manual fabrication process of foam samplers, since only a small number of foam samplers were needed in present study. Thus, it may be unjust to conclude on the higher precision of the foam sampler compared with the cyclone samplers, as the latter were mass-produced. Indeed, the nylon cyclone and SKC cyclone showed approximately the same level of precision and bias. In order to consider both accuracy and precision, the mean square error should be used to judge the performance of the samplers. The foam sampler was found to be ideal for liquid DOP aerosols. The foam was comparatively better than the cyclones when solid particles like potassium sodium tartrate were used, provided the particle size was smaller than 5 mm. The foam sampler performed very poorly when solid particles larger than 10 mm were used.

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NEW PROTOCOL FOR TESTING PERSONAL INHALABLE AEROSOL SAMPLERS: WIND TUNNEL EVALUATION. V. Aizenberg, S. Grinshpun, K. Willeke, O. Witschger, University of Cincinnati, OH; J. Smith, P. Baron, NIOSH, Cincinnati, OH

Modern industrial hygiene puts ever-increasing demands on the monitoring of workplace airborne particular contaminants. Several personal inhalable aerosol samplers are currently widely used and more are under development. Accordingly, it is well recognized that establishing an accurate, precise, and less costly sampler performance testing protocol is essential.

In our recent study, we introduced a simplified aerosol sampler performance testing protocol. The main innovation of this protocol was a small rectangular simplified torso, 33 H 21 H 21 cm^3, that can be used in significantly smaller wind tunnels. The simplified torso simultaneously collects samples in three primary orientations: 0 , 90, and 180 degrees. In the present study, we extensively tested and substantially enhanced this new protocol. Three commercially available samplers (the GSP, IOM, and 37-mm closed-faced cassette) and a recently developed "button" sampler were evaluated in a large cross-section wind tunnel. The samplers were tested at two wind velocities (50 and 200 cm/s) and three orientations (0, 90, and 180 degrees). Three particle sizes (7, 29, and 70 mm) were used.

Analysis of variance has been done on the samplers' performance data. It shows that aerosol sampling efficiency demonstrated by all four samplers mounted on the simplified torso is statistically not different from when they are mounted on the full-size manikin. Thus, the simplified protocol to a large extent meets requirements set by the IH and aerosol communities on the testing of personal aerosol samplers.

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OCCUPATIONAL HEALTH STANDARDS AND THE ROLE OF THE OCCUPATIONAL HYGIENE SPECIALIST: AN OUTSIDER'S VIEW OF THE RUSSIAN EXPERIENCE. J.H. Vincent, University of Minnesota, Minneapolis, MN; Y. Thomassen, National Institute of Occupational Health, Oslo, Norway; E. Nieboer, McMaster University Hamilton, ON, Canada

The authors visited Russia in February 1997 and met with senior officials in the Russian Federation Department of Sanitary and Epidemiological Surveillance in both Moscow and St. Petersburg. The purpose of the visit was to learn about the development and application of occupational health standards in that country, and to see how these were similar to and different from the approaches taken in other countries. Russian occupational exposure standards are very stringent and so, in principle, provide a very high level of protection of workers. However, based on experience in the West, we know that these are difficult to enforce. Indeed, it is not clear to what extent the Russian exposure standards are enforced. Based on the observations of these outsiders, it is suggested that the development of a strong and distinctive occupational hygiene discipline and profession in Russia would provide a bridge to enable more effective implementation and interpretation of those standards.

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OCCUPATIONAL HYGIENE IN VIETNAM: CHALLENGES AND OPPORTUNITIES. M.A. Waters, T. Meinhardt, R. Mullan, M. Nguyen, NIOSH, Cincinnati, OH

NIOSH representatives were hosted by the Vietnamese National Institute of Occupational and Environmental Health (VNIOEH) in the Ministry of Health to determine needs for the development of occupational hygiene in Vietnam. Occupational health organizations and workplaces visited included VNIOEH, Labour Protection Institute, provincial preventive medicine and occupational health centers, medical and public health schools, coal mine, tobacco factory, rubber plantation and manufacturing facility, farms, construction sites, and small business enterprises.

The Vietnamese work as part of an informal economy in which the vast majority (approxi-

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