FIELD INVESTIGATION OF WATER-PROOF MATERIAL AND THEIR EFFECT ON CONTROLLING SEEPAGE

EXAMEN SUR LE TERRAIN DU MATERIAU IMPERMEABLE ET SON EFFET SUR LE CONTROLE D'INFILTRATION ETUDE DE CAS: CANAUX DU RESEAU D'IRRIGATION DE 'AMIR KABIR INDUSTRIAL & AGRICULTURAL COMPANY'

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ABSTRACT

In semi-dry areas, like Iran, water and its demand are critical issues. Nowadays for doing some project and hydro programming and increasing agricultural yields, conveying water has important role. Water loss from the conveyance system takes place due to seepage and to a much lesser extent due to evaporation. At the time of channel construction some lining materials are normally used. Numerous joints in concrete lining are the weak points that eventually cause seepage loss of water. For this reason, different material such as mastic or tar and other similar materials have been used.

In the present study, agricultural & Industrial network of Amir Kabir was chosen. Three different sections with 100 m length were selected for discharge measurement. The water proofing materials used include conflux-LM and injection material for specific concrete (E. M, super repair) and super liquid and (S.P.A. plaster) at three sections. After using of supplement materials, discharge measurement were been done again and analyzed. The percentage of water loss in 100 m of canal were 0.047, 0.047, 0.041, respectively.

It may be mentioned that on the basis of average infiltration, the initial water loss is about 24 lit m^{-2} a day.

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Key words: *Geo textile and concrete cover, Polyurethane material, Injection supplement of concrete, Super repair materials.*

RESUME

L'eau et sa demande sont des questions cruciales dans les zones semi-arides de l'Iran. Aujourd'hui, le transport d'eau joue un rôle important dans les projets, la programmation hydrologique et le rendement agricole. L'infiltration donne lieu à la perte d'eau et à un tout petit niveau, à l'évaporation. Au moment de la construction du canal, les matériaux de revêtement sont normalement utilisés. De nombreux joints dans le revêtement des canaux sont les points faibles qui donnent lieu à la perte d'eau du système. A cette fin, différents matériaux tels que le mastic ou le goudron/bitume et d'autres matériaux similaires sont utilisés.

Dans l'étude actuelle on a retenu le réseau agricole et industriel d'Amir Kabir. Trois différentes sections de longueur de 100 m ont été retenues pour mesurer le débit. Le matériau imperméable utilisé comprend 'Conflux-LM' et le matériau d'injection pour le béton spécifique (E. M, super réparation), super liquide et (SPA en plâtre) à trois sections. Après utilisation des matériaux complémentaires, on a de nouveau mesuré et analysé le débit. Le pourcentage de perte d'eau dans le canal de longueur de 100 m était de 0,047, 0,047, 0,041 respectivement.

Il est à mentionner que sur la base de l'infiltration moyenne, la perte d'eau initiale était de 24 lit m^{-2}//jour.

Mots clés : *Géo textile et couverture en béton, matériau polyuréthane, supplément d'injection de béton, matériaux de super réparation.*

1. INTRODUCTION

Faced with the ever increasing demand for water and its limitation in Iran, scientists have been trying to find ways and means of water saving to ensure its sustainable use, particularly in the agriculture sector. To provide irrigation to the crops water has to be conveyed over long distances from its source such as a reservoir. During this transit of water, considerable water loss takes place due to seepage from the canals. Conveyance loss of irrigation water has been a long standing problem in several countries of the world, including Iran. According to the findings by FAO, the water loss in conveyance through unlined channels in various countries varies from 3 to 86 per cent (Table 1).

Table 1. Water seepage through uncovered channels

Country	Project	Initial loss from inflow water
U.S.A	46 projects in Illinois river	3-86 (medium 40) 18-44 (medium35)
Pakistan	Channel Bary-Doab Ganjeh-Koubadak network	47 25
Mexico	….	30-50
Turkey	Komra flat Manman flat	40 30
Egypt	Nile delta new channels in drought areas	8-10 50
Soviet Union(pervious)	….	20-35
India	Gangeh channel	44
Iran	Garmsar network	40

According to the research information in Iran, in traditional irrigation systems, from 100 liter of supply, 30 to 40 liters are lost during transit of water from the source to the farm and another 30 to 40 liters are lost in the farm due to unscientific application and use of water and inadequate land preparation. Only 20 to 40 liters are effectively consumed by the plants. The efficiency of the Irrigation & drainage networks in Iran is only about 35%. It is obvious that this low efficiency is to be improved. One of the ways to reduce losses of irrigation water is to use canal lining. Linings may be of concrete or other suitable material. The objective of the present study was to determine the losses of irrigation water in conveyance in channel sections with three different types of linings.

2. MATERIALS AND METHODS

In this study, 3 different sections of channel (100m length each) were selected out of the total length of about 14 km in each of the channels. The canal inflow at the head is about 6.16 $m^3 s^{-1}$, which gradually reduced to 3.3 $m^3 s^{-1}$ due to intermediate water extraction. The channels were trapezoidal in shape with side slope of 1:1.15, were concrete lined and had a design velocity of 0.69 $m s^{-1}$. The selected channel sections were from 0.050 to 0.150 km, from 0.150 to 0.250 km and from 0.250 to 0.350 km. The lining material studied in the selected 100 m long sections were:

- (Con flex- LM) elastic mastic based on resin polyurethane (used in section 1);
- (S.P.A- plaster-R): Adding material with very high power and influenced on related water (used in section 2) and
- E.M. Super Repair: Special materials due to cement powder have been used because of concrete resin are very sticky on types of surfaces and materials (used in section 3).

