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Measuring Acid Rain—A Guide for Amateur Scientists

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Topic

Measuring Acid Rain—A Guide for Amateur Scientists

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Introduction

The pH level of rain is one key indicator of the degree of pollution in the air. Harmful acids in the air often show up in the form of "acid rain," which can damage plants, forests, and even the ecological balance of the earth, both directly or indirectly. Unfortunately, accurately accessing the degree of acid rain is not simple. The contents of rain can vary greatly depending on geological and/or meteorological conditions. On the same day, rain that is heavily polluted may fall on one spot while only a few kilometers away the rain may be relatively clean. This wide variation makes the gathering of rainfall monitoring reports from many points essential in analyzing the state of acid rain. And with a little help from scientific experts and the proper tools, almost anyone can help with this effort, and play a role in environmental preservation programs.Horiba's special kit for measuring acid rain is the first step towards becoming an amateur environmental scientist. With an automatic rain collector, a glass electrode pH meter, a conductivity meter, and a guide on how to measure acid rain, the kit is easily used even by those with no special knowledge of laboratory procedures. This article gives a brief description of the principles of measuring acid rain using this tool.

Measuring pH

When rain is formed through the condensation of water vapor in the atmosphere, it is (or should be) neutral (near pH 7); in other words, it is distilled water. However, as it falls to the ground, it absorbs some of the carbon dioxide (CO_2) that is naturally present in the air, and becomes slightly acidic. The acidity of water saturated with CO_2 is about pH 5.6, and in general, a natural rain free of pollution should have an acid level no higher than this.

For reliable measurement results, the pH of rain should be measured with a glass electrode pH meter. Calorimetric methods such as litmus paper and pH-indicating reagents may be simpler to handle but they are not suitable to monitoring rainfall, because a false pH reading may be caused by chemicals in the rain that affect color. They also make it hard for non-specialists to obtain accurate quantitative data. The compact Twin Series pH meter included in Horiba's acid rain monitoring kit has made it possible for many ordinary citizens in Japan to become involved in efforts to monitor acid rain. The Twin Series employs a unique pH sensor developed by Horiba that uses a flat membrane of pH-sensitive glass and needs only a single drop (0.1 ml) of rain water for measurement. All the meter's functions, including calibration, are fully automated, and the pH value is shown on an easy-to-read digital display. The meter is also small enough to fit in a pocket.

Measuring Conductivity

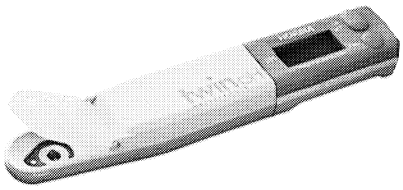
Rain which has passed through polluted air may not even be acidic if it has come into contact with suspended particles or other chemicals that neutralize the acid in the rain. Yet it is still polluted. This is why it is not enough simply to measure the pH to determine the contamination of rain. In addition to pH, the rain's conductivity is another important index of its purity. An abnormal conductivity reading even when the pH is normal is a sign that there may be exotic ions present in the water, and that the sample should be sent for laboratory testing. Horiba's test kit also includes an simple conductivity meter. Like the Twin Series pH meter, it is compact and features automatic operation.

Raingoround, Acid Rain Collection System

Sequential Sampling of Rain

Sometimes, when rain first begins to fall it is highly acidic and can damage plants, yet after a while the acidity drops and the average acidity of the entire rainfall is low.
The overall acidity of rain in a particular location can only be gauged by measuring rain samples that have been collected at regular intervals over a period of time.
The "Raingoround" rain collector, included in Horiba's kit,

makes it possible to collect samples of rain for every 1 mm of rainfall in separate cups, and as the procedure below shows, it is all automatic.

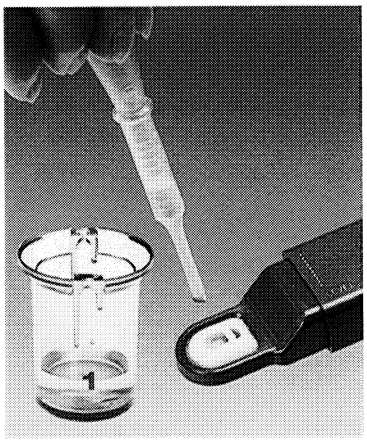


B-112, Compact pH Meter

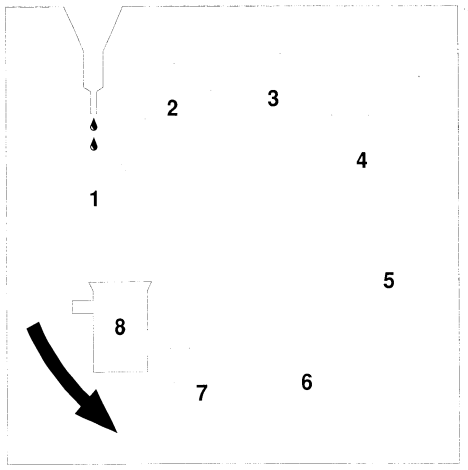
1. The lid covering the rain collecting funnel opens automatically when it starts raining.
2. A rotating wheel holding 8 cups positions the first cup to catch the rain and when the volume of the sample reaches 5 ml, equivalent to 1 mm of rainfall, the next cup swings down into position.
3. In this way the Raingoround collects sequential samples of rain automatically for each 1 mm of rainfall in separate cups.
4. The wheel stops rotating at the position of the last cup, No. 8, and the overflow from it is collected in a beaker inside the Raingoround.

