DUST DEPOSIT GAUGE to B.S. 1747 Part 5. 1972 (confirmed Jun 91)

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LIST OF ITEMS REQUIRED:

Dust deposit tubes (4) on metal stand
1 litre collection bottles (8 off)
Sheet plastic netting
Turbidity measurement tube (optional)
250 ml. Measuring cylinder (optional)
Plastic wash bottle
Rubber squeegee
Plastic funnel
Wire mesh sieve - 1mm

INSTRUCTIONS FOR USE

Introduction

The Directional Dust Deposit Gauge was developed by C.E.R.L. as a way of measuring the tendency of objects to become dirty in a dusty atmosphere. Because it is equipped with four tubes which are set at the four compass points (N,S,E,W) the gauge will also provide some indication of the directional character of the dust deposits. The gauge will measure dust pollution in the location where it is set up. The position should be selected carefully, since dust deposition rates can vary considerably over even quite short distances, and will be influenced by the proximity of buildings, trees, or other wind obstacles.

The gauge collects dust deposits from four wind directions in bottles located at the bottom of each of the collecting tubes. The gauge is normally used with a period of exposure equal to one calendar month. After this time the dust in the bottles can be assessed in a number of ways. The simplest measurement, is to wash adhering dust from the tubes into each bottle, remove the bottles, and make the volume in each bottle up to a fixed volume with clean water then the turbidity of each of the four solutions is measured. The turbidity is a measure of the "covering power", or tendency of the dust to "soil" objects near to ground level. The collected dust suspension in water, from each bottle, can also be filtered, dried, and weighed, to give a further measure of dust deposits from each of the four directions.

Gauge assembly

The gauge is supplied either on its own free standing base, or on a single steel square tube, which the user should mount in his own vertical support. The user should position the gauge so that the collecting tubes are pointed in the N,S,E,W, directions using a compass, or local

map. Whichever model of stand is used it should be securely fastened to the ground to prevent the gauge being moved be wind. The plastic netting supplied should be wrapped around the openings in the collecting heads to prevent contamination of the measurements by bird droppings.

The gauge should normally be located in an open space, at say the site of complaint, or several can be located at convenient distances from a dust source.

Operation of the gauge

Fresh clean bottles should be placed in the gauge ideally on the first day of each month. The starting day for a measurement period should be recorded. It may be necessary to place an inhibitor in each bottle to prevent algae growth. Use say 5ml(teaspoon) of bleach, or 25mg. copper sulphate. If an inhibitor is used then account of its presence should be made if analysis is undertaken on the dust deposit.

On the first day of the subsequent month (or when the chosen measurement period is over), the inside of each tube is wash down with clean water using the wash bottle provided, to ensure all dust goes into the collecting bottles. Use a squeegee if necessary to remove any dust which adheres to the inside walls of the collecting tubes. Remove the bottles, place a secure cap on them, make sure they are labelled with locations, and direction (which tube they came from), and the measuring period. Replace with clean bottles on each of the four tubes. Record any unusual event that may have occurred during the measuring period.

Examination of the dust deposit

a. Turbidity measurement. (Requires additional equipment). The turbidity value of the solution is an approximate measure of the amount (weight) of dust in the solution. A turbidity measurement is therefore a simple way to obtain a measure of relative dust deposits from the four directions sampled using the gauge.

Take the bottle and filter carefully through the 1mm stainless steel mesh, to remove any dead insect, leaves or other large debris or objects. Use the funnel provided with the piece of 1mm mesh in the top. Place the funnel in the 250 ml. measuring cylinder, and pour the contents of the bottle through the mesh. The filtered solution will be collected in the measuring cylinder. It will be necessary to use a little more fresh water, added to the bottle then shaken and poured through the mesh, to ensure that all the dust is transferred to the solution in the measuring cylinder. Use the minimum amount of water possible for the operation.

Make the volume of the filtered solution to a fixed amount, e.g. 100ml., or 150 ml., or 200 ml. The volume you choose to make up will depend on the minimum volume which you can use such that all four bottles are made up to the same volume.

The solution is then shaken to ensure the dust is evenly suspended, then poured into the clean turbidity tube, which is held downwards against a clean white surface (e.g. a clean sheet of paper). Look thorough the top of the tube, and stop adding solution when you can just no longer see the "CROSS" on the bottom of the tube. The "Turbidity" reading is read off from the logarithmetic scale on the side of the tube.

Hints on using the turbidity tube.

If your solution is very "murky" you will not get a very accurate reading unless you dilute it further with clean water. Turbidity values on the scale are linear with concentration.

e.g. Say you have a reading of 300 units - quite a murky solution which you obtained from dilution of the contents of one bottle to 100 ml. You could dilute the bottle to say 400 ml. (add another 300 ml. clean water). and repeat the turbidity measurement. Say you now find a reading using the tube of 80 units. This means that your original reading on a 100 ml. dilution solution would have been 320 units (4 x 80 units).

When recording results it is best to record turbidity measurements at all the dilutions you have made, but try to relate then back to one fixed dilution for all bottles so that relative dust deposit levels for the four directions can be more easily compared.

If you are subsequently plan to filter the solutions to obtain weights for the dust deposits, then keep the volumes of dilution to a minimum, or you will have very large amounts of water to filter off. Or you could shake the "murky" solution thoroughly, divide exactly in half, use one half to dilute with clean water to obtain a more accurate turbidity measurement, and filter the other half. Remember to multiply the weight of the filtered dust by two!

b. Filtering/weighing the dust deposit. For this you will require a filter funnel and filters, small vacuum pump, oven (110 deg.C) and a laboratory balance accurate to 0.0001 g. A dry filter paper is weighed prior to use. The solution from one of the bottles is filtered through the paper (assisted by the vacuum pump). Ensure all the dust deposit is transferred to the filter by washing out the bottle with small amounts of fresh water. The filter paper is carefully removed from the funnel, dried to constant weight in the oven, and reweighed. Dust weight is the difference between final weight and the initial weight of the empty filter paper.

The dust deposit as mg. per m^2/day can be calculated as follows:

$$\text{Deposit rate} = \frac{\text{wht deposit(mg.)} \times 10{,}000}{\text{no.days} \times 44.18}$$

where: wht.deposit = dry weight of filtered dust

no. days = number of days during which the bottle was exposed to dust

This formulae assumes the deposit area is the 75mm internal diameter of the dust collection tubes.

Note: By comparing weights of dust deposits with the relevant turbidity value it is possible to build up an approximate relationship between turbidity and dust weight for a particular location.

c. Additional examination of the dust deposit. It is possible to undertake a variety of additional measurements of the dust collected e.g.

The pH of the collected liquid

Chemical analysis of the dust deposit
Mass of the ash from combustion of the dry dust deposit
Analysis of the filtrate from separation of the dust deposit
for soluble salts (e.g. chloride, sulphate etc.)

SCHEMATIC DRAWING OF DUST GAUGE