

SOIL GAS SAMPLING AND -ANALYSIS



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Soil gas analysis can yield a lot of information concerning the soil environment. Using a 'piercing probe' and an oxygen content meter the growing conditions for shrubs and trees can be defined. And who would not want to be able to measure the extent of soil pollution in an area without time-consuming soil drilling?

14.35 Soil oxygen content analysis system

This system consists of a short soil probe and an oxygen content meter. The probe is pushed into the soil manually.

Once at the right depth the probe is lifted slightly. In this way the probe opens itself. Next, the oxygen content meter is connected to the probe and, using a bellows, soil gas is drawn through the meter and the O₂ content is measured, and with that an important growing parameter for trees and plants, can be read. The probe has a small dead volume, so that a measurement can be executed

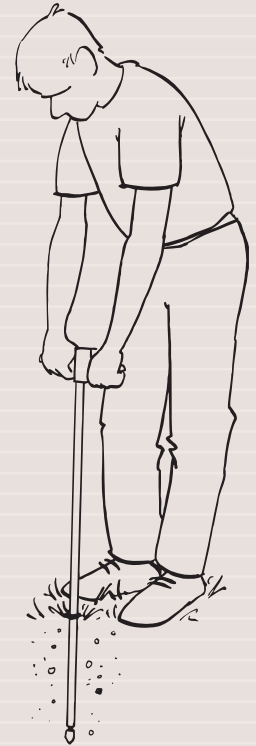
accurately within minutes. The oxygen content meter operates with an electrochemical cell. This cell has a limited service life (about 1.5 years), but can be calibrated easily with air (21%) and with a gas free of oxygen (natural gas, nitrogen).

14.37 Soil gas sampling system for manual operation for probes up to 3 m depth

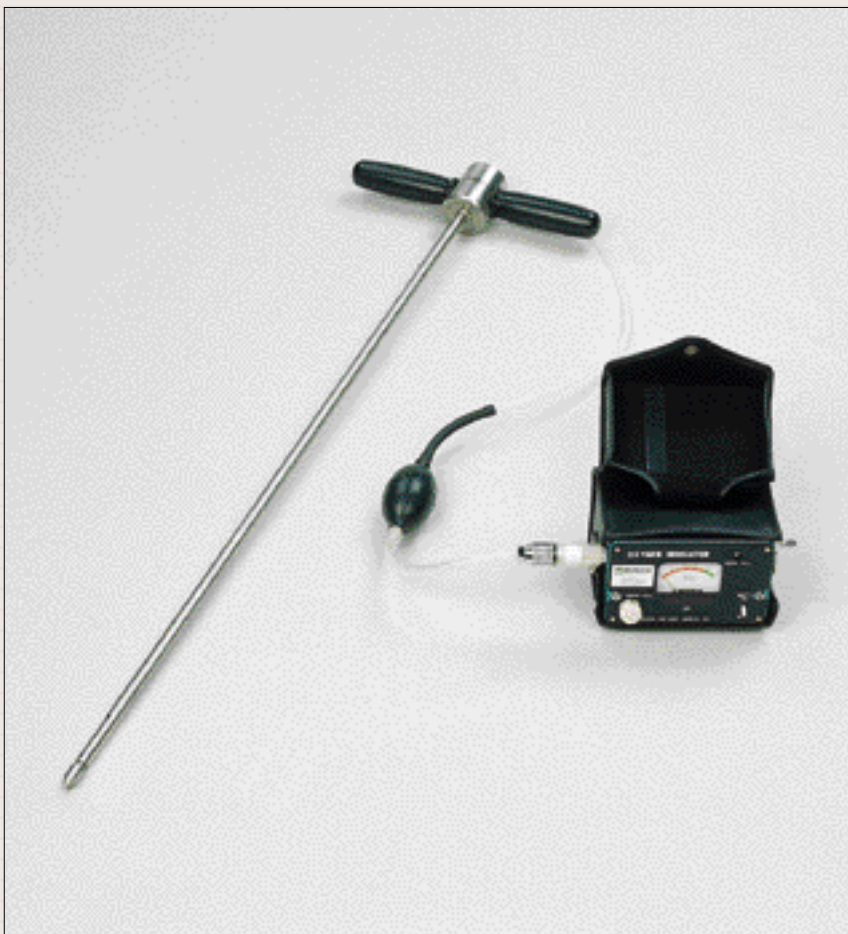
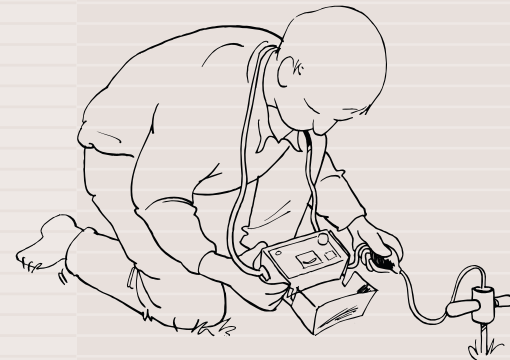
14.38 Soil gas sampling system with electric persuasion hammer and extendable probes

