

ACTIVATED CARBON

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SYNONYMS

Activated charcoal, decolourizing carbon

DEFINITION

A solid, porous, carbonaceous material prepared by carbonizing and activating organic substances. The raw materials, which include sawdust, peat, lignite, coal, cellulose residues, coconut shells, petroleum coke, etc., may be carbonized and activated at high temperature with or without the addition of inorganic salts in a stream of activating gases such as steam or carbon dioxide. Alternatively, carbonaceous matter may be treated with a chemical activating agent such as phosphoric acid or zinc chloride and the mixture carbonized at an elevated temperature, followed by removal of the chemical activating agent by water washing.

Chemical names

Carbon

C.A.S. number

7440-44-0

Chemical formula

C

Formula weight

12.01

DESCRIPTION

Powder or granules, black, odourless

FUNCTIONAL USES

Adsorbent, decolourizing agent

CHARACTERISTICS

IDENTIFICATION

Solubility

Insoluble in water and organic solvents

Adsorption

Place about 3 g of powdered sample in a glass-stoppered flask containing 10 ml of dilute hydrochloric acid (5%), boil for 30 s, and cool to room temperature. Add 100 ml of iodine TS, stopper, and shake vigorously for 30 sec. Filter through filter paper (Whatman No. 2 or equivalent), discarding the first portion of filtrate. Compare 50 ml of the filtrate with a reference solution prepared by diluting 10 ml of iodine to 50 ml with water, but not treated with carbon. The colour of the carbon treated iodine solution shall be lighter in colour than that of the reference solution, indicating the adsorptivity of the sample.

PURITY

<u>Adsorption power</u>	Not less than 90% and not more than 110% of the value stated on label. See description under TESTS
<u>Loss on drying (Vol. 4)</u>	Not more than 15% (120°, 4 h) (See Volume 4 under "GENERAL METHODS, Inorganic Components.")
<u>Sulfide compounds</u>	To 1.0 g of the sample in a conical flask add 5 ml of 1 N hydrochloric acid and 20 ml of water. Heat to boiling. The fumes released do not turn lead acetate paper brown. (Lead acetate paper is prepared by saturating filter paper with lead acetate TS and drying the paper at 100°).
<u>Acid soluble substances</u>	Not more than 3% To about 1 g of the sample, accurately weighed, add 25 ml of dilute nitric acid TS and boil for 5 min. Filter whilst hot through a sintered-glass filter (10) and wash with 10 ml of hot water. Evaporate the combined filtrate and washings to dryness on a water bath, add to the residue 1 ml of hydrochloric acid, evaporate to dryness again and dry the residue to constant weight at 103±2°.
<u>Sulfated ash</u>	Not more than 5% Heat a silica or platinum crucible to redness for 30 min, allow to cool in a desiccator and weigh. Accurately weigh about 1 g of sample in the crucible and add 2 ml of sulfuric acid TS. Heat at first on a water bath, then cautiously over a flame, then progressively to about 600°. Continue the incineration until all black particles have disappeared and allow the crucible to cool. Add a few drops of dilute sulfuric acid TS, heat and incinerate as before and allow to cool. Evaporate and incinerate carefully, allow to cool, weigh, and repeat the ignition for 15 min to constant weight.
<u>Water extractable substances</u>	Not more than 4% Transfer about 5 g of sample, accurately weighed, into a 250 ml flask provided with a reflux condenser and a Bunsen valve. Add 100 ml of water and several glass beads, and reflux for 1 h. Cool slightly, and filter through Whatman No 2 or equivalent filter paper, discarding the first 10 ml of filtrate. Cool the filtrate to room temperature, and pipet 25.0 ml into a tared dish. Evaporate the filtrate in the dish to incipient dryness on a hot plate never allowing the solution to boil. Dry for 1 h at 103±2° in a vacuum oven, cool and weigh. Calculate the percentage of water extractables in the filtrate, based on the sample weight and volume of sample taken for gravimetric measurement.
<u>Alcohol soluble substances</u>	Not more than 0.5% To 2.0 g of sample add 50 ml of ethanol (96 per cent) and boil under a reflux condenser for 10 min. Filter immediately, wash residue with 10 ml of warm ethanol and filter. Quantitatively transfer the combined filtrate into a tared beaker containing a few

antibumping stones. Evaporate to dryness on a water bath and dry to a constant mass at $103 \pm 2^\circ$. The residue on evaporation weighs not more than 10 mg.

