

Carbon Dioxide

二酸化炭素

CO₂: 44.01

Carbon Dioxide contains not less than 99.5 vol% of CO₂.

Description Carbon Dioxide is a colorless gas at room temperature and under atmospheric pressure. It is odorless.

A 1-mL volume of Carbon Dioxide dissolves in 1 mL of water, and the solution is slightly acid.

1000 mL of Carbon Dioxide at 0°C and under a pressure of 101.3 kPa weighs about 1.978 g.

Identification (1) Put a flaming wood splinter into Carbon Dioxide: the flame is extinguished immediately.

(2) Pass Carbon Dioxide into calcium hydroxide TS: a white precipitate is produced. Collect the precipitate, and add acetic acid (31): it dissolves with effervescence.

Purity Maintain containers of Carbon Dioxide between 18°C and 22°C for not less than 6 hours prior to the test, and correct the volume of Carbon Dioxide to 20°C and under a pressure of 101.3 kPa.

(1) Acid—Place 50 mL of freshly boiled and cooled water in a Nessler tube, and pass 1000 mL of Carbon Dioxide into it for 15 minutes through an introducing tube about 1 mm in diameter extending to 2 mm from the bottom of the Nessler tube, then add 0.10 mL of methyl orange TS: the solution has no more color than the following control solution.

Control solution: To 50 mL of freshly boiled and cooled water in a Nessler tube add 0.10 mL of methyl orange TS and 1.0 mL of 0.01 mol/L hydrochloric acid VS.

(2) Hydrogen phosphide, hydrogen sulfide or reducing organic substances—Place 25 mL of silver nitrate-ammonia TS and 3 mL of ammonia TS in each of two Nessler tubes A and B, and designate the solution in each tube as solution A and solution B, respectively. Pass 1000 mL of Carbon Dioxide into solution A in the same manner as directed in (1): the turbidity and color of this solution are the same as that of solution B.

(3) carbon monoxide—Introduce 5.0 mL of Carbon Dioxide into a gas-cylinder or a syringe for gas chromatography from a metal cylinder holding gas under pressure and fitted with a pressure-reducing valve, through a directly connected polyvinyl tube. Perform the test with this according to the Gas Chromatography under the following conditions: no peak is observed at the same retention time as that of carbon monoxide.

Operating conditions—

Detector: A thermal-conductivity detector.

Column: A column about 3 mm in inside diameter and about 3 m in length, packed with 300 to 500 μm zeolite for gas chromatography (0.5 nm in porous size).

Column temperature: A constant temperature of about 50°C.

Carrier gas: Hydrogen or helium.

Flow rate: Adjust the flow rate so that the retention time of carbon monoxide is about 20 minutes.

Selection of column: To 0.1 mL each of carbon monoxide

and air in a gas mixer add carrier gas to make 100 mL, and mix well. Proceed with 5.0 mL of the mixed gas under the above operating conditions. Use a column giving elution of oxygen, nitrogen and carbon monoxide in this order with a well-resolving of their peaks.

Detection sensitivity: Adjust the sensitivity so that the peak height of carbon monoxide obtained from 5.0 mL of the mixed gas used in the selection of column is about 10 cm.

(4) Oxygen and nitrogen—Introduce 1.0 mL of Carbon Dioxide into a gas-measuring tube or syringe for gas chromatography from a metal cylinder under pressure with a pressure-reducing valve through a directly connected polyvinyl chloride tube. Perform the test as directed under Gas Chromatography according to the following conditions, and determine the peak area A_T of air. Separately, introduce 0.50 mL of nitrogen into the gas mixer, draw carrier gas into the mixer to make exactly 100 mL, allow to mix thoroughly, and use this mixture as the standard gas mixture. Perform the test with 1.0 mL of this mixture in the same manner as directed in the case of Carbon Dioxide, and determine the peak area A_S of nitrogen: A_T is smaller than A_S , and no other peak appears.

Operating conditions—

Detector: A thermal-conductivity detector.

Column: A column about 3 mm in inside diameter and about 3 m in length, packed with silica gel for gas chromatography (300 to 500 μm in particle diameter).

Column temperature: A constant temperature of about 50°C.

Carrier gas: Hydrogen or helium.

Flow rate: Adjust the flow rate so that the retention time of nitrogen is about 2 minutes.

Selection of column: Collect 0.5 mL of nitrogen in a gas mixer, add Carbon Dioxide to make 100 mL, mix well, and proceed with 1.0 mL of the mixture under the above operating conditions. Use a column giving well-resolved peaks of nitrogen and Carbon Dioxide in this order.

Detection sensitivity: Adjust the detection sensitivity so that the peak height of nitrogen obtained from 1.0 mL of the standard gas mixture composes about 50% of the full scale.

Assay For the withdrawing of Carbon Dioxide, proceed as directed in the Purity. Place 125 mL of a solution of potassium hydroxide (1 in 2) in a gas pipet of suitable capacity. Measure exactly about 100 mL of Carbon Dioxide in a 100-mL gas buret filled with water. Force the entire volume of gas into the gas pipet, and shake for 5 minutes. Draw some of the unabsorbed gas into the gas buret, measure the volume, force the residual back upon the surface of the liquid in the gas pipet, and repeat this procedure until a constant volume of the residual reading is obtained. Determine the volume V (mL) of the residual gas, and correct its volume V to 20°C and under a pressure of 101.3 kPa.

$$\begin{aligned} \text{Volume (mL) of CO}_2 & \\ &= \text{calculated volume (mL) of the sample} \\ &\quad - \text{calculated volume } V \text{ (mL)} \end{aligned}$$

Containers and storage Containers—Pressure metal cylinders.

Storage—Not exceeding 40°C.