

Letter to the Editor

To the Editor:

We are writing in reference to the recent article by Haupt and Paszkiewicz (2006). The authors note that cyclic airflow testing, particularly focused on carbon bed residence time, is an issue under consideration by the ISO/TC 94/SC15 Respiratory Protective Devices working group. To provide additional data for discussion, our laboratory has conducted a small number of tests similar to those done by Haupt and Paszkiewicz. Our results generally agree with the authors', with one significant exception. We will describe relevant portions of our testing and our conclusion below.

We tested two carbon beds similar to the small cartridge the authors used. One was a small cartridge 8.0 cm in diameter containing 55 cm³ (24 g) of 12 x 20 mesh activated carbon (mean particle diameter 1.25 mm). The other carbon bed was a similar volume of the same carbon contained in a test fixture. Bed dimensions for the latter were approximately 8.9 cm diameter x 0.9 cm deep. Cyclic and continuous flow breakthrough tests were conducted at 29 or 30 L/min using 300 ppm cyclohexane at 70% RH and 22 °C. For the cyclic flow tests the breathing machine was set at 20 inhalations/min and a tidal volume of 1.44 L. The average bed residence time at the 30 L/min flow rate was approximately 0.1 sec. The breakthrough curves for our tests are shown below in Figures 1 and 2.

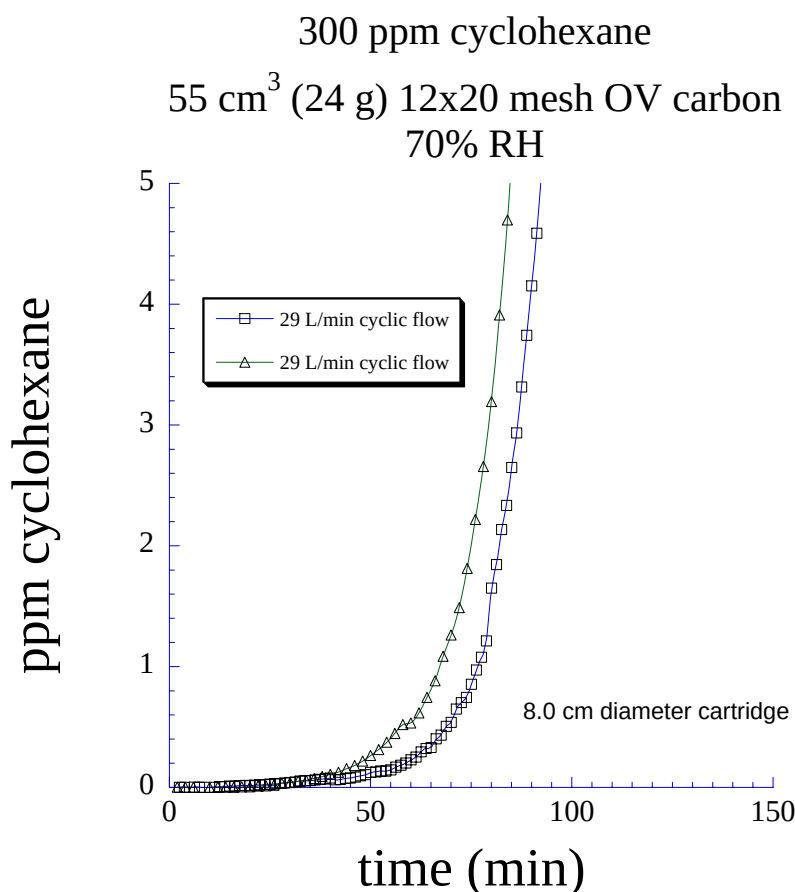


Figure 1. Cyclic flow tests on 8.0 cm diameter cartridge.

