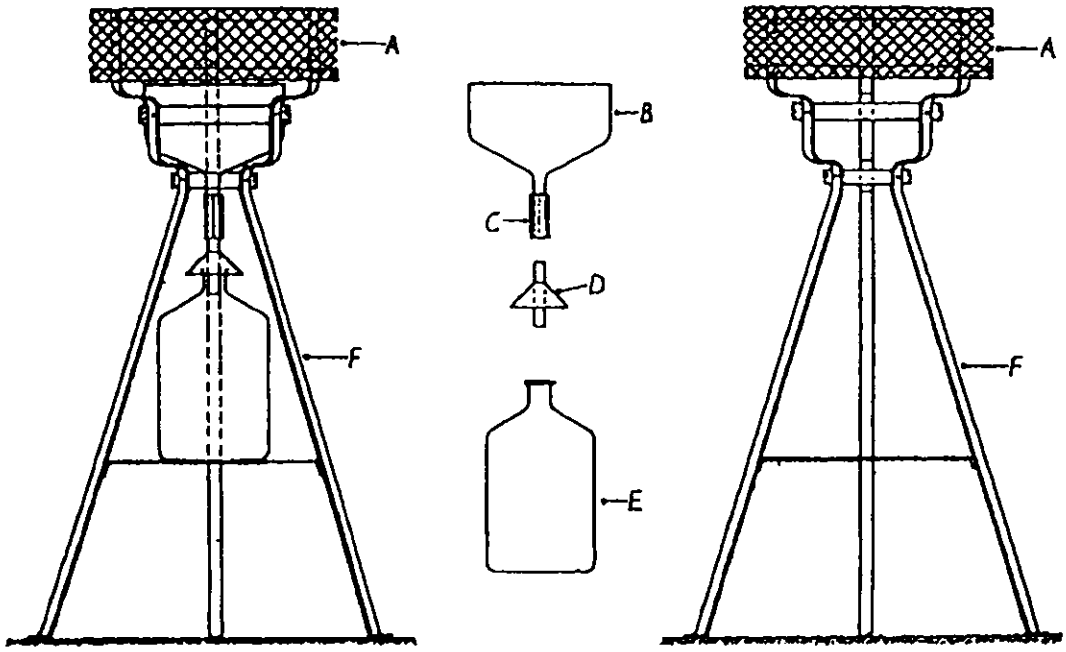
9.4 Dust fall measurement methods

9.4.1 Introduction

Of all the air pollutants, dust fall is the name given to smoke, soot, or other impure particles that settle along with the rain, due to their own weight. Of the dust fall measurement methods [1-7], this explanation deals with the deposit gauge method, which is both the most widely used and the most general.

9.4.2 Sampling method

The dust fall totals are compiled as shown in Fig.9.4.1. The wire mesh A protects the trap funnel B somewhat, preventing birds from cutting off the connection. If a glass collecting bottle is being used during the winter, because there is a risk of it being damaged by frost, the bottle is best wrapped in a suitable insulating material, or else in place of glass, a polyethylene bottle should be used.



A. Wire mesh (to keep out the birds)
B Glass collecting bowl
C. Rubber tubing
D. Inverted funnel
E. Collecting bottle
F. Stand

Fig.9.4.1 Deposit gauge assembly

The deposit gauge should be erected on the surface of a wide vacant space, and the distance from all surrounding buildings also needs to be a minimum distance of double the height from the collection funnel to the height of the

building.

In Japan, in order to prevent a sandstorm from blowing up from the ground surface, in many cases the gauge is installed on the roof of a building five to 15m in height above the ground, in which case, it is essential to pay attention to the positioning of funnels, and so forth.

The deposit gauge must be fixed firmly in place with either nails or bolts. Because the period of collection is one month, if lichens begin to form, there is a danger of the collected substances undergoing chemical changes. In order to prevent this, 0.02N copper sulfate solution 10 mℓ is added to the collecting bottle. One month later, the collecting funnel is examined, and any clearly foreign bodies such as leaves, insects, and so forth, are removed. Next, a burette brush is passed through the spigot of the glass funnel and moved up and down until it reaches inside the connecting tube. Approximately 250 mℓ of water, which has been collected in the bottle, is poured into the funnel (if the water in the bottle is insufficient, a fixed quantity of distilled water is used instead.) The sediment that has adhered to the inside of the collection funnel is passed through a policeman, and the water, which has been clouded by the solids is allowed to flow into the bottle, during which time the inside of the connecting tube is cleaned with a burette brush.

The bottle is then replaced with a pre-prepared clean one, and the dust meter is ready for another month of measurements. A cork stopper is placed firmly in the collecting bottle containing the water and the solids, and the following information is recorded on a label which is then affixed to the bottle.

Details of the site, the collecting period, an accurate measurement of the diameter of the collecting funnel and, if distilled water was used to clean the container, the quantity, and the effects, if any, of foreign bodies on the sediment, are all entered.

