

## RESPIRATOR ARTICLE ABSTRACTS

We review the articles published in the American Industrial Hygiene Association Journal and the Applied Occupational and Environmental Hygiene Journal for information that is applicable to the field of respiratory protection; we then publish abstracts of these articles. We appreciate the cooperation of the American Industrial Hygiene Association and the American Conference of Governmental Hygienists in allowing us to do this.—Ed.

"Respirator Cartridge Service-Life: Exposure to Mixtures" by Young Hee Yoon, James H. Nelson, and Jaime Lara, *American Industrial Hygiene Association Journal*, September 57:809–819, 1996.

Expressions associated with a previously developed procedure to assess respirator cartridge service-life were modified to address the cartridge breakthrough properties of each of individual compounds comprising systems with more than two components. These were applied to specific ternary and quaternary test mixtures. Experimental breakthrough data were collected for (1) acetone/cyclohexane/toluene, (2) ethyl acetate/cyclohexane/toluene, (3) cyclohexane/toluene/m-xylene, (4) ethyl acetate/cyclohexane/toluene/m-xylene, and (5) acetone/cyclohexane/toluene/m-xylene. Data indicate that as an exposure experiment proceeds, a compound that is adsorbed relatively weakly by the carbon bed may be displaced by a more strongly adsorbed component, which may result in a breakthrough concentration for displaced compounds that exceeds the challenge concentration in the mixture. The approach described accounts for the displacement phenomenon and can predict the ratio of the number of displaced molecules to the corresponding number of displacing molecules. Experimental data for each multicomponent system were used to determine values of three parameters ( $k'$ ,  $\tau$  and  $A_m$ ) for each compound in each challenge system. The value  $k'$  characterizes the rate of adsorption of a compound under applicable experimental conditions,  $\tau$  indicates the capacity of the charcoal, and  $A_m$  describes the effectiveness of a compound in displacing a previously adsorbed compound. Parameter values were applied to calculate complete breakthrough curves for each compound of each mixture. Calculated curves were compared with corresponding experimental data; reasonable agreement justifies simplifying assumptions incorporated into the application of the approach to mixtures of more than two compounds. The time-dependence of the weight of each compound adsorbed by the carbon was calculated. The service-life of respirator cartridges exposed to multicomponent mixtures depends on the challenge concentration of each component of the system and is significantly influenced by the displacement effect. The adsorption capacity of the carbon and the breakthrough time for weakly adsorbed compounds are decreased significantly by exposure to mixtures.

"The Assigned Protection Factor According to ANSI" by T.J. Nelson, *American Industrial Hygiene Association Journal*, August 57:735–740, 1996.

The American National Standards Institute (ANSI) standard for respiratory protection (ANSI Z88.2 1992) lists assigned protection factors (APFs) for various respirators. The committee that developed the APFs based its decisions on a review of available studies of respirator performance. If workplace studies were available, these formed the basis for the number assigned. If no such studies were available, then laboratory studies, design analogies, and other information were used to decide what value to assign. For half-mask air purifying respirators, four workplace protection factor studies were consulted to arrive at an APF. For loose-fitting facepiece powered air purifying respirators (PAPRs), five workplace studies and two laboratory studies were reviewed. For full-face air purifying, helmet/hooded PAPRs, and most supplied air respirators, no work-

place studies were available. The APF was based on laboratory studies or decided by analogy to other equipment. For the remaining respirators only single workplace protection factor studies were available, and these were used by the committee to assign an APF. The database available to the ANSI committee was limited. Most of the studies available for review were not published. The committee in a sense was required to perform peer review on the information to use the data. Studies completed after the ANSI committee finished its deliberations, when added to the data used, continue to support the APFs assigned by ANSI.

"The Effect of Vapor Polarity and Boiling Point on Breakthrough for Binary Mixtures on Respirator Carbon" by Coreen A. Robbins and Patrick N. Breysse, *American Industrial Hygiene Association Journal*, August 57:717-723, 1996.

This research evaluated the effect of the polarity of a second vapor on the adsorption of a polar and a nonpolar vapor using the Wheeler model. To examine the effect of polarity, it was also necessary to observe the effect of component boiling point. The 1% breakthrough time ( $1\% t_b$ ), kinetic adsorption capacity ( $W_e$ ), and rate constant ( $k_v$ ) of the Wheeler model were determined for vapor challenges on carbon beds for both p-xylene and pyrrole (referred to as test vapors) individually and in equimolar binary mixtures with the polar and nonpolar vapors toluene, p-fluorotoluene, o-dichlorobenzene, and p-dichlorobenzene (referred to as probe vapors). Probe vapor polarity (0 to 2.5 Debye) did not systematically alter the  $1\% t_b$ ,  $W_e$ , or  $k_v$  of the test vapors. The  $1\% t_b$  and  $W_e$  for test vapors in binary mixtures *can* be estimated reasonably well, using the Wheeler model, from single-vapor data ( $1\% t_b \pm 30\%$ ,  $W_e \pm 20\%$ ). The test vapor  $1\% t_b$  depended mainly on total vapor concentration in both single and binary systems.  $W_e$  was proportional to test vapor fractional molar concentration (mole fraction) in mixtures. The  $k_v$  for p-xylene was significantly different ( $p \leq 0.001$ ) when compared according to probe boiling point; however, these differences were apparently of limited importance in estimating  $1\% t_b$  for the range of boiling points tested (111 to 180°C). Although the polarity and boiling point of chemicals in the range tested are not practically important in predicting  $1\% t_b$  with the Wheeler model, an effect due to probe boiling point is suggested, and tests with chemicals of more widely ranging boiling point are warranted. Since the  $1\% t_b$ , and thus, respirator service life, depends mainly on total vapor concentration, these data underscore the importance of taking into account the presence of other vapors when estimating respirator service life for a vapor in a mixture.