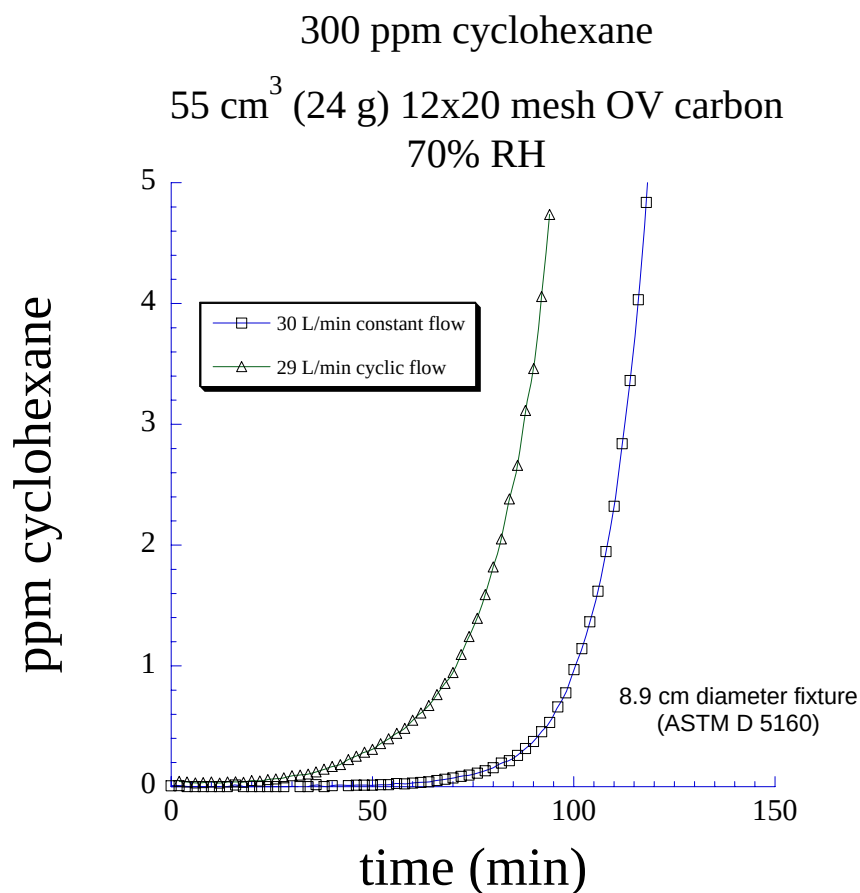


Figure 2. Constant flow and cyclic flow tests on 8.9 cm diameter test fixture.

The 1% breakthrough times for our tests are compared below with those shown in Haupt and Paszkiewicz's Figure 2 for the CA-705/OV cartridge they tested:

1% Breakthrough Time (min)

	Continuous Flow	Cyclic Flow	Cyclic Flow Reduction (%)
CA-705/OV	105	52	50
8.0 cm Cartridge			
Test 1	---	86	---
Test 2	---	78	---
8.9 cm Test Fixture	113	87	23

The continuous flow breakthrough times indicate about the same capacities for the CA-705/OV and the test fixture carbon bed. It also appears the small cartridge performs roughly the same as the test fixture bed when it is tested under the same conditions. While a reduction in breakthrough time with cyclic flow has been shown by others (Suzin, 2000; Linders 2003), differences in test conditions make it impossible

to estimate how much reduction in 1% breakthrough time is "normal." Overall, we consider this portion of our results to be in reasonably good agreement with the authors' work.

The breakthrough curves below show how our results disagree with Haupt and Paszkiewicz's study. Their Figures 2 and 3 show an immediate penetration of 1 to 3 ppm for the CA-705/OV for both continuous and cyclic airflow rates of 30 to 80 L/min. The authors note in their discussion that this phenomenon has not been reported before. They conclude the immediate breakthrough was likely due to the cartridge's shallow bed depth (resulting in inadequate residence time) with a possible limited effect caused by air channeling through the cartridges. We believe our results demonstrate that channeling rather than residence time was likely the sole cause of the immediate breakthrough Haupt and Paszkiewicz observed. This observation is consistent with at least one other study in which bed residence times were well below 0.1 sec (Nelson and Harder, 1972).

In closing, while we agree there is a point at which bed residence time is inadequate for cyclohexane adsorption with this carbon at these test conditions, it appears to be well below 0.1 sec. We believe that, with proper bed design and sorbent selection, a cartridge with a 0.1 sec residence time can be useful in some workplaces.

Sincerely,
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References

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