



Standard Guide for Gas-Phase Adsorption Testing of Activated Carbon¹

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1. Scope

1.1 This guide covers the evaluation of activated carbons for gas-phase adsorption. It presents a procedure for determining the dynamic adsorption capacity, N_o , and critical bed depth, d_c , for an activated carbon used to remove a specific adsorbate from a gas stream under conditions chosen by the user.

1.2 The values stated in SI units are to be regarded as the standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* Specific hazards statements are given in Section 8.

2. Referenced Documents

2.1 ASTM Standards:²

D 2652 Terminology Relating to Activated Carbon

D 2854 Test Method for Apparent Density of Activated Carbon

D 2867 Test Method for Moisture in Activated Carbon

D 3467 Test Method for Carbon Tetrachloride Activity of Activated Carbon

E 300 Practice for Sampling Industrial Chemicals

3. Terminology

3.1 Definitions:

3.1.1 *breakthrough*—the appearance in the effluent of a specified concentration of an adsorbate of interest.

3.1.2 Other terms relating to this guide are defined in Terminology D 2652.

4. Summary of Guide

4.1 An activated carbon bed that contains a known amount of carbon is challenged with an adsorbate in a gas stream under

conditions of flow rate, adsorbate concentration, temperature, pressure, and relative humidity set by the user. The time to breakthrough of a specified concentration of adsorbate is measured. The measurement is repeated using the same conditions but varying the amount of carbon in the bed. For many practical systems, a plot of breakthrough time versus amount of carbon is linear. The slope and x-intercept of this line can be used to calculate the dynamic capacity, N_o (expressed as grams adsorbate/grams carbon or grams adsorbate/cm carbon) and critical bed depth, d_c , characteristic of the activated carbon under the conditions used in the test.

5. Significance and Use

5.1 Activated carbon is used extensively for removing gases and vapors from air or other gas streams. The physical and chemical characteristics of an activated carbon can strongly influence its suitability for a given application. The procedure in this guide allows the evaluation of the dynamic adsorption characteristics of an activated carbon for a particular adsorbate under conditions chosen by the user. It is necessary that the user choose test conditions that are meaningful for the application (see Section 9).

5.2 This guide can also be used to evaluate activated carbons that have been impregnated with materials to enhance their effectiveness at removing gases otherwise poorly adsorbed on activated carbon.

5.3 The procedure given in this guide is not generally applicable for evaluation of carbons used as catalysts for such purposes as decomposition of low levels of ozone or oxidation of SO_2 to SO_3 .

5.4 The procedure given in this guide can be applied to reactivated or regenerated activated carbons.

5.5 Fig. 1 shows the adsorbate concentration profile in an activated carbon bed at breakthrough. The bed has a zone at the inlet in which the adsorbate concentration is equal to the influent concentration. In this region the carbon is at equilibrium with adsorbate. The adsorbate concentration in the remainder of the bed drops until at the outlet it is equal to the breakthrough concentration. The shorter the length of this mass transfer zone (adsorption zone), the more effectively the carbon in the bed is utilized. A bed whose depth is less than the length of this zone will show immediate appearance of adsorbate in the effluent (breakpoint).

¹ This guide is under the jurisdiction of ASTM Committee D28 on Activated Carbon and is the direct responsibility of Subcommittee D28.04 on Gas Phase Evaluation Tests.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the Standard's Document Summary page on the ASTM website.