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Irrigation Canals Lining: Moving from a Short- to Long-Term Effectiveness of Seepage Control with the Use of Geosynthetics

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ABSTRACT

Worldwide statistical data on lengths of unlined and lined irrigation canals are scarce. Irrigation country profiles issued by FAO do not provide any information on the lengths of canals which have been lined so far. However, the length of irrigation canals serving about 150 million hectares irrigated with surface water, out of a global irrigated area of 325 million hectares can be estimated to be in the order of one to two million kilometers.

A number of benefits are expected when lining a canal: a reduction of seepage losses, an increase of the canal transit capacity together with a reduction of weed infestation and of routine maintenance costs, and a reduction of the twin menace of waterlogging and salinization.

Concrete lining has historically been the preferred method of lining by many irrigation agencies. Brick layers have been frequently used in countries with cheap labor cost, such as in the Indo-Gangetic alluvial plain in India and Pakistan. Concrete as a lining material, can theoretically last up to 50 years under high quality of design and construction, without physical failure. However, there are now strong theoretical and field evidence that a majority of hard (i.e. concrete) surface linings deteriorate within a few years following their installation, to the point where seepage losses of the canals are as high as before the concrete liner was installed.

Cracks are typically caused by change of morphology of the subgrade, and develop on concrete-lined canal slopes under certain geotechnical conditions and/or harsh climatic environments. Soils with high plasticity, subject to swelling, as well as gypsum and collapsible soils are the most likely to generate differential settlement of the sub-base. Frost heave is a major cause of cracking in areas exposed to long periods of below-freezing temperatures. Finally, quality of construction, such as poor compaction of embankment and poor vibration of concrete, is also a frequent cause of rapid deterioration of the concrete veneer, therefore of the effectiveness of the seepage control.

“Very thin plastic films”, as they were named before the word “geomembrane” was coined by Professor J.P. Giroud, have been used at various scales since the 1960s. Today the geosynthetics industry offers a wide range of durable products, far better than the ones that were used more than 50 years ago. A variety of installation techniques are also available: exposed or protected. The challenge for irrigation agencies is to select the type of geomembrane and the design of the lining system adapted to a particular project, taking in consideration several factors such as: soils, climatic conditions and risk of vandalism. The duration of the closure period is also a critical design parameter when retrofitting an existing canal.

