5088.0 - Activated carbon fiber (ACF) characterization as sorbent media for respiratory protection

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Abstract

Background and Objectives. In the United States, millions of workers are required to wear respirators on a regular basis. Activated carbon fiber (ACF) represents a lightweight alternative to granular active carbon, which is used in organic vapor respirator cartridges. ACF may also find an application in thin, facepiece respirators for both organic vapors and particulates. The primary objective of this project was to determine the adsorption characteristics of several ACFs for volatile organic compounds (VOCs) at occupationally relevant concentrations.

Methods: To determine how the ACF might perform if incorporated into a thin respirator, breakthrough experiments were performed. ACFs were challenged with VOC-containing air flow. We then recorded the amount of time that elapsed before the downstream concentrations of VOC reached 10% of the upstream concentrations. Three VOCs (toluene, hexane, and MEK at 200 ppm) were selected as occupationally-relevant. The Wheeler-Jonas model was then used to determine ACF adsorption capacity.

Results: The best performing ACF-VOC pairs when using three layers of material are as follows: ACF with nominal surface area of 1200 m^2/g had a 10% breakthrough time of 27 minutes against a 200 ppm MEK challenge (adsorption capacity 168.13 mg/g); ACF with nominal surface area 2000 m^2/gram had a 10% breakthrough time of 34 minutes against a 200 ppm toluene challenge (capacity 380.59 mg/g); ACF with nominal surface area 2000 m^2/g had a 10% breakthrough time of 18.67 minutes against a 200 ppm hexane challenge (capacity 220.7 mg/g).

Conclusions. Based on our results, ACF materials could conceivably be incorporated into thin respirators for short-term vapor protection, increasing wearer's comfort and possible compliance. If used in accordance with the "Voluntary Use" provisions of OSHA's Respiratory Protection Standard, an ACF-containing respirator represents an additional way to reduce chemical exposures to well below regulatory limits when low-level VOC exposures are a concern.

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Learning Areas

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