Frequently Asked Questions

1. What is the difference between a deposit gauge and a directional gauge ?

A deposit gauge measures dust deposition, i.e. dust falling out of the sky, whilst a directional gauge measures dust flux, i.e. the horizontal component of wind-blown dust. This flux is the vector product of airborne particle concentration (mass per unit volume) and the horizontal component of the windspeed (velocity) and thus has the units of mass per unit area per unit time. It is unfortunate that the units of dust flux are therefore the same as those of dust deposition, adding confusion. It is NOT possible to convert readings obtained by the directional gauge into deposition rates as the calculation would require knowledge of particle size, particle concentration and wind velocity components, most of which are not known. Adding the flux from the four collecting heads of a BS1747 Pt5 gauge does not magically convert the numbers into a deposition rate, as some practioners imagine. Furthermore, the efficiency of the gauge is very variable due to the fact that air is not allowed to flow through the collecting tube, thus generating a stagnation point near the gauge aperture. Any dust particles which make their way into the collecting tube do so because of their kinetic energy; variations of particle mass and velocity therefore alter the collection efficiency.

2. How is the sample analysed ?

For a simple gravimetric analysis, the sample, which is basically a bottle of dirty water, should be removed from site and taken to the laboratory. Care should be taken to ensure that any dust still attached to the collectors is rinsed down with clean water into the sample bottle. (In the case of a Frisbee-type gauge the sample will also include the foam particle trap which will need to be rinsed out in the laboratory with clean water; the resulting dust will form part of the sample. This is very important, as tests have shown that the particle trap usually contains between 20% and 40% of the total dust collected.) The sample should then be passed through a 1mm mesh seive to remove extraneous items such as leaves, insects and large, i.e. non wind-blown, dust. This primary filtrand should be discarded and the filtrate passed through a suitable preweighed glass microfibre filter such as Whatman GF/A. After this secondary filtration, the GF/A circle together with its filtrand should be carefully dried in an oven at approximately 100deg C and reweighed when at room temperature; the oven-drying process will take about an hour. Temperature and humidity in the laboratory should be the same as when the filter was preweighed. Subtracting the tare weight gives the mass of dust. The balance should be able to weigh to 0.0001 g.

In the summer, algae in the sample is often a problem. Although the mass of this algae is usually very small compared with the mass of dust, it does cause severe difficulties to the filtration process, as the filters clog, sometimes to such an extent that it can take hours rather than minutes to filter a sample. Chemical biocides can be used to limit algal growth, but they do not seem particularly effective. The best solution is to exclude sunlight by enclosing the sample bottle in a lightproof bag such as a bin liner, or by covering the bottle with black adhesive tape. Unfortunately, black bottles are very difficult or very expensive to buy.

If there is a large volume of liquid to be filtered, it is a good idea to allow the sample to settle for an hour or so before filtering. It should then be carefully poured into the filter funnel so that the supernatant, clearer, liquid is filtered first. In this way, the filter will remain relatively unloaded for most of the process as the dirtiest water is last through the filter. The overall process will be quite rapid compared with attempting to filter a homogeneous mixture. If great precision is not called for, the supernatant liquid can be decanted and discarded, but before using this short cut on a regular basis, a test should be carried out on a supernatant sample to satisfy the user that the quantity of dust lost is insignificant.

3. How is the deposition rate calculated ?

This depends upon the type of dust gauge being used. Although rather self-evident, it should be noted that deposition rates can only be calculated from the measurements made by a deposition, or deposit, gauge. Examples of deposit gauges are the ISO gauge, BS1747 Pt1 gauge, Frisbee gauge, NILU gauge and Bergerhoff gauge. The former BS1747 Pt5 gauge, also known as the CERL gauge is *NOT* a deposit gauge - more of this above. Deposition is usually quoted as milligrams per square metre per day (mg/m^2/day) and can vary from zero to infinity, although results are usually in the range 10 to 1000 mg/m^2/day. The milligrams refer to the mass of dust collected by the gauge, square metre refers to the horizontal area of the dust collector in m^2 and day refers to the number of days for which the gauge has been exposed to the dustfall. In the calculation be sure to use the correct units - for example, the areas used must be in square metres, NOT square millimetres. Examples follow for the New Bergerhoff gauge and the Frisbee gauge made by Ian Hanby (other manufacturers may have differently sized collectors). The following symbols are used:

/ represents division and * represents multiplication

Bergerhoff Gauge

- The collector is a 1.5 litre PET bottle with a neck diameter of 90mm, so its area is 0.00636m^2.
- If the gauge collects W mg in D days, then the deposition rate is given by:
- Deposition = W/0.00636/D or 157.2*W/D mg/m^2/day
- For example, if 14mg were collected in 28 days, the result would be:
- Deposition = 157.2*14/28 = 78.6mg/m^2/day

Frisbee-type Gauge

- The collector is an anodized aluminium device looking like an inverted Frisbee. It has an operational diameter of 227mm so its area is 0.04m^2.
- If the gauge collects W mg in D days, then the deposition rate is given by:
- Deposition = W/0.04/D or 24.7*W/D mg/m^2/day
- For example, if 175mg were collected in 30 days, the result would be:
- Deposition = 24.7*175/30 = 144.1mg/m^2/day

4. How is the dust flux calculated ?

Flux is usually quoted as milligrams per square metre per day (mg/m^2/day) and can vary from zero to infinity. The milligrams refer to the mass of dust collected by the gauge, square metre refers to the vertical area of the dust collector in m^2 and day refers to the number of days for which the gauge has been exposed. In the calculation be sure to use the correct units - for example, the areas used must be in square metres, NOT square millimetres. Only the BS1747 Pt5 (CERL) gauge is normally used as a flux gauge, and the following example is for that gauge. The following symbols are used:

/ represents division and * represents multiplication

BS Directional Gauge

There are four collectors spaced at 90deg intervals around the stand. Each collector is a vertical plastic cylinder with an internal diameter of about 75mm and with a rectangular slot 340mm x 45mm, so its area is 0.0153m^2. The tube diameter is of no relevance to the calculation.

- If the collecting head under consideration collects W mg in D days, then the flux is given by:
- Flux = W/0.0153/D or 65.36*W/D mg/m^2/day
- For example, if 200mg were collected in 32 days, the result would be:
- Flux = 65.36*200/32 = 408.5mg/m^2/day
- This calculation needs to be repeated for the remaining three heads.

Unless a lot is known about particle sizes, horizontal wind velocities and dust concentrations, the numbers calculated as shown above have little meaning other than to give a vague indication of where the dust at that point has come from. For this information a sticky pad wound around a circular cylinder with a vertical axis is cheaper and easier to use.

5. Why is the internal pipework of a Frisbee-type gauge in two or three parts ?

When a Frisbee-type gauge is sent out, the internal pipework consists of one long and one short piece which push-fit together to form an assembled length of 1245mm. The reason for this is that if the pipework were sent out as one full length piece it would probably get broken in transit, whereas the system used allows the longer of the two pieces to be protected by putting it into the tripod stem. The smaller piece is shipped in one of the sample bottles. When replacements are supplied, the pipework is usually divided into two or three approximately equal pieces which, when joined together, have the same overall length of 1245mm. This minimizes the risk of them getting broken in transit and reduces the length of the carton. The three-piece version is short enough to go by Royal Mail First Class or Special Delivery. If desired, the pieces can be permanently joined on site using a Solvent Weld Cement, available from any Plumbers' Merchant.

6. Why are some results from the Sticky Pad Reader obviously wrong ?

There are some circumstances when the Sticky Pad Reader can give a result which is higher than the 'clean' reading. This is obviously paradoxical as the pad cannot be cleaner than clean. The cause is usually creases or folds on the sticky pad altering the reflected light patterns. In future, try to keep the pad flat and uncreased. If it is necessary to read a damaged pad, it will be necessary to move the reader to a slightly different location on the pad to obtain a sensible reading. Another possible reason for a high reading is if the dust captured is highly reflective, eg glass; the device was originally devised by Beaman & Kingsbury to measure road dust.

Readings which are too low are less easy to detect, as the incorrect reading is often within a valid range. The usual cause is when a label or some form of annotation is placed on the non-sticky side of the pad. Although it may be thought that this is unimportant, it is not, and has a large effect on the reading, as the pad is translucent. The remedy is to keep any annotations at the top or bottom edges of the sticky pad, or on the siliconized backing paper. Finger prints or flies on the sticky surface can also give low results, but these blemishes are obvious and can usually be avoided by moving the reader to a nearby position.

Finally, when replacing the backing paper on the exposed sticky pad, make sure that it is the right way round. If it is incorrectly replaced it will not come off and the sample will be lost. Also remember to mark which edge is the top of the pad to avoid east/west ambiguity.

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