9.4.3 Analysis

Generally, for analysis, the following items are needed for the report:

① Quantity of solution collected: The quantity of solution minus any distilled water that was added and the copper sulfate solution.

② Solution pH value: Unnecessary if water was added.

③ Quantity of undissolved substances.

④ Quantity of tar: Potion of the ③ that is soluble is CS_2. In Japan, acetone is used in place of CS_2.

⑤ Quantity of ash: Obtained by extracting the CS_2, and burning off the residue.

⑥ Flammable substances other than tar: Namely,(6)=(3)-(4)-(5).

⑦ Total of soluble matter.

⑧ Quantity of Ca^{++}, Cl^-, SO_4^{--}, etc.

⑨ Quantity of solids: This is the sum total of both the soluble and insoluble substances. An outline of the analytical operation is shown systematically in Fig.9.4.2.

When the solution quantity is 300 mℓ or less, distilled water is added to make it up to 300 mℓ. Filter paper such as Toyo filter paper No. 5C, or another ashless filter paper, is used. For extracting the tar, after drying and

weighing the water-insoluble matter on the filter paper, Soxhlet extraction is carried out, but normally several hours are required. The extracted insoluble matter is then heated forcefully in an electric oven at 800℃ to determine the ash content. A fixed quantity of the filtered solution (1 to 2 ℓ) is placed on either a platinum or porcelain dish for which the weight is known, dissolved in water, and evaporated to dryness. Next, this is dried for two to three hours in a dryer at 105℃, after which it is left to cool in a dessicator and weighed, the difference in weight both before and after the evaporation tray is determined, and is converted to the solution weight and the total weight of the soluble matter is thereby determined. At present, the ion components of multiple substances, such as SO_4^{2-}, NO_3^-, Cl^-, NH_4^+, Ca^{2+}, Mg^{2+}, and Na^+ can be analyzed using ion chromatography.

The quantity of dust fall (or its components) is expressed as t/km^2/month (= g/m^2/month), and expressed by Eq. (1).

$$\text{Quantity of dust fall} = 1.273\frac{w}{D^2} \times 10^4 \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \quad (1)$$

Here, w = Total quantity (or components) of analysis values (g)

D = Diameter of collecting bowl (cm)

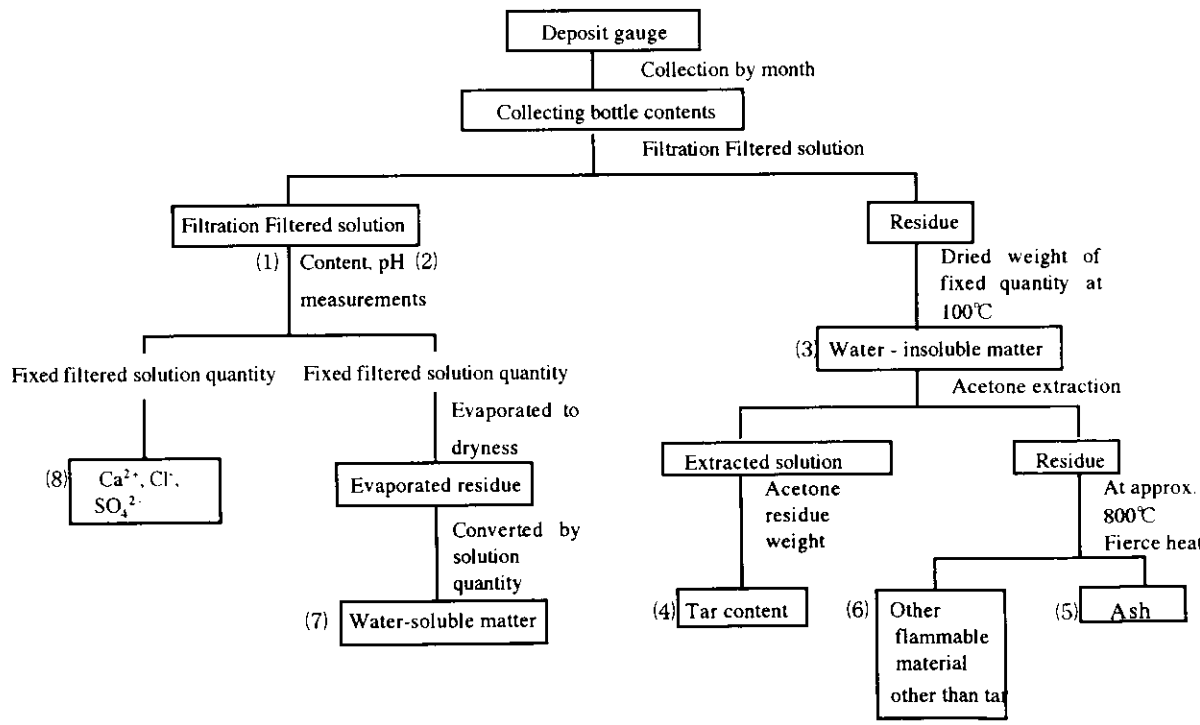


Fig.9.4.2 Deposited matter general analysis system