Using these soil gas sampling systems, it is possible to draw volatile substances quickly from the layer just above the ground water. Depending on the analytical equipment available, the concentration of the volatile substances in the soil sample can be measured instantly in the field. These systems can be combined with various analysis equipment. Sample transfer is possible by means of inert containers.

The opening of the soil air probe.



Drawing-in and analysing the soil gas oxygen content.



Soil oxygen content analysis system



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With this equipment the spread and concentration of the pollution can be established on the spot immediately, after which a limited but directed plan can be set up for drilling and sampling.

This technique can also be used to investigate the progress of the clean-up process. Soil gas sampling involves a minimal interference with the area to be investigated. Because of the application of 'lost' points the probes used are very simple.

This makes them cheap and easy to replace in case of damage or severe contamination.

The inlet nipple has two inlet points, one for purging the probe and the other for sampling or in-line analysis. In a number of cases it is possible to lower the probe into the groundwater, pull it open, let it fill up with groundwater, draw clean air through a teflon tube through the groundwater and strip the volatile substances from the groundwater for direct analysis.

For an indicative analysis of organic substances the ground water can be sampled straight away.

Since the probe contains no plastics, adsorption or release of volatile substances is avoided.

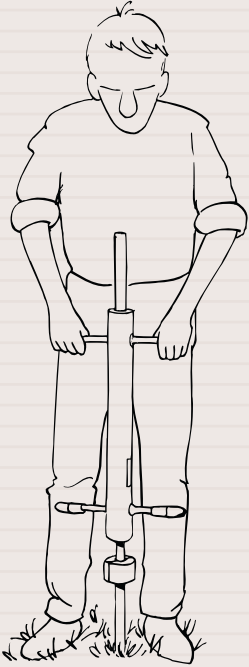
14.37 The manual system

The probe consists of a tube fitted with a solid 'lost' point. The probe is hammered into the soil, using a clamp anvil and a driving weight.

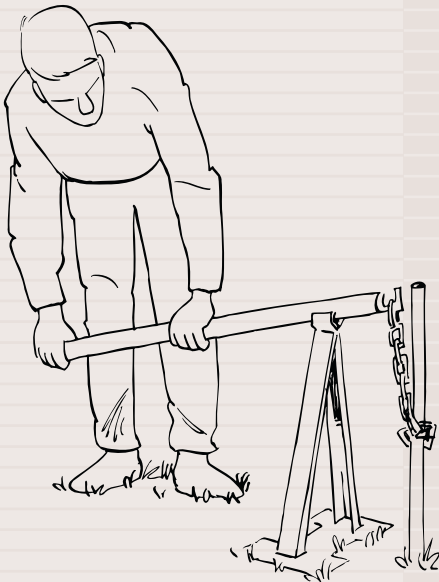
A lifting jack is used to raise the probe slightly. Through an inlet nipple the air can be drawn up, using a suction pump (e.g. a peristaltic pump).

Included in the manually operated set are: probes, sets 'lost' points, clamp anvil, driving weight, lifting jack, inlet nipples, various tubes and accessories, pressure gauge, peristaltic pump, gas-syringes and tools.

Inserting the soil gas probe using a clamp anvil and a driving weight.



Lifting the probe using the lifting jack.