Alkali soluble coloured substances

To 0.25 g of sample add 10 ml of 2 N sodium hydroxide and boil for 1 min. Cool, filter and dilute the filtrate to 10 ml with water. Prepare a reference solution by mixing 1.90 ml of solution A (1% hydrochloric acid) and 0.10 ml of a solution B (9.6 ml of ferric chloride TS + 0.2 ml of cobaltous chloride TS + 0.2 ml of cupric sulfate TS). The colour of sample solution shall not be more intense than that of the reference solution.

Cyanogen compounds

Mix 5 g of sample with 50 ml of water and 2 g of tartaric acid. Distil the mixture, collecting 25 ml of distillate below the surface of a mixture of 2 ml of sodium hydroxide TS and 10 ml of water contained in a small flask placed in an ice bath. Dilute the distillate to 50 ml with water, and mix. Add 12 drops of ferrous sulfate TS to 25 ml of the diluted distillate, heat almost to boiling, cool, and add 1 ml of hydrochloric acid. No blue colour is produced.

Higher aromatic hydrocarbons

Extract 5 g of the sample with about 45 ml of cyclohexane in a continuous extraction apparatus for 2 h. Collect the extract and dilute to 50 ml with cyclohexane. Examine under ultraviolet light at 365 nm. The colour or fluorescence of the solution is not more intense than that of a 83 ng/ml solution of quinine prepared in 0.01N sulfuric acid, examined under the same conditions.

Arsenic (Vol. 4)

Not more than 3 mg/kg
Accurately weigh about 4 g of the sample into a conical flask, add 80 ml of 2 N hydrochloric acid, extra pure, and boil gently under reflux for 1 h, filter and wash the filter with 2 N hydrochloric acid. Cool and quantitatively transfer the filtrate into 100 ml volumetric flask and make up to volume with the same acid. Determine arsenic using atomic absorption hydride generation technique.

Lead (Vol. 4)

Not more than 5 mg/kg
Determine using an AAS/ICP-AES technique appropriate to the specified level using the solution prepared under arsenic.

Zinc (Vol.4)

Not more than 25 mg/kg
Determine using an AAS/ICP-AES technique appropriate to the specified level using the solution prepared under arsenic.

TESTS

PURITY TESTS

Adsorption power

To about 0.3 g of dried sample, accurately weighed, in a 100 ml ground-glass-stoppered conical flask, add 25.0 ml of a freshly prepared solution of 0.5 g of phenazone in 50 ml of water. Shake thoroughly for 15 min. Filter and reject the first 5 ml of filtrate. Pipette 10.0 ml of the filtrate into a conical flask, add 1.0 g of potassium bromide and 20 ml of dilute hydrochloric acid TS. Using 0.1 ml of ethoxychrysoidine solution as indicator, titrate

with 0.1 N potassium bromate until the colour changes from reddish-pink to yellowish-pink. Titrate slowly (1 drop every 15 sec) towards the end of the titration. Carry out a blank titration using 10.0 ml of the phenazone solution.

Calculate adsorption power from:

$$[235.3 (a - b)]/[d \times m]$$

where

a is the volume (ml) of 0.1 N potassium bromate consumed by the blank;

b is the volume (ml) of 0.1 N potassium bromate consumed by the test solution;

m is the mass (g) of dried sample; and

d is the value stated on the label.