https://doi.org/10.29321/MAJ.10.A03766

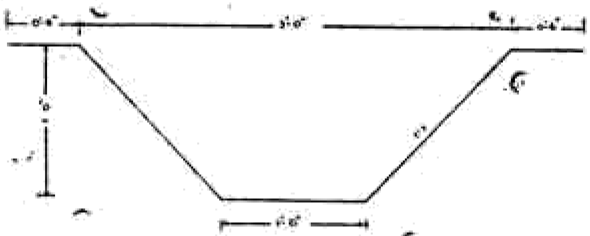
Soil Cement Lining for Small Irrigation Channels

by

M. SANGIAH[1], N. MUNIANDI[2] and R. K. SIVANAPPAN[3].

Introduction: The problem at present is as to how best the available water can be utilised for maximum agricultural production. Therefore, the engineers concerned with Agriculture are now concentrating their attention in devising ways and means for efficient transmission and application of irrigation water to fields. It has been well established that a large portion of irrigation water is lost in field irrigation channels by seepage during conveyance. The water that percolates deep into the ground below the effective root zone of the crop is not available for plant growth and hence it becomes a loss to cultivator. In developing countries like India, adoption of the generally accepted lining materials for farm channels to prevent seepage is prohibitive on account of cost and hence the need for developing cheap methods of lining small field irrigation channels.

Materials and Methods: In order to assess first the importance of lining irrigation channel in the area, the rate of seepage loss in unlined earthern channel was determined by two field methds namely (a) in flow-out flow method (b) still-pool-water-level method. For assessing seepage loss by the inflow-outflow method, a number of small channels, each 200 ft. long, 1 foot width and with a side slope of 1 : 1 were formed in the experimental fields. The cross section of the earthern channel is shown in sketch No. 1. The cross-sectional area of the earthern channel was 2 square feet. Stilling basins with facilities for fixing 90°V-notches, were formed at the head and tail end of each channel to measure the rate of inflow into, and outflow from, the channel. The soil in which the earthern channels were formed was sandy clay loam to sandy loam. The permeability of this soil was found by permeability test to be $0{\cdot}7704 \times 10^{-5}$ inch per hour.



SKETCH NO. 1

CROSS SECTION OF (UNLINED) EARTHEN CHANNEL

---

[1] Assistant Agricultural Engineering (Civil), [2] Agricultural Engineering Supervisor and [3] Professor of Agricultural Engineering, Agricultural College and Research Institute, Coimbatore - 3.

Received on 17—7—1967.

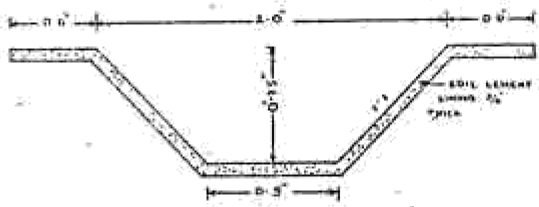
A series of tests was carried out in these 200 ft. long earthern cannels and it was found that the constant rate of seepage in 200 ft. length was about 12 to 18 per cent of the inflow for a flow range of about 0·1 to 0·2 cusec. Depth of flow in the earthern channels during the test was 0·1414 ft. The seepage loss (expressed as the qnantity per square foot of wetted area) was from 0·22 to 0·31 c. ft. per square ft. of wetted area per hour.

In the 'still-pool-water-level method' small pits of 3 feet square were formed in the area adjoining the experimental channels, the elevation of the bottom of the pit being the same as the bed of the channel. Water was allowed to stand in pit to the same depth as the depth of flow in the channel and the change of water level in the pit with respect to time was noted by means of a precise gauge and a stop-watch. The observations for each test were continued till the rate of change of water level became constant. From these observations it was found that the constant rate of seepage varied from 0·19 to 0·26 cft. per square ft. of wetted area per hour. The slight difference in the results obtained by the two methods may be due to small variations in field conditions and observation errors.

As the channel seepage was thus found by field studies to be substantial, research was carried out to evolve cheap methods of lining such channels to reduce the channel seepage. Of the various lining materials tried, lining with soil cement mix evolved (as described under) was found to be one of the cheapest and satisfactory methods of water proofing of small irrigation channels.