Soil gas sampling system, manually operated

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14.38 The electric hammer powered system

Using this system greater depths can be reached with relatively little effort. The probe itself can be extended in steps of 1 m. The probe fitted with a 'lost' point is pushed into the soil using an electric hammer. The probe can be extended until the desired depth is reached. After lifting the tube slightly, the gas is pumped up through the inlet nipple on top, and consequently sampled or analysed directly.

Note: Stripping volatile substances from the ground water is not possible.

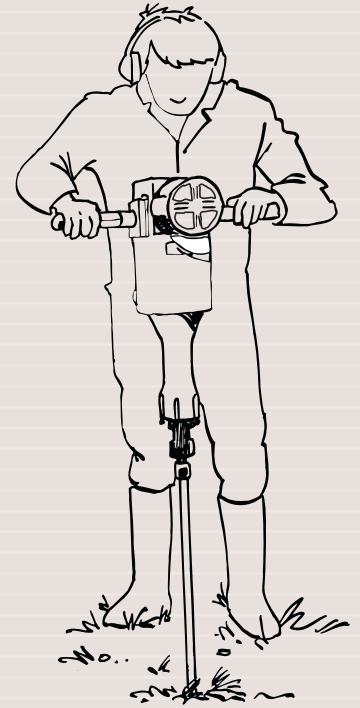
The set includes amongst others: extendable probes, sets of 'lost' points, generator, electrically powered hammer, lifting equipment, peristaltic pump with pressure gauge, tubes, syringes, etc.

Limitations

- ❑ Impermeable soils, certainly if they are wet, pass too little gas to permit measurements.
- ❑ Aromatics (benzene, toluene, etc.), deep under the surface will, as a result of the absence of oxygen and micro-organisms, only be decomposed slowly. Close to the surface however, the circumstances are ideal for bio-degradation. For this reason these substances will only be found in the soil gas near the floating layer. The probe should therefore be brought close to the floating layer.

Chlorinated hydro-carbons (trichloroethylene, etc) are chemically stable and thus can be detected easily. Polycyclic aromatic hydro-carbons have too low a vapour pressure.

Inserting the soil gas probe into the soil using an electric hammer.

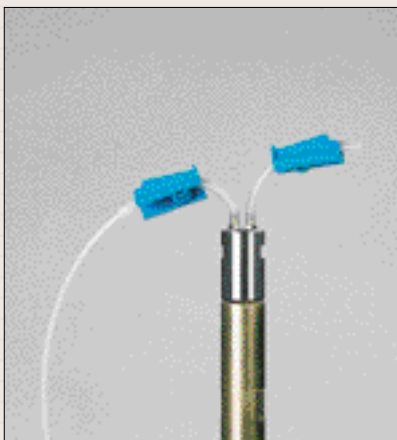
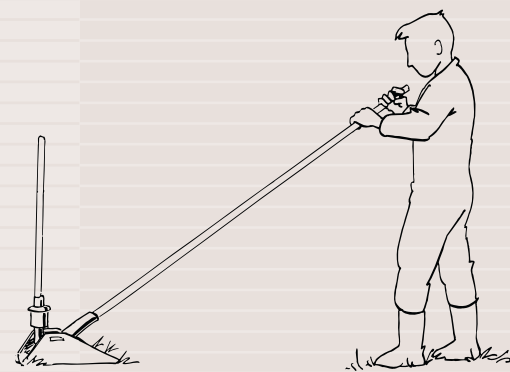


Soil gas probe with lost points



Extraction equipment

Lifting the probe using a mechanical rod puller.



Soil gas probe with inlet nipple



Probe with peristaltic pump 12 Vdc

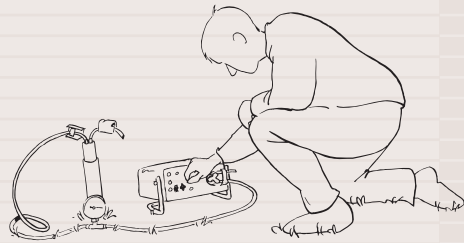


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Pumping up the soil gas with the peristaltic pump 12 Vdc

