Performance Efficiency of Respirator's Chemical Cartridges Available in the Philippine Market

Research Paper No. 1992-01

Department of Labor and Employment
Occupational Safety and Health Center
North Avenue corner Agham Road,
Diliman, Quezon City, Philippines

Performance Efficiency of Respirator's Chemical Cartridges Available in the Philippine Market

Abstract

A laboratory experiment to determine the service lives of gas/vapor cartridges available in the local market was conducted by the ECD/OSHC. Eighteen different models (90pcs.) of cartridges were subjected to the same laboratory procedures and the breakthrough times were measured. Several predictive equations were reviewed and considered to find the best method of predicting the service life of a specified model of respirator cartridge without having to test each cartridge against CCl4 vapor. These were used as bases for the actual testing done in the laboratory. Breakthrough times which resulted from the laboratory experiment were compared with that of the breakthrough times predicted from modified Wheeler and Nelson's equations.

Results showed that 90 % of the samples tested had breakthrough times of 50 minutes and over. It is also showed that while the Wheeler equation predicted breakthrough times which are nearer the experimental ones, calculated breakthrough by Nelson's equation were largely different.

The test results have provided some information not only on the performance efficiencies of gas/vapor cartridges available in the market but also on the improved test method and predictive equations for the certification of gas/vapor cartridges. Recommendations were given on the most suitable testing method and predictive equation. It is also suggested that reworking the certification programs test conditions for vapor cartridges be made based on the evaluated results.

Summary

Eighteen models of commercially available chemical cartridges were tested using only one laboratory method and breakthrough times were measured. Experimental determination of cartridge breakthrough time was done using carbon tetrachloride as test gas. Several predictive equations were reviewed and used to predict the service lives of chemical cartridges without having to test each cartridge against CCl4 vapor. These were Nelson's equation, Klotz equation, Modified Wheeler equation and Mecklenburg equation.

For the laboratory part of the study, cartridges of each type were disassembled, carbon were sieved and measurement were made to determine charcoal volumes, charcoal weight, bed area and average particle diameter. These were used in predicting the breakthrough time of the cartridge using Wheeler's equation, Mecklenburg equation, Modified Wheeler's equation and Nelson's equation. Breakthrough times from these predictive equations were compared with experimental breakthrough times in terms of percent deviation.

For the experimental breakthrough times, these should be 50 minutes or more for the prescribed gas concentration of 300 ppm. From test results, it was observed that 83% of the test cartridge models performed efficiently in terms of their breakthrough times.

Comparison of the experimental breakthrough times with that obtained from predictive equation of Nelson and Wheeler showed that Wheeler equation gave a more accurate prediction of breakthrough times than that of Nelson.

After analysis of the data gather in the laboratory experiment, it be can concluded that the experimental breakthrough time for cartridges against CCl4 vapor can be checked with that of the breakthrough time calculated using Wheeler's equation.

While the study investigated on the equations which limits the test method of chemical cartridges to using only carbon tetrachloride as a test gas, it nevertheless gave information on the protection afforded by the different types of cartridges locally available in the market