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Influencing Factors of Carbon Dioxide Concentration Increase of Filtering Respirators

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ABSTRACT

Carbon dioxide concentration increase (CO_2 increase) is a test item for filtering respirators prescribed by Japanese government standards. The value of CO_2 increase is taken to represent the space inside the facepiece when the facepiece is put on a wearer's face, practically participating in the ventilation of inhaled and exhaled air, thus one of the indicators of respirator performance. We analyzed the results of CO_2 increase of filtering respirators in relation to the structural conditions and the kinds of materials to investigate their effects on the measurements.

The instrument used for the measurement of CO_2 increase was composed of a dual-cylinder-type breathing machine connected to a dummy head, driven at 2,000 ml per stroke and 15 strokes per min, which inspires the room air blown to the dummy head at about 0.5 m/sec and exhales a prepared air containing 5% CO_2. The inhaled air of 5 cycles of respiration was stored in a plastic bag after 15 cycles of respiration and measured subsequently with an infrared absorption meter.

As to the effect of material on CO_2 increase, filtering facepiece respirators for particles made of filter containing carbon gave higher values by 6 to 113% than those of the same shape and size without carbon. A gas mask attached with cartridges showed higher CO_2 increase when the inhalation valves were removed or made loose against air-tightness than the particulate respirators of the same conditions, and the effect was the largest when the cartridges were for organic vapors. This means that CO_2 increase is not a simple indication of the space inside the facepiece contributing to ventilation. CO_2 gas seems not inert to active carbon or other chemical adsorbents in these tests. However, an exhalation valve fixed on a filtering facepiece did not affect CO_2 increase in comparison with that without the valve. The variation of the air-flow resistance against inhalation also did not show any significant effect on CO_2 increase.