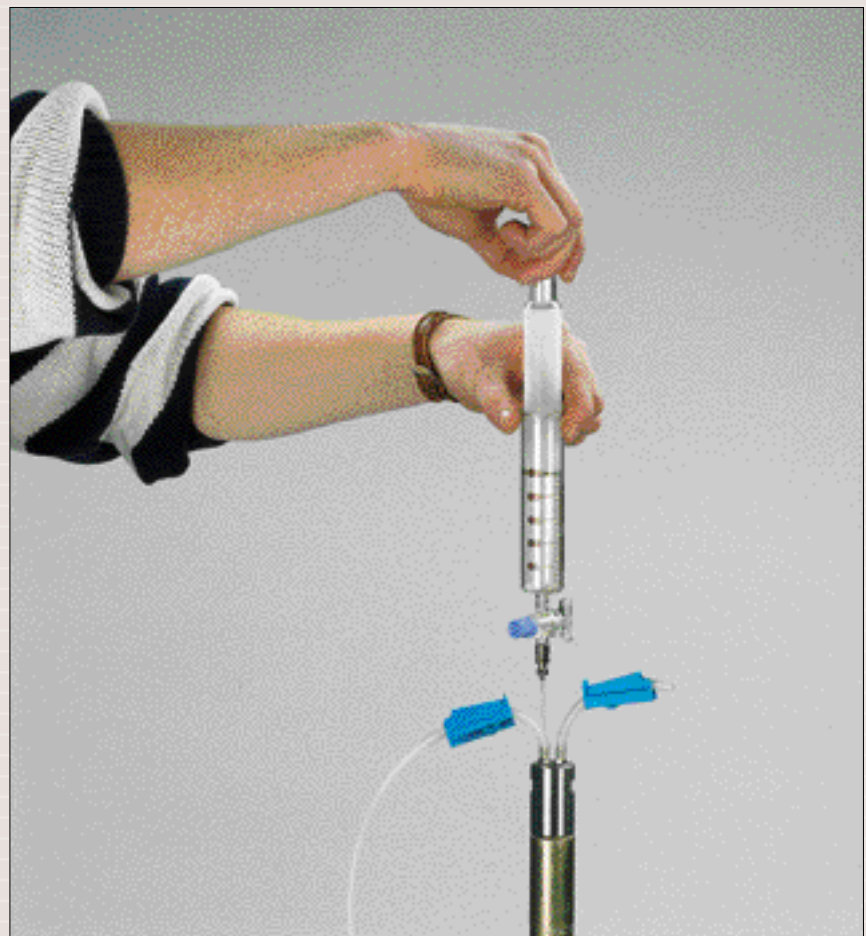
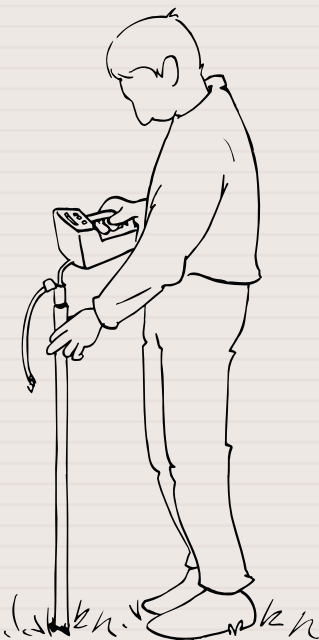


Advantages

- ❑ Simple and effective, also in soils with a lot of stones and rubble.
- ❑ The cheap but solid point only needs to last one boring. Because of the 'lost' point principle, the construction of the probe can be very simple. In case of damage the probe can easily be replaced.
- ❑ Probes can easily be cleaned (possibly using steam) in the field, or at the home base. The cheap tubes allow you to carry a day's supply with you.
- ❑ Shape and diameter of the probe/point combination prevent leakage alongside the probe from the surface.
- ❑ A simple check of the permeability of the soil and the efficiency of drawing soil gas, by means of a pressure gauge.

- ❑ The manually-operated and electric hammer-powered sets can be combined easily.
- ❑ By adding a few gouges, you can convert the electric hammer-powered soil gas system into a percussion drilling set.
- ❑ The 'lost' aluminium points do not form a threat to the environment; after iron, aluminium is the most common mineral in the earth's crust.

The systems can be combined with various analysis equipment e.g. gas chromatograph, PID, FID, OVA detector tubes, etc. (not supplied by us).



Soil gas syringe