Pak. J. Agri. Sci., Vol. 28, No. 1, 1991

USE OF POLYETHYLENE FILM FOR LINING WATER COURSES

Arshad Ali & M. Asghar Rana
Faculty of Agricultural Engineering & Technology,
University of Agriculture, Faisalabad

The concrete and bricks when used for watercourse lining are not completely impervious and some seepage losses are likely to occur. Provision of some impermeable layer like polyethylene sheet beneath some protective cover can guarantee complete check to the seepage losses for many years at a relatively very low initial investment. Trapezoidal watercourse with 7.6 cm thick layer of bricks as a protective cover laid over the plastic film was 54% cheaper and gave complete seepage control as compared to the conventional lining (double brick lining in a rectangular design).

INTRODUCTION

Losses of irrigation water in conveyance from mogha to the field outlets average about 47% (Lowdermilk *et al.*, 1978). Earthen improvement has been found to reduce the delivery losses by about 50%, increasing thereby the delivery efficiency from 50 to 75% (Reuse *et al.*, 1975) but this is only short lived.

Lining is a long term effective method of controlling seepage losses from the watercourse but the cost of conventional lining technique is so high that this cannot be recommended for a massive lining programme in the county. There is thus a strong need to develop alternate low cost lining techniques those can effectively control seepage losses from the watercourses.

The plastic film had failed when used as an exposed lining. However, it has proved effective and durable as buried lining as long as the protective cover remains intact (Anonymous, 1978). In India, the polyethylene film, when used for lining canals, with tiles as a protective cover has been found relatively cheap, durable and highly impermeable fulfilling all the requirements of a good lining (Anonymous, 1979).

Polyethylene film 0.2 mm thick was also used for lining a number of watercourses located in all the districts of Punjab during 1972-73 in rectangular design with 11.2 cm thick brick masonry protective covers. The seepage losses were observed to be cut off by about 99% (Anonymous, 1978a). Research was also conducted on polyethylene lining on trapezoidal watercourses at Niaz Beg Field Research Station, Lahore and found its performance efficiency satisfactory (Anonymous, 1978b). However, performance efficiency of lining decreased mainly due to mishandling of buried membrane by the cultivators during silt clearance. Experience on the country's watercourse system indicates that simple soil cover would not protect the film against the attack of rodent.

Experimental lining of trapezoidal watercourses with polyethylene film was tried at the University of Agriculture, Faisalabad, providing 7.6 cm thick layer of brick as a

protective cover laid over the film. The results of this experiment revealed that plastic film liner with a rigid protective cover was found to be very cheap and one of the most effective materials for reducing seepage losses to almost negligible quantity from earthen cannels. The considerable saving in cost has been achieved.

MATERIALS AND METHODS

Experimental lining of trapezoidal watercourses with polyethylene has been tried out at the University of Agriculture, Faisalabad, providing 7.6 cm thick layer of bricks as a protective cover laid over the film employing the following techniques:

1. 7.6 cm thick brick masonry cover in 1:8 cement mortar both on bed and sides.

2. 7.6 cm brick pitching grouted with 1:8 cement mortar both on bed and sides.

3. 7.6 cm thick simple brick pitching on sides and grouted bed only with 1:8 cement mortar.

4. 7.6 cm thick simple brick pitching on sides with 30 cm thick earth cover on bed.

Seepage losses were measured by ponding method (Kemper, 1983).

RESULTS AND DISCUSSION

The results of this experiment revealed that plastic film liner with a rigid protective cover was found to be very cheap and one of the most effective materials for reducing seepage losses. The cost analysis of this type of lining system showed considerable savings in cost (Table 1) when compared with conventional practice of lining rectangular watercourses having 22.5 cm thick brick masonry walls in 1:8 cement mortar. The brick lining of 7.6 cm thick having a plastic film underneath and plastered properly was 54% cheaper as compared to conventional lining technique (Table 2).

The performance of polyethylene lined watercourse sections was evaluated over the last 10 years and has been found to be quite effective in controlling seepage. The field trials conducted in India have also confirmed the effective age of the film to be over 20 years. A life of about 50 years was confined through tests at IPRL, Amritsar, India (Anonymous, 1979).

It is not out of place to mention here that in the beginning of the above mentioned experiment, 30 cm thick soil cover was also provided on one section. But just after lining, slipping of soil from the sides on the lines section occurred as the water flowed through it. The slipped soil was then put back and compacted, but it again did not attain a stable position. It was attributed to (i) increased velocity of flow, (ii) steep side slope of 1:1 and (iii) sandy nature of soil texture..

Experience of lining with polyethylene in other countries indicates that homogeneous well compacted earth linings of different thickness can be used as a protective cover in most of the stable reaches of a water channel provided the soil is impervious, non-erodible and does not crack or disintegrate under wetting/drying/weathering action and the side slopes of channel are flatter than angle or repose in such soil mixes.

