

Quadrant II – Transcript and Related Materials

Programme: Bachelor of Science (Third year)

Subject: Chemistry

Paper Code: CHD101

Paper Title: Basic Topics in Analytical Chemistry

Unit: 3. Sampling techniques

Module Name: Sampling of gas

Module No: 19

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Notes:

Sampling of Gases

Sampling of gases is more difficult than sampling solid or liquids. There are practical difficulties in physically taking samples of a gas. The method used to remove samples of one gas may not be applicable to another gas. Secondly, the prevention of contamination of a gas by air is a major problem.

Source: Gases are found in distribution systems, industrial gas wells, city gas stacks or chimneys or in the open atmosphere.

General apparatus

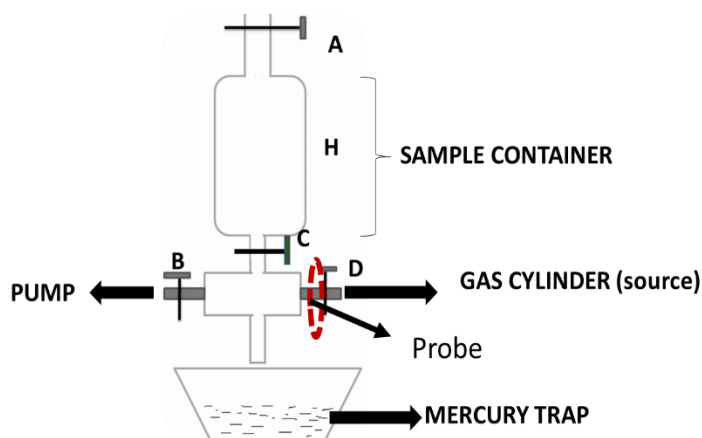


Figure 1: apparatus for sampling of gas

The apparatus used for the removal of gas samples consists of a sample probe, a delivery

line for the sample and a container for the sample.

Sample probe: is that part of the apparatus which extends into a vessel or a pipe containing the gas. The probe should extend to about one-sixth the diameter of the gas container.

Delivery line: Channel/passage for the sample gas to be delivered (from source) through the probe to the sample container.

Sample container: it is the vessel in which the gas sample is collected and this may vary in size from 250mL to several cubic feet depending upon the material to be sampled. Containers are made of glass, steel or iron.

Sample probes, delivery lines and sample containers are provided with stopcocks or valves to control gas flow. The stopcocks should be clean and well-greased with high vacuum grease. Before a sample is taken; the gas in question is allowed to come in contact with the lubricant to establish equilibrium. A mercury trap is usually provided to avoid excess pressure being developed (Refer **Figure 1**)

Procedure for sampling of gas: Three methods are used for removing sample of gas.

These are

1. Expansion into an evacuated sample container
2. Displacement method and
3. Flushing method.

1) **Expansion method**: In this method, the sample container is evacuated by working the pump attached to the container. The container is also warmed to remove gases adsorbed on the walls. The sample probe (tube to which D is attached **Fig. 1**) is then inserted into the gas container and the gas flows into the sample container by natural expansion.

However, since perfect vacuum is never obtained, some residual impurity will contaminate the gas sample. In order to avoid contamination, the process of evacuating and filling the sample container is repeated several times. Excess gas passes out through the mercury trap. This method is mainly applicable to draw samples of gas from bulk such as the atmosphere or containers filled with gas at the atmospheric pressure.

2) **Displacement method**: in this method a liquid, generally mercury, water or a saturated salt solution (20% solution of sodium chloride acidified with hydrochloric acid or a 20% solution of sodium sulphate acidified with sulphuric acid) is used to

displace all the air from the sample container, sample probe and the delivery line. This method is similar to the collection of oxygen, in laboratory, by displacement of water.

Limitation: not suitable for accurate sampling because, some of the constituents of a gas mixture being sampled may dissolve in the displaced liquid. Another possibility is that the sample gas may be saturated with the vapours of the liquid.

- 3) **Flushing method:** in this method air in the sample container is completely removed or flushed out by the gas being sampled. This may be done by the apparatus shown in **Fig. I** Initially, the stopcock B is closed, the probe is inserted into the gas container and stopcocks **A, C** and **D** are opened. The gas flows into the container **H** and displaces air from it. When it is determined that air has been completely flushed out, **A** is closed and the gas is allowed to completely fill the container **H**. Stopcocks **C** and **D** are then closed.