Discharge measurements in the channels were done before and after using the lining materials.

3. CONLUSIONS AND DISCUSSION

Tables 2, 3 and 4 give the measured discharges before applying the lining and the Tables 5, 6 and 7 give the measured discharges after applying the lining.

Table 2. Discharge measurement at section (1) before using lining

Sect 1 Measurement Numbers	Inflow, m^3/s	Outflow, m^3/s	Losses ratio
1	6.13	5.84	0.047
2	5.37	5.17	0.038
3	6.10	5.85	0.041
4	4.50	4.30	0.044
Average	5.60	5.34	0.047

Table 3. Discharge measurement at section (2) before using water stop materials

Sect 2 Measurement Numbers	Inflow, m^3/s	Outflow, m^3/s	Losses ratio
1	5.92	5.60	0.540
2	5.70	5.48	0.038
3	5.72	5.45	0.047
4	5.22	4.95	0.052
Average	5.64	5.37	0.047

Table 4. Discharge measurement at section (3) before using lining

Sect 3 Measurement Numbers	Inflow, m^3/s	Outflow, m^3/s	Losses ratio
1	5.60	5.38	0.039
2	5.20	4.95	0.048
3	5.90	5.70	0.034
4	5.20	4.98	0.042
Average	5.47	5.25	0.041

At section (1), all breaks and junctions have been filled with polyurethane mastic materials and results are as followings.

Table 5. Discharge measurement at section (1) after using lining

Sect 1 Measurement Numbers	Inflow, m³/s	Outflow, m³/s	Losses ratio
1	5.80	5.69	0.019
2	6.10	6.02	0.013
3	5.20	5.10	0.019
4	5.10	5.04	0.012
Average	5.55	5.46	0.015

Table 6. Discharge measurement at section (2) after using lining

Sect 2 Measurement Numbers	Inflow, m³/s	Outflow, m³/s	Losses ratio
1	5.40	5.34	0.011
2	6.00	5.97	0.005
3	4.93	4.90	0.006
4	5.40	5.36	0.007
Average	5.43	5.39	0.007

Table 7. Discharge measurement at section (3) after using lining

Sect 3 Measurement Numbers	Inflow, m³/s	Outflow, m³/s	Losses ratio
1	5.60	5.45	0.027
2	4.90	4.70	0.041
3	6.00	5.84	0.026
4	5.50	5.36	0.025
Average	5.52	5.35	0.030

Before using supplement material Conflux-LM and injection material for specific concrete (E. M, super repair) and super liquid and (S.P.A. plaster) have been used at three sections, and percentage of water loss at 100 meter of canal at their section, in tables 1,2 and 3 respectively, are 0.047, 0.047, 0.041, respectively. After using of supplement materials, discharge measurement were taken again and analyzed.

In table 5, at section number one, with using polyurethane mastic, average water loss from canal was 0.015, and in table 6, at section two, this average was 0.007, and finally, in table 7, at section 3 (with using supper repair materials), percentage of water loss decreased about 0.03.

At it is mentioned (tables 2 and 5) after using mastic, the rate of seepage decreased about {(0.015-0.047)/0.047} = 68% but at practical usage using this material will have the following problems:

At deep junction, because of being expensive firstly one fume layer should been used and at small junction just above lager should be fill with this materials. This problem will be more after dredging.

At using of injection specific concrete supplement; (tables 3 and 6), about {(0.007-0.047)/0.047} 85% decrease is seen, and at section (3); (tables 4 and 7) just {(0.030-0.041)/0.041} = 27% reduction in seepage loss occurred.

4. CONCLUTIONS AND RECOMMENDATIONS

From the theoretical point of view, It's better to used mastic as supplement but this materials are very expensive. Hence, supper supplement with rate of 85% decrease are suggested more (at case study: Amir Kabir network).

Considering average deep infiltration of about 4252207 m^3 $year^{-1}$ in the network and wetted area of channels of about 483290 m^2, initial water loss is about 24 lit m^{-2} a day. Also, once applied, it is not essential to use supplement material at network channel subsequently.

In order to prevent against canal breakage and failure, suitable solutions exist and it is better to use above solutions. But it is suggested that some new polymeric materials be used due to their better performance, subject however to availability of skill in handling such material. Some useful references on the topic of this paper are given below.

REFERENCES

Hossaini, S. M., Abrishami, J., 2002. Hydraulic in opening canals, published by Astan Ghods Razavi, 8th edition, Mashhad, Iran.

Ramezanpour, A.A., Shahnazari, M.R., 1999. Technology of concrete, Published by Elm and Sana'at University,Tehran, Iran.

Schilton, G, 2003. Practical and up to date of technical characteristics of concrete mixtures. The Magazine in concrete technology, number 2.

Casual orders in designing irrigation and drainage, 2004. Management and planning organization, assistant office of protecting affairs, center of scientific and publish documents, publication number 281.

Hein, W., Meter, B., 2003.Amont of water and its effect on Portland cement hydration, magazine of concrete technology, Number 2.

Hydraulic Engineering, 2000, Naue Fasertechnik GmbH & Co. KG, (www.naue.com)

Leek, D.S., Herper, A.M., Ecop, C., R., 2003. Specification and production of durable reinforced concrete. Transportation research record ,1948, transportation board, Washington.

United States department of the interior bureau of reclamation. Design of small canal structure, water resource publication.