The maximum volume of samples collected, including the overflow beaker, is equivalent to 28 mm of rainfall.

The Raingoround needs no power supply, weighs only 900 grams (two pounds) and can be installed on any flat and level surface. Moreover, the rotating wheel and rain collecting funnel have been carefully designed to ensure that the sample volume of each cup is precisely equivalent to 1 mm of rainfall. Requiring no complex operations at the measurement site, the Raingoround is the ideal tool for collecting sequential samples of rain, especially by students,



Measuring Acid Rain



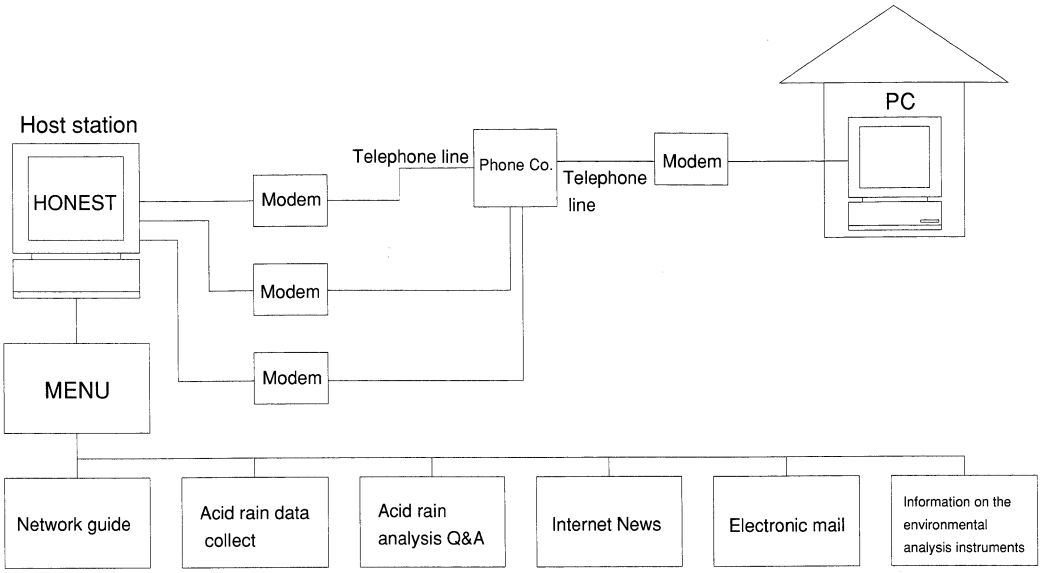
Operation principle of the Raingoround

volunteers and other non-specialists.

The HONEST Acid Rain Information Network

To support volunteer acid rain monitoring activities, Horiba has created an online electronic information network where volunteers can enter their measurement results into a database. Access requires only a simple and free registration procedure. The network, named "HONEST," was launched at 6:00 a.m. on June 6, 1992, Japan time, to coincide with the opening of the UN Conference on the Environment and Development (UNCED)—the Earth Summit held in Rio de Janeiro. Any registered member can add a report to the HONEST database provided that it meets certain basic requirements: 1) the data must include both a pH and conductivity reading; 2) the pH value must have been measured with a glass electrode pH meter; 3) the readings must have been obtained with original rain samples including the initial rainfall; 4) the record of total rainfall in millimeters on the date the samples were taken must be included; and 5) the report must be in a format compatible with the HONEST system.

To ensure the reliability of the data, Horiba provides HONEST members a set of calibration standards for occasional correlation. Members can also receive scientific support and technical information about monitoring acid rain by accessing HONEST at any time. As of September 1997, some 700 acid rain monitors had registered with HONEST and over 8,000 reports of rain had been accumulated.



HONEST Acid Rain Information Network

Expanding the Acid Rain Monitoring Program

Horiba's kit for measuring acid rain has helped expand the monitoring of acid rain in Japan, mostly through the greatly increased participation by non-specialist members of the general public. Horiba is now looking to expand the program, and has donated kits and provided technical assistance to acid rain monitoring programs in Chongqing district and the city of Shanghai in China. And in Kyoto, Horiba's home, a local chapter of the Lions Club has donated 60 kits to 24 elementary schools and 36 junior high schools around the prefecture. An interim report of their success in measuring acid rain will be given at a young peoples program associated with COP3, the 3rd Session of the Conference of Parties to the United Nations Framework
Convention on Climate Change, to be held in Kyoto starting December 1, 1997.

Further information about Horiba's activities related to the environment preservation programme can be found on the Horiba home page titled "GAIAPRESS" at:
http://www.horiba.co.jp

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