Soil cement is a mixture of ordinary portland cement and the natural soil in specified proportions. The soil to be used should contain about 70 to 80 per cent (by weight) of sand and the rest of clay and silt. If the soil contains more of clay or silt cracks will develop; if it contains more of sand, loss by seepage will be more. The following are the practical hints for the cultivators for selecting the soil conforming to the above specifications. A small sample of the soil is made into mud plaster by adding just the required quantity of water and plastered on the sides of the channel for a length of 1 or 2 ft. It is allowed to dry for a day or two. If the plaster develops cracks while drying, it indicates that the soil contains more of finer particles and to obtain the proper soil cement, sand is to be added. By trial and error small quantities of sand is added and the mix which does not develop crack should be found. If the samples do not develop cracks on drying, excess sand may be suspected. To ensure the correct proportion clay should be added in small quantities and the mix which tends to develop cracks is found and the mix which preceed this sample is taken as the proper mix. This soil and cement should be mixed in the ratio of 8 : 1 by volume for preparing the soil cement plaster.

Before lining the channel, the channel should be prepared to the exactly required dimensions allowing for a lining thickness of $\frac{3}{4}''$ to 1''. The sides and bed for the channel should be compacted well with rammer. The soil cement plaster should be prepared by adding required quantity of water in the same manner as the ordinary cement mortar. It should be applied immediately to the sides and bed of the channel by a mason so as to make a smooth finished surface. The lining thickness should be $\frac{3}{4}''$ to 1''. After initial settting, the work should be cured for at least seven days so that it will attain sufficient strength. The cross section of the lined channel (Soil Cement) is shown in sketch No. 2.



SKETCH NO 2
CROSS SECTION OF SOIL-CEMENT LINED CHANNEL

TABLE 1. *The inflow and outflow quantities for soil cement channel*

Inflow Measurement				Outflow Measurement			
Clock time (Hrs. & Min.)		Head over V. notch. (cm.)	Inflow (cusec)	Clock time (Hrs. & Min.)		Head over 'V' notch (cm.)	Outflow (cusec.)
4	15	8·60	0·1105	4	20	7·50	0·0789
4	20	8·60	0·1105	4	25	8·00	0·0930
4	25	8·60	0·1105	4	30	8·40	0·1048
4	30	8·60	0·1105	4	35	8·40	0·1048
4	35	8·60	0·1105	4	40	8·40	0·1048
4	40	8·60	0·1105	4	45	8·40	0·1048
4	45	8·60	0·1105	4	50	8·40	0·1048
4	50	8·60	0·1105				

Calculations :

Constant inflow : 0·1105 cusec

Constant outflow : 0·1048 ,,

Constant loss : 0·1105 − 0·1048 = 0·0057 cusec.

Total wetted area : $1·1 \times 20 = 220$ sft.

Loss in cft/hr/sft. : $\frac{0·0057}{220} \times 3600 = 0·09545$ cf/hr/sft.

Percentage of constant seepage loss : $\frac{0·0057}{0·1105} \times 100 = 5·2$ percent

Results and Conclusions: The channels were got lined with soil cement in the above manner and tested for their performance in reducing seepage loss. Seepage loss in these 200 ft. long lined channels in the inflow-out flow method was studied using 90° 'V' notches for the measurement of inflow, and a gauge to measure the rate of flow into the channel. The readings are given in Table No. 1. The bed width of the lined channel was 9'' and the depth was 7·5'', the side slope being 1 : 1. The cross sectional area of this lined channel was 0·8594 sq. ft. The depth of flow during the test was 0·123 ft. The cost of lining for the above channel was Rs. 40/- per 100 ft. length. That is, the cost per square ft. of lined area worked out to about 16 paise.

Tests conducted in the lined channels indicated that the seepage loss was only about 5 per cent of the inflow in 200 ft. length for a flow range of 0·1 to 0·2 cusec, whereas the loss in unlined earthern channel was as high as 12 to 18 per cent of the inflow. The study revealed that the soil cement lining reduces the seepage loss by about 70 per cent resulting in considerable saving of irrigation water.

The soil cement lining saves about 70 per cent of the irrigation water lost by seepage; it also prevents leakage and weed growth. The cost of lining per square foot of lined area is only 16 paise and hence it is very cheap. The cost may slightly vary in different regions. The evaporation loss has been neglected for calculation purposes as it is small compared to seepage loss. The above lining has stood well so far, that is one year. However the durability is yet to be studied.

As the soil required for the lining is invariably available in rural areas, the soil cement plaster can be readily prepared at any place and widely adopted for channels for conserving irrigation water. Undoubtedly, therefore, the cheapness of the lining will attract even ordinary farmers towards the adoption of this lining for water proofing of small irrigation channels.

Acknowledgements: Acknowledgements are due to Sri N. Sankaranarayana Reddi, Joint Director of Agriculture (Engineering), Madras for his valuable guidance in carrying out this research work. We are much indebted to the Dean, and Associate Professor of Agronomy, Coimbatore, for the help and encouragement in the study. Much indebtedness is also due to Sri P. R. Ramaswamy, Principal, Government College of Technolgy, Coimbatore for his kind co-operation and timely help for carrying out permeability tests.