Pak. J. Agri. Sci.
25(4) 318, 1988

A COMPARATIVE STUDY OF EFFECTIVENESS OF CEMENT AND LIME AS STABILIZERS TO REDUCE SOIL EROSION

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A laboratory study was made to across the effectiveness of cement and lime as stabilizers to control soil erosion. It was concluded that clay soil can be effectively rendered resistant to soil erosion caused by rain drop impact by treating even with as low as 1% Portland cement or hydrated lime.

INTRODUCTION

The amount of soil erosion caused when rain falls on farm land depends upon three factors:

(i) The nature of rain

(ii) The way the land is being cultivated

(iii) The kind of soil

The ability of rain to cause erosion is called the 'erosivity'. Naturally, the greater the amount of rain, the greater is its power to damage the soil, but the kind of rainfall also makes a difference. In fact the erosivity depends on the kinetic energy of the rain. Kinetic energy is the energy possessed by any moving body.

$$\text{Kinetic energy} = 1/2 \times \text{mass} \times (\text{velocity})^2$$

'Erosivity' is the highest for the kind of rain common in the tropics and sub-tropics, that is, thunderstorm rain with large drops and high intensities. The 'erosivity' of rain can be calculated, but we cannot do much about changing it to reduce erosion.

There are two ways in which management of land affects erosion. The first is to decide what kind of farming is best, or what rotation to follow, or how a particular crop should be grown. These are all included in what may be called be 'biological erosion control'. The other aspect is the physical control of soil and water movement by the use of drains, banks, terraces and other earth moving methods. This is called 'mechanical erosion control'.

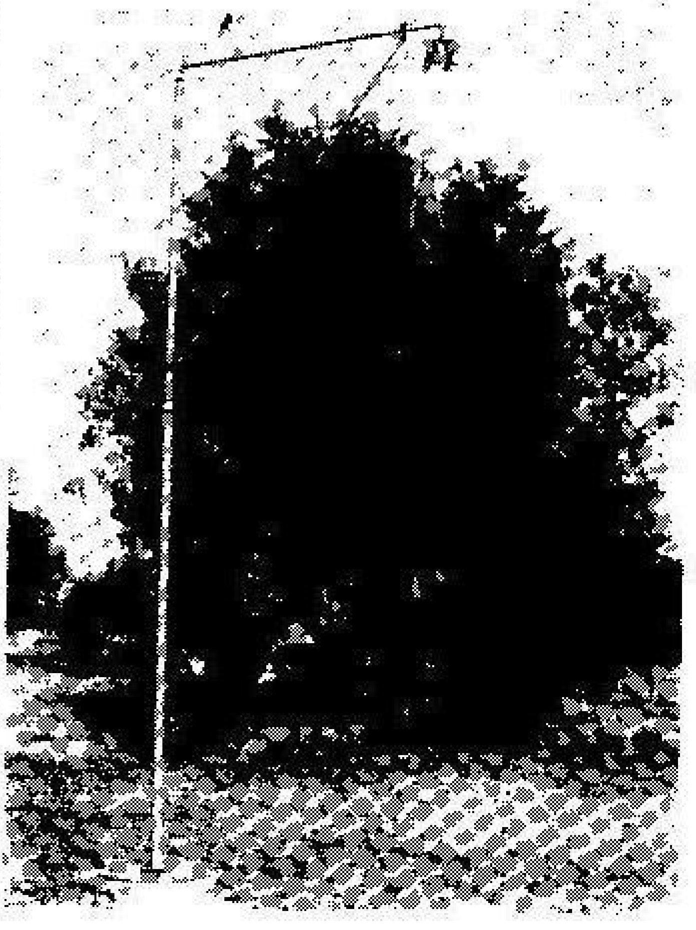
The third factor upon which the erosion depends, is the type of soil. Some soils are more easily eroded because of their chemical and physical properties. In general, light or sandy soils are more easily eroded than heavy or clay soils. The extent to which a soil is vulnerable to erosion is defined as its 'erodibility', which can be measured. In the present study an attempt was made to study the effect of cement and lime as stabilizers to reduce soil erosion. This technique of soil erosion control is usually applicable to farm roads in rural areas.

MATERIALS AND METHODS

The soil type used in this investigation was 'silty loam'. This soil had 28% sand, 65% silt and 7% clay. The plasticity index of the soil was 10. The maximum dry density and optimum moisture content of the soil was 1720 kg/m^3 and 16.9% respectively. The specific gravity of the soil was 2.6. Other materials used in this study were Portland cement and hydrated lime.

A low cost rainfall simulator was designed and developed in the laboratory of the Department of Basic Engineering, University of Agriculture, Faisalabad. It consisted of motor and pump, waste water valve, regulators and galvanized pipe of 1.27 cm diameter. Four showers produced rain from a height of 4.57 meters from the ground level (Plate 1).

The rainfall simulator was used to measure the erodibility of 102 mm diameter test specimens compacted at the maximum dry density and optimum moisture content. The specimens were cured at 30°C for 28 days before they were exposed to a rainfall storm of 100 mm/hour intensity. The surfaces of the specimens were maintained at 2% slope to the horizontal which is the general value of the cross slope in farm roads. The amounts of eroded soils (natural and treated) were collected separately for each specimen and dried in an oven at a temperature of 105 to 110°C. For each treatment level, three specimens were tested to find the 'average erodibility'.



RESULTS AND DISCUSSION

The results of the investigation are shown in Table 1. The results show that Portland cement treatments are more effective in reducing soil erosion than those of hydrated lime. It was also observed during the trial tests that the decrease in the 'erodibility' of cement treated samples took place more rapidly than that in lime treated samples.

It should be noted that in these experiments that only the erosion resistance with respect to the impact effect of rain-drops was tested. The erosion resistance to the tractive force of running water was not tested. A second difference between the laboratory tests and field scale use was that of the completeness of mixing attainable in the two situations. Laboratory scale mixing is more efficient and complete than any feasible field scale method of mixing the stabilizer. As a result, it is likely that a significantly higher content of stabilizer would be required to ensure the presence of the minimum amount needed at all points throughout the material in the field.

Table 1. *Effect of cement content on the erodibility of soil*

Types of stabilizer	Stabilizer content (%)	Erodibility (tons/acre/hour)	Decrease in soil erodibility (%)
Portland cement	0	90	-
	1	75	16.7
	2	51	43
Hydrated lime	0	110	-
	1	99	10
	2	71	35

CONCLUSIONS

1. Portland cement treatments are more effective than those of hydrated lime in controlling the erodibility of soil.
2. Low-cost simulator developed in the Department of Basic Engineering showed reasonably good performance.

REFERENCES

Hudson, N.W. 1975. Field Engineering for Agricultural Development. Clarendon Press, Oxford.

Chaudhry, M.A.A. 1982. Design and characterization of soil-sodium chloride mixes for low-cost pavements, Ph.d. Thesis, University of Leeds, U.K.

Young, R.A. and J.L. Wiersma. 1973. The roll of rainfall impact on soil detatchment and transport. Water Resources Research, 9.