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MASTER

A SMALL WEIGHING-LEACHING LYSIMETER FOR
BIOLOGICAL RESEARCH

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INTRODUCTION

Energy use predictions for the next few decades indicate that coal will be mined and burned to fulfill expected energy demands. Commercial scale processes are being designed to treat coal with organic solvents to produce gaseous, liquid and solid products for transport and combustion.

Some of the environmental concerns about solvent refined coal products and residues are: 1) Can great quantities of residues be disposed of safely and relatively inexpensively in shallow land fills? and 2) Can inadvertent spills on soils be cleaned up without leaving toxic residuals accessible to biota?

To help answer these questions a small-weighing-leaching lysimeter was designed and constructed based on previous field experience (Hinds, 1973, Hinds, 1975, Hinds, et al., 1979).

CONSTRUCTION AND MATERIALS

The lysimeter consists of two lengths of plastic irrigation pipe (PVC). One length, nominally 6 inches in diameter inserted in a hole bored into the ground (Figure 1). This serves as a sleeve to receive a second pipe length, nominally 5 inches in diameter. The second pipe length is closed at the bottom with a pipe-end cap and permanently sealed to the pipe with adhesive. This segment is loaded with soil. By fitting this segment with a bail the entire segment can be tared and weighed to determine the water content of the contained soil column. The total weight is about 25 kg.

Leachate can be obtained by fitting a porous ceramic cup into the bottom of the lysimeter and applying negative pressure through a tube that leads from the porous cup to the ground surface by passing through the small space between the outside of the lysimeter and the inner wall of the sleeve (Figure 1). This converts the weighing lysimeter to a leaching lysimeter.

The lysimeter is large enough to accommodate the growth of crop plants, eg., wheat, barley or alfalfa. Soil water content of the lysimeter can be closely controlled by frequent weighings and irrigation. Leachates can be obtained periodically for bioassay and chemical analysis by appropriate irrigation.

Figure 1. Diagram of weighing-leaching lysimeter in outdoor setting.

The advantages of small weighing-leaching lysimeters for experimental studies are:

- 1) Soil (rooting substrate) is exposed to realistic outdoor environments, wind, rain, snow, freezing, thawing, wetting, drying, plant roots and microbial activities and seasonally changing temperature regimes and sunlight.
- 2) Outdoor exposures can be maintained 5-10 years or more to detect changes in the plant uptake and toxicity of SRC materials as affected by aging.

- 3) Lysimeters can be sacrificed to observe depths of root penetration, and general health and vigor of root systems.
- 4) Soil water content can be carefully controlled in individual lysimeters by weighing and irrigation to provide comparable soil moisture environments in plant growth experiments.
- 5) Number of lysimeters is not limited by available space as is often the case in conventional growth chambers and greenhouse experiments.
- 6) Lysimeter arrays in the field can be protected from damage by vertebrate animals by appropriate fencing and screening.
- 7) Construction, and materials costs are relatively inexpensive.
- 8) Relatively small amounts of "test" materials are required for each lysimeter (i.e. pilot plant batches).
- 9) Lysimeters permit replication and randomization of treatments and controls for statistical tests.
- 10) Leachates obtained from lysimeters can be used in biological toxicity tests.
- 11) Small lysimeters can be retired to disposal sites when experimental trials are terminated at low costs of decommissioning.

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