ALCOA OF AUSTRALIA LIMITED

ENVIRONMENTAL RESEARCH NOTE NUMBER 3

A Rapid Technique for the Separation of Roots from Lateritic Soil Cores

ALCOA
AUSTRALIA

G. F. KAEDING (ALCOA)
G. L. AINSWORTH (ALCOA)
February, 1980

A RAPID TECHNIQUE FOR THE SEPARATION OF ROOTS FROM LATERITIC SOIL CORES

INTRODUCTION

Lateritic soil cores obtained by hollow auger drilling in the Darling Range vary in length up to 40 m with each segment of core representing 76 cm of the soil profile. The soil types interesected vary from surface humic material through ferruginous caprock and lateritic horizons, to pallid kaolinitic clay sub-soils and saprolite (weathered granitic or dolerite bedrock).

Throughout this profile there exists a network of roots ranging from very coarse to microscopic in size. In order to determine root distribution, a suitable separation technique is required. The technique used for breaking down the laterite must not only be effective in separating coarse angular rock fragments, but also be effective in dispersing the wet clays with as little damage to root material as possible. Speed in material handling and simple apparatus are other major considerations.

Preliminary tests indicated that water washing alone was not fully effective. Further, many roots did not float and would have been lost using the water washing method described by Cahoon and Morton (1960). This paper briefly describes the results from laboratory tests of three alternative techniques. Method 3 evolved from a qualitative evaluation of the shortcomings of Methods 1 and 2.

METHODS AND RESULTS

Method 1

Dry sieving with an "Endecott" test sieve shaker proved ineffective for breaking up large compacted fragments of core. A further disadvantage was that root material tended to be broken down by the abrasive action of angular rock fragments.

Method 2

In this technique a 15 cm core sample was placed in two litres of water. A "Soniprobe" ultrasonic converter probe was then inserted and operated over it's entire frequency range for periods ranging from 5 to 30 minutes. Such probes are widely used for liquid processing and biomedical applications and as a means of dissolution and dissagglomeration of many substances including fibrous materials. Effectiveness was variable depending on soil type. A surfactant (Calgon) and chemical flocculant (calcium chloride) were added in some cases but with little improvement. Results are given in Table 1.

TABLE 1. Effect of various treatments on separation of root material from different soil types.

Sample No	Soil Depth & Description	Treatment			Comments
		Ultrasonics	Other	Duration (mins)	
1	10.5m hard laterite well cemented	x		5	Not completely dispersed by ultrasonics. Water without agitation just as effective.
2.	12.0m laterite, well cemented	x		5	Ultrasonics removed clay surface more rapidly than water only.
3.	6.1m friable laterite	x		5	Clay dispersed rapidly. Cemented laterite still intact.
4.	9.0m friable laterite	x		5	Complete dispersion of matrix. Residue of solid laterite pebbles.
5.	15.9m pallid 90% quartz	x		5	Water dispersed clay rapidly. No further reaction using ultrasonics.
6.	Pallid clay	x		5	Not completely dispersed by ultrasonics. Water without agitation just as effective.
7.	Hard clay, laterite	x	Surfactant *	30	Clay well dispersed by surfactant. Hard laterite still intact.
8.	11.65m brown clay		Stirring, flocculant •	5	After 1 hour left standing result not much better than that of water only.
9.	3.4m sandy friable laterite		Vigorous shaking	0.5	Rapid dispersion of matrix.
10.	14.5m pallid very fine clay	x	Surfactant *	5	Ultrasonics dispersed soln instantly. Calgon didn't seem to influence speed of dissolution.

• Chemical flocculant, calcium chloride.
* Surfactant commerically known as "Calgon".

Method 3

As water immersion proved to be effective in removing the clay from the rock fragments, water immersion with agitation using a modified sieve shaker arose as a possible solution.

Apparatus

The offset cam of a sieve shaker produces a vertical movement which results in the soil material being continually agitated and assists in the continuous clearing of the sieve apertures. Water pressure further aids this clearing process by dispersing the clay material. An additional benefit of water pressure is that roots tend to be washed through the sieve much more rapidly than with dry sieving, thereby reducing the period of time they are in contact with the large angular rock fragments.

Graduation of sieves minimises the possibility of excess roots being retained in any one sieve. A final sieve size of 0.212 mm minimises root loss to the extent that very few root fragments appear in the overflow of water and silt. Some break up of material is inevitable, especially in the coarsest sieve, but this is minimised by the rapid transfer of root material from the coarse into the finer sieves.

In order to adapt the sieve shaker, an open-top 22.5 litre plastic drum was fitted to the sieve shaker over the sieve rods and the holes around the rods sealed with rubber seals. The container has a basal tap which is connected to a 20 mm diameter hose for rapid drainage of water and silt. The water is entirely restricted within the drum and hence water contact with the electrical components of the instrument is prevented. A sieve brace plate is secured to the sieve support rods and located immediately above the top sieve. This is fitted with a common garden hose "rose" spray fitting, with 60 holes which direct fine water jets over the entire surface of the top sieve.

The sieves used by the authors are 20.4 cm in diameter with 5.1 cm sides. They are fitted with lurene O-rings to prevent loss of material between sieves. Sieve aperture sizes are 3.35 mm, 0.85 mm, 0.355 mm and 0.212 mm. A diagram of the apparatus is given as Figure 1.

