PPF005: Poster presentation

Improvement of Quantitative Fit Test Methods using Ambient Aerosols

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Abstract

Fit testing is a critical step to ensuring the efficiency of tight-fitting respirators. However, it may not always be conducted for various reasons, including time (>7 mins) and cost. As a result, a fast fit test method would help increase the willingness of the employers, users, and respiratory protection program administer to implement fit testing. This study aimed to evaluate the feasibility to improve the instrumental settings, sampling system design, and data analysis procedure.

In the present study, investigation of the fit factors was divided into three levels: experimental testing with constant flow, simulation tests using a breathing machine, and tests on human subjects. To simulate leakage, capillaries (10 mm in length) with different size (0.7-1.5 mm) were used. The ratio of total to leak flow rate was considered the "true fit factor, FFt". Ambient particles were aspirated through the capillaries into the N95 or P100 masks, when operated at constant flow rates of 5-85 L/min. The measured fit factors were determined by a TSI Portacount and an OPS 3330. In addition, the effects of breathing pattern and lung deposition loss on the fit factor measurement were also analyzed. The fit factor data were used to explore the minimal sampling time that approximated the FFt.

Results showed that the particle measurement response time for Portacount and OPS were 5 and 2 seconds, respectively. For P100 respirators, most measured fit factors were close to the FFt, whereas there was an underestimation while using N95 respirator due to filter penetration. For the breathing simulation tests, the fit factor was overestimated because of partial mixing and aerosol deposition loss in the capillary. The overestimation of the fit factor became more apparent when breathing flow increased because of the flow re-distribution. The measured fit factor would be close to the FFt when using the highest concentration during a breathing cycle. Consequently, with improved design, a fit test would take approximately only 20 seconds, where the whole fit testing process could be reduced from 7.5 to 2.5 minutes for Portacount, and 1.5 minutes for OPS.