



Designation: D5217 – 17

Standard Guide for Detection of Fouling and Degradation of Particulate Ion Exchange Materials¹

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1. Scope

1.1 This guide presents a series of tests and evaluations intended to detect fouling and degradation of particulate ion exchange materials. Suggestions on reducing fouling and on cleaning resins are given.

1.2 This guide is to be used only as an aid in the evaluation of particulate ion exchange material performance and does not purport to address all possible causes of unsatisfactory performance. The evaluations of mechanical and operational problems are not addressed.

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, health, and 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

[D1129 Terminology Relating to Water](#)

[D1782 Test Methods for Operating Performance of Particulate Cation-Exchange Materials](#)

[D2187 Test Methods and Practices for Evaluating Physical and Chemical Properties of Particulate Ion-Exchange Resins](#)

[D2332 Practice for Analysis of Water-Formed Deposits by Wavelength-Dispersive X-Ray Fluorescence](#)

¹ This guide is under the jurisdiction of ASTM Committee D19 on Water and is the direct responsibility of Subcommittee D19.08 on Membranes and Ion Exchange Materials.

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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.

[D2687 Practices for Sampling Particulate Ion-Exchange Materials](#)

[D3087 Test Method for Operating Performance of Anion-Exchange Materials for Strong Acid Removal](#)

[D3375 Test Method for Column Capacity of Particulate Mixed Bed Ion-Exchange Materials](#)

[D3682 Test Method for Major and Minor Elements in Combustion Residues from Coal Utilization Processes](#)

[D3683 Test Method for Trace Elements in Coal and Coke Ash by Atomic Absorption](#)

[D5042 Test Method for Estimating the Organic Fouling of Particulate Anion Exchange Resins](#)

[D6302 Practice for Evaluating the Kinetic Behavior of Ion Exchange Resins](#)

[E830 Test Method for Ash in the Analysis Sample of Refuse-Derived Fuel](#) (Withdrawn 2011)³

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms used in this standard, refer to Terminology [D1129](#).

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *air lance, v*—to subject to a stream of air under pressure.

3.2.2 *organic fouling, n*—the buildup of organic material in or on anion exchange resins by sorption during the service cycle and incomplete removal during normal regeneration.

4. Significance and Use

4.1 Resins used in demineralization systems may deteriorate due to many factors including chemical attack, fouling by organic and inorganic materials, mishandling, or the effects of aging. Detection of degradation or fouling may be important in determining the cause of poor demineralizer performance.

5. Sampling

5.1 Follow the recommendations of Practices [D2687](#) for obtaining samples of particulate ion exchange materials. Core samples are important for obtaining representative samples;

³ The last approved version of this historical standard is referenced on www.astm.org.

however, special problems may dictate other sampling requirements, such as surface, interface, or other samples.

6. Preliminary Examination

6.1 Examine the sample visually or with the aid of a magnifier for any abnormalities. Note any unusual color, precipitates, biological material (slime), particulate matter, or small pieces or fragments of resin. Note that the color of resin may vary from lot to lot or with normal use and would not be considered unusual.

6.2 Note any peculiar odor associated with the sample, such as from oil, solvents, or biological activity.

7. Moisture and Particle Size Distribution

7.1 Follow procedures given in Test Methods [D2187](#), Test Methods A, B, and D for determining moisture (water retention capacity) and particle size distribution.

7.2 Compare the values obtained in [7.1](#) to those expected for the resin when in good condition. It is preferred that new resin, treated in the same way, be used for this comparison, but manufacturer's specifications can also be used.

8. Mixed-Bed Resin Separation

8.1 Observe resin during separation according to Test Methods [D2187](#), Test Method A. Adjust backwash rate to give optimum separation, then let resin settle and observe interface and note degree of cross-mixing.

9. Ash Content and Metals Analysis

9.1 Follow the procedure given in Test Method [E830](#) for determining the ash content of the pretreated and dried sample. A larger sample portion may be used for low-ash resins.

9.2 Analyze the ash for silica or metals such as iron, copper, manganese, barium, aluminum, calcium, magnesium, or others which might be suspected as contaminants. Use X-ray fluores-

cence analysis to determine major elements (see Practice [D2332](#)). Employ digestion, fusion, and analysis techniques as would be used for other types of ash (see Test Methods [D3682](#) and [D3683](#)). Note that some elements may be lost during the 575°C ashing, and spike recoveries must be checked.

10. Detection of Organic Fouling of Anion Resins

10.1 Follow procedures given in Test Method [D5042](#) for estimation of the degree of organic fouling of anion resins.

10.2 For a more rapid, but less reliable evaluation of the resin, the caustic-brine extract from Test Method [D5042](#) may be judged by color rather than by total organic carbon measurement: the darker the color, the heavier the organic fouling. Note that colorless foulants such as detergents or synthetic polyelectrolytes will not be detected.

11. Column Performance Testing

11.1 Follow procedures given in Test Methods [D3375](#), [D3087](#), or [D1782](#) as needed to evaluate the performance of mixed bed, anion, or cation exchange materials, respectively.

12. Kinetics Testing

12.1 The evaluation of the kinetics properties of ion-exchange resins is especially important for anion resins used in high flow rate applications such as condensate polishing.

12.2 Test the resin's kinetics properties according to Practice [D6302](#) or published procedures such as those by the Central Electricity Generating Board⁴ and Rohm & Haas Company.⁵

⁴ Harris, R. R., "Anion Exchange Kinetics in Condensate Purification Mixed Beds-Assessment and Performance Prediction," *Proceedings of EPRI Condensate Polishing Workshop*, October 1985, pp. 31-40.

⁵ McNulty, J. T., et al., "Anion Exchange Resin Kinetic Testing: An Indispensable Diagnostic Tool for Condensate Polisher Troubleshooting," *Proceedings of International Water Conference*, October, 1986.

TABLE 1 Detection of Fouling and Degradation of Particulate Ion Exchange Materials

| Section No. | Property Tested | Test Results | Possible Indications |
|-------------|---------------------------------|---|---|
| 6 | Visual appearance | Unusual color or precipitates Pieces/fragments present | Coating on beads from foulants or improper regeneration Physical degradation |
| 6 | Odor | Unusual odor | Fouling of resin by oil, solvents, etc. or biological activity |
| 7 | Moisture | Higher than expected (>10 % above) Lower than expected | Degradation of resin causing decrosslinking Fouling of resin by heavy materials, such as metal oxides |
| 7 | Particle size distribution | Smaller sizes than expected Larger sizes than expected | Physical degradation or non-representative sample Loss of smaller beads by backwash or through strainers |
| 8 | Mixed bed resin separation | Poor separation | Ionic form of resin may not be correct Resin may be fouled Particle size distribution of beads may be incorrect |
| 9 | Ash content and metals | Higher than expected | Fouling of resin by expected metal oxides or silica (from corrosion products, influent water, or regenerants) |
| 10 | Organic fouling of anion resins | Moderate to severe | Presence of sufficient organic fouling to affect performance |
| 11 | Column performance | Poorer than expected | Degradation or fouling sufficient to affect performance |
| 12 | Kinetics | Poorer than expected | Degradation or fouling sufficient to affect performance |