

Experiment No. : 9

To estimate the concentration of carbon monoxide in exhaust sample

Apparatus required :

- 1) Round bottom flask, 2) Pipette,
- 3) Measuring flask, 5) Weighing tube,

Chemical required :

- 1) 0.1M p-sulphaminobenzoic acid solution
- 2) 0.1 M AgNO_3
- 3) 0.1 M NaOH

Theory :

The main sources of CO in air are gasoline engine exhaust, gases produced by volcanoes, decaying organic materials and burning of coal shown in Table. It is an important gaseous pollutant injurious to health. It combines about 300 times faster than O_2 with haemoglobin in blood to form carboxyhaemoglobin which impairs normal oxygen transport system of blood. Consequently, cells that depend on oxygen for life maintenance are starved. Low level of CO poisoning may produce symptoms like reduction in reaction time, psychomotor impairment, headache and dizziness. At high level it may cause nausea, heart palpitations, difficulty in breathing and even death. The toxic effects of CO are well known, acute toxicity being experienced at levels well in excess of 100 to 200 ppm. Below these level, the long-term effects of CO inhalation are less documented. The amount of pollutants, that are automobile exhaust depend on a number of factors, including the design and operation of automobile, road condition, gasoline quality etc.

When an alkaline solution of the silver salt of p-sulphaminobenzoic acid is allowed to react with CO, a colloidal suspension of silver is formed, whose absorption maximum at 425 m μ can be determined by spectrophotometry. It can detect from 20 ppm to 2 ppm (minimum detectable limit) using a sample volume of 125 ml. Concentration in the range of 400-1800 ppm can be determined by the same method using less-sensitive absorbance peak at 600 m μ .

Procedure :

- 1) Mix 20 ml of p-sulphaminobenzoic acid solution with 20 ml. of 0.1 M AgNO_3 solution. To this mixture, add 10 ml of 1.0 M NaOH solution until a clear colorless solution is obtained.
- 2) Place 10 ml of this absorbing solution in a flask that is fitted with a ground glass stopcock, and evacuate the flask through the stopcock until the absorbing solution begins to boil.
- 3) Admit a measured volume of air sample in flask by sieving through the sample collecting pipette to the stopcock of the evacuated flask or by injecting a sample by gas pipette as the stopcock is opened.
- 4) Return the flask to atmospheric pressure by opening the stopcock to pure air and shake the flask on automatic shaker for a period of 2 hrs + 5 minutes.
- 5) Standard from known volume of CO (which can be obtained by adjusting the pressure on manometer) are prepared in the same manner, making sure that standards and samples have the same color development time during shaking.

Calculation and Calibration :

A standard curve is drawn using known solution of pure CO. Gas tight micro-liter syringes are used to transfer aliquots of CO to the evacuated absorption flask. Consequently, the number of microliters of CO can be derived directly from the standard curve, where ppm of CO = (μl of CO) / liter of air sample.

Results :

Precautions :

- i. In case of suspended interference, admit the sample through HgSO_4 silica gel filter.
- ii. Where this reaction depends on the weak reducing properties of CO, other reducing gases (e.g. H_2S or olefin) can interfere through reduction mechanism on the precipitation of Hg_2S .