Application of ASTM Activated Carbon Test Methods to Utility Fly Ash

Henry G. Nowicki, Ph.D./M.B.A., Mick Greenbank, Ph.D. and Richard Morrical, P.E.

Professional Analytical and Consulting Services, Inc.
PACS Laboratory and Consulting Services, 409 Meade Drive, Coraopolis PA 15108
E-mail: Hnpacs@aol.com, Phone: 724. 457. 6576, and Fax: 724. 457. 1214

Summary

Our firm's 25 years of experience performing American Society for Testing Material (ASTM) and other standard routine analytical chemistry methods for activated carbon (AC) has been found to be useful for fly ash measurements. Useful ASTM test method titles and methods numbers are:

Method Number	Test Method Description
D 2652-94	Terminology Relating to Activated Carbon
D 2854-96	Apparent Density of Activated Carbon
D 2862-92	Particle Size Distribution of Granular Activated Carbon
D 2866-94	Total Ash Content of Activated Carbon
D 2867-95	Moisture in Activated Carbon
D 3379075	Tensile Strength and Young's Modulus for High-Modulus Single-Filament Materials
D 3466-76	Ignition Temperature of Granular Activated Carbon
D 3467-94	Carbon Tetrachloride Activity of Activated Carbon
D3802-79	Ball-Pan Hardness of Activated Carbon
D 5919-96	Adsorptive Capacity of Activated Carbon by a Micro-Isotherm Technique, Determination of
D 3860-89a	Adsorptive Capacity of Carbon by Isotherm Technique, Determination of
D 3922-89	Operating Performance of Granular Activated Carbon for Removal of Soluble Pollutants from Water, Estimating the
D 2865-96	Apparent Density of Activated Carbon
D 3803-89	Nuclear-Grade Activated Carbon
D 3838-80	pH of Activated Carbon
D 3860-89	Practice for Determination of Adsorptive Capacity of Activated Carbon by Aqueous Phase Isotherm Technique
D 3922-89	Practice for Estimating the Operating Performance of Granular Activated Carbon for Removal of Soluble Pollutants from Water
D 4069-95	Impregnated Activated Carbon Used to Remove Gaseous Radio-Iodines from Gas Streams
D 4607-94	Iodine Number of Activated Carbon, Determination of
D 5029-89	Water Solubles in Activated Carbon
D 5158-93	Particle Size of Powdered Activated Carbon, Determination of

D 5159-91	Dusting Attrition of Granular Activated Carbon
D 5160-95	Gas-Phase Adsorption Testing of Activated Carbon
D 5228-92	Determination of Butane Working Capacity of Activated Carbon
D 5742-95	Determination of Butane Activity of Activated Carbon
D 5832-95	Volatile Matter Content of Activated Carbon Samples
D 5919-96	Practice for Determination of Adsorptive Capacity of Activated Carbon by a Micro-Isotherm Technique for Adsorbates at ppb Concentrations

Source: ASTM

American Waste Water Association (AWWA) Standard for Powdered Activated Carbon

B 600-96	Phenol Value
B 600-96	Tannin Value

Source: AWWA

What these ASTM and other standard methods can do for the fly ash measurements will be provided. Examples of data will be presented in tabular form at this poster.

Also, acid digestion of the ash and water solubles followed by metals identification and quantification using AA, ICP, and GFAA is applicable to fly ash analysis. The EPA Toxicity Characteristic Leaching Procedure (TCLP) has been applied to activated carbon and can be used on fly ash materials. The Brunauer, Emitt, Teller (B.E.T.) surface area methodology as used in AC analysis is useful for fly ash materials and the carbon obtained from high carbon content fly ash. Some examples of these analytical techniques will be used to demonstrate application to fly ash. Microscopy is useful to examine shapes and sizes of fly ash particles just like AC. Examples of these AC analytical techniques will be presented to demonstrate their application to fly ash.

These test methods and others are useful to the fly ash applications. The unburned carbon content of fly ash determines its use in ready mix concrete. The ready mix concrete market has specifications on carbon content and particle sizing for the purchased fly ash. These are test methods routinely done at activated carbon testing labs. High carbon content (> 3%) on fly ash is known to bind the additives which are useful to provide concrete for low temperature environments. The low NOx and particulate boilers now in use to satisfy environmental regulations typically produce 8-12% loss on ignition (LOI) in older facilities and 4-6% LOI in new facilities. These are LOI ranges for typical coal fired power plants, however there are plants producing ash with 80% carbon and lower than these ranges; thus laboratory testing is needed to monitor the LOI at each plant. Particle sizing is important for this market; 85% of the ash must pass a 325 U.S. mesh screen. Technologies are available to separate the organic material from fly ash. It will be important to use the unburned carbon in value added applications. These value added carbon applications include coke for high temperature heating and activated carbon for vapor and liquid phase adsorption. Test methods which provide physical and chemical characterizations and demonstrate new applications for the unburned carbon will be important to this industry. The use of this fly ash carbon is an emerging area where the expertise of the activated carbon industry should make contributions.