The other salient recommendations in the use of plastic lining are that (i) the subgrade should be compacted to minimum bulk density of 1:8 g/cm3 and (ii) if earth cover is to be provided the side slope of 2:1 is considered satisfactory. However, as already mentioned the main disadvantage of this type of lining is the need for frequent maintenance of watercourse section which remains earthen even when substantial amount has been spent for lining.

permeability can be ensured by incorporating polyethylene film below 5 cm thick concrete or 7.6 cm thick brick lining at an additional cost of Rs. 18.0 per square meter. The seepage losses in this study were found almost zero with the provision of polyethylene sheet. The cost of polyethylene lining can further be reduced by another 15% by providing simple brick pitching on sides and bed grouting with 1:8 cement mortar as a protective cover.

Table 1. Comparative cost of lining trapezoidal watercourses with polyethylene film employing different protective covers

S. No.	Protective cover	Cost	
		Rs./ linear meter	Rs./ square meter
1.	7.7 cm thick brick masonry cover in 1:8 cement mortar both on bed and sides.	78.84	54.30
2.	7.6 cm thick brick pitching grouted with 1:8 cement mortar both on bed and sides.	67.46	46.25
3.	7.6 cm thick simple brick pitching on sides and grouted bed with 1:8 cement mortar.	53.83	36.32
4.	7.6 cm thick simple brick pitching on sides with 30 cm thick earth cover on bed.	44.00	31.82

* Cost of 100 microns polyethylene film = Rs. 3.50 per sq. meter.
Cost of earth work involved = Rs. 8.60 per cu. meter.
Price Index 1982-83.

As already pointed out, the concrete and bricks are not completely impervious and some seepage losses are likely to occur. Provision of some impermeable layer like polyethylene film beneath these linings can guarantee complete check to the seepage losses for 5 to 10 years. Thus effective im-

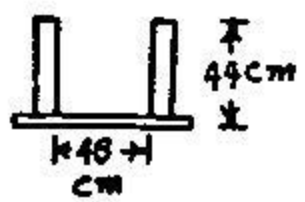
REFERENCES

Anonymous. 1978 a. Seepage losses from unlined and lined watercourses. Irrigation Research Institute, Lahore. Publ. No. IRRI 455/Phy WCL.

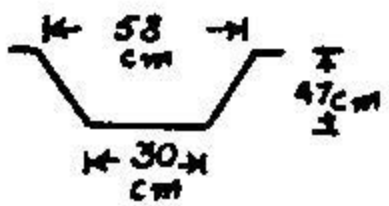
Table 2. Comparative cost of conventional and polyethylene lining

	Conventional lining* Double brick lining in a rectangular design		Polyethylene lining (7.6 cm thick brick masonry with protective cover)	
A)	Material cost:		Material cost:	
1)	Bricks 137 @ Rs. 750/1000	Rs. 103.00	Bricks 52 @ Rs. 750/1000	Rs. 39.00
2)	Cement 0.39 bags @ Rs. 108/bag	Rs. 42.00	Cement 0.20 bags @ Rs. 108/bag	Rs. 22.00
3)	Sand 0.17 m^3 @ Rs. 90/m^3	Rs. 15.00	Sand 0.085 m^3 @ Rs. 90/m^3	Rs. 7.00
4)			Polyethylene film	Rs. 18.00
	Sub-total (a)	Rs. 160.00	Sub-total (a)	Rs. 86.50
B)	Labour cost:		Labour cost:	
1)	Skilled	Rs. 40.00	Skilled	Rs. 10.00
2)	Unskilled	Rs. 30.00	Rs.	8.00
	Sub-total (b)	Rs. 70.00	Sub-total (b)	Rs. 18.50
	Total cost	Rs. 230.00 per linear meter	Total cost	Rs. 104.50** per linear meter
		Rs. 169/m^2		Rs. 82.0/m^2

Cross sectional area .. 0.21 m^2
Perimeter .. 1.36 m.



Cross sectional area .. 0.21 m^2
Perimeter .. 1.28 m.



Anonymous. 1978 b. Polyethylene plastic a lining material for watercourses. Pak. Agri. Res. Council, Islamabad. Publ. No. IRRI-11/Pak/ARs-6/FG.Pa.224.

Anonymous. 1979. Canal lining incorporating polyethylene film. Irrigation and Power Res. Instt., Amritsar, India. Publ. No. Phy/R. 19.

Kemper, W.D. 1983. Methods of measuring seepage rates. Diagnostic Analysis of Irrigation Systems. Vol. 2. Evaluation Techniques, Water Management Synthesis Project, Univ. Service Centre, Colorado State Univ., Fort Collins, Colorado, U.S.A.

Lowdermilk, M.K., A.C. Early and D.M. Freeman. 1978. Farm irrigation constraints and farmers responses: Comprehensive field survey in Pakistan. Water Management Technical Report No. 48, Colorado State Univ., Fort Collins, U.S.A.

Reuse, J.O., G.V. Skogerboe and D.J. Merray, 1975. Water management programme to improve agricultural productivity in Pakistan: An Appraisal. Water Management Technical Report No. 42, Colorado State Univ., Fort Collins, Colorado, U.S.A.