Designation: ~~D7385 – 13~~ D7385 – 21

Standard Guide for Estimating Carbon Saturation by Temperature Rise ~~upon~~Upon Immersion[1]

This standard is issued under the fixed designation D7385; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide covers the measurement of the temperature rise resulting from the heat of immersion when a known mass of a specified organic liquid is added to a sample of activated carbon. If the carbon has been in use as an adsorbent and may therefore be partially or fully exhausted, its degree of saturation may be estimated by comparing its temperature rise with that of an unused sample of the same activated carbon.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this 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~~ safety, health, and ~~health~~environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D2652 Terminology Relating to Activated Carbon

D2854 Test Method for Apparent Density of Activated Carbon

~~D2867 Test Methods for Moisture in Activated Carbon~~

~~E300 Practice for Sampling Industrial Chemicals~~

3. Terminology

3.1 Terms related to this guide are defined in Terminology D2652.

4. Summary of Guide

4.1 A measured volume of activated carbon is added to a known volume of a selected organic liquid in a container provided with means to measure the liquid temperature. The apparatus is sealed after the addition of the carbon and the maximum rise in

[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.

temperature is recorded. The degree of saturation of a used carbon is estimated by comparing its temperature rise with that of the original unused activated carbon of equivalent moisture content, measured under the same conditions. If no such reference sample is available, a commercial unused activated carbon of the same physical type from a reputable manufacturer may be substituted; such substitution should be noted in the report.

5. Significance and Use

5.1 It is often useful to estimate the degree of saturation, and hence the expected remaining service life, of activated carbon that has been in use for some time. This guide is applicable when such information must be obtained fairly rapidly under field conditions without access to optimal analytical instruments.[3] The organic liquid used should be of the same organic composition as that adsorbed on the carbon sample.

6. Apparatus and Materials

6.1 *Apparatus*—The apparatus should consist of a container such as a small bottle or flask to accommodate the carbon, the organic liquid, and a thermometer or thermocouple with a range to allow for a temperature rise of up to about ~~30 °C,~~30 °C, graduated in intervals of ~~0.5 °C,~~0.5 °C, with facility to interpolate to ~~±0.1 °C.~~±0.1 °C. A liquid-in-glass thermometer should not use ~~mercury,~~mercury because of the greater risk of breakage under field conditions. The container should be provided with a rubber stopper or other suitable closure to seal the contents after the carbon has been added to the organic liquid. Appropriate containers include an Erlenmeyer or Florence flask of about 125 to 250 mL capacity or a similar-sized narrow-necked bottle.

6.2 *Materials*—Many organic liquids that are insoluble in water but readily soluble in other adsorbates that may already be on the carbon are potentially useful. Special attention needs to be given when choosing the organic liquid. The organic liquid chosen to determine the degree of saturation needs to be of the same organic composition and similar adsorptivity as the organic compound adsorbed on the carbon sample in use. In this manner, displacement of the adsorbed organic by the organic liquid is minimized. In general, alkane organic compounds have a higher adsorptivity as their molecular weights increase and aromatics have a higher adsorptivity than alkanes. Those that have been tried include mineral oil, hexane, cyclohexane, and kerosene. Mineral oil is essentially harmless and not readily ~~flammable,~~flammable so its use does not require warnings for personnel untrained in handling laboratory chemicals, but it has the disadvantage of high viscosity, which may inhibit rapid mixing with the carbon. Mineral oil and kerosene are mixtures, not pure chemicals, so they are best suited for comparative results when samples from the same batch are used. Commercial hexane is also impure, but small differences in adsorptivity among its isomers may not seriously affect the precision of the method. Cyclohexane generally contains fewer isomers and may be used instead.

7. Procedure

7.1 The procedure applies to unimpregnated activated carbon with a moisture content not greater than about 10 ~~percent~~% by weight. Carbons with greater moisture content can also be used but the results may be less reproducible. In any case, the carbon should be free-flowing, not agglomerated. If the carbon is taken from an adsorber with bulk water, drain the water and let the carbon dry in air before testing it. Activated carbons that incorporate catalysts or are ~~especially~~specially formulated for catalytic activity may also be used.

7.2 About 20 ± 0.1 mL of the organic liquid is placed in the container and its temperature is noted and recorded. About 10 ± 1 mL of the carbon, at the same ambient temperature, is quickly added to the liquid, which must completely cover the carbon; if not, the quantities should be readjusted as needed and the procedure repeated. A convenient method for measuring carbon volume is described in Test Method D2854. The carbon is delivered into an appropriately sized graduated cylinder by free fall from a vibrating feeder. The container with its thermometer or thermocouple is sealed and the contents shaken. If the test is carried out under field conditions where the ambient temperature may be rapidly changing, a standby control vessel containing only the organic liquid, to monitor such change and to provide an appropriate temperature, may be used. The temperature is measured every 30 s until it reaches a maximum, which is then recorded.

7.3 A parallel test should be carried out on a sample of the unused carbon taken from the same batch as the carbon under test.

8. Calculation

8.1

[3] ~~H.W. Stone and R.O. Clinton,~~ Stone, H. W. and Clinton, R. O., *Ind. Eng. Chem.*, Anal. Ed., Vol 14, ~~131 (1942)~~ 1942, p. 131.