Operational Procedure

(1) A selected volume of soil, typically half a core segment (800-1100 g), is placed into the top (coarsest mesh) sieve and the set of sieves is placed in the container and secured tightly with wing nuts to allow for maximum vibrational speed.

(2) Adequate water pressure is then applied and the machine set for a preselected time; pressure and time depend on soil characteristics.

(3) The sieves are subsequently removed from the machine, seperated, and placed in an oven for drying.

(4) Dry samples of soil are reduced to a manageable volume using a sample splitter.

Performance Data

(1) Washing and shaking time, depending on soil characteristics, is 8-12 mins.

(2) Operation of the shaker over an eight hour period will seperate a maximum of 20 core segments.

(3) Drying time, which also depends on soil characteristics, varies between 90-120 mins at a temperature of 105°C in a forced draught oven.

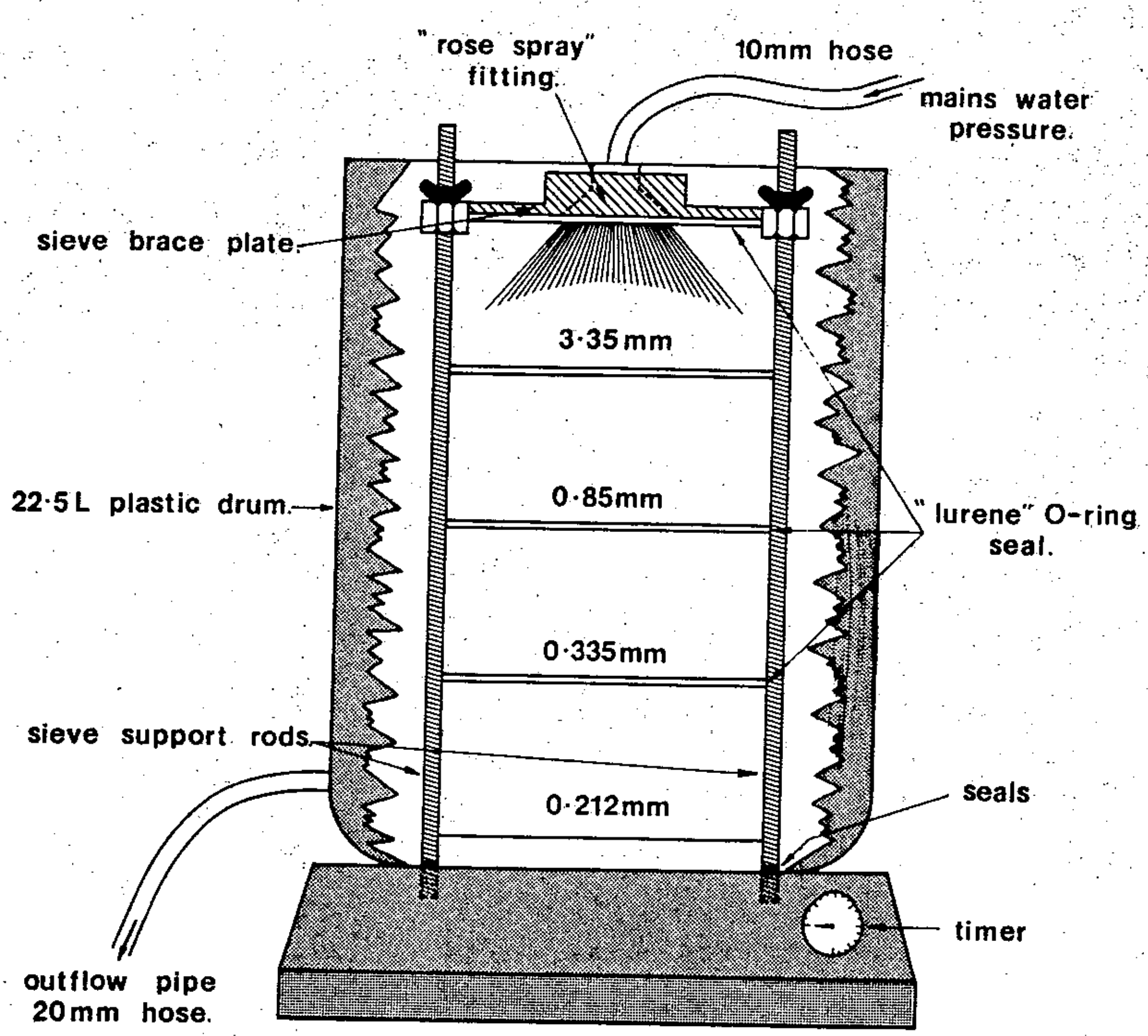

FIGURE 1. Cutaway diagram of modified 'Endecott' test sieve shaker.

DISCUSSION

Method 3 is a practicable, efficient and reliable technique for the rapid breakdown of lateritic soil cores for the subsequent determination of root content using the method of Newman (1966).

REFERENCES

Cahoon, G.A., and Morton, E.S. (1960). An apparatus for the quantitative separation of plant roots from soil. American Society for Horticultural Science 78, 593-596.

Newman, E.I. (1966). A method of estimating the total length of root in a sample. Journal of Applied Ecology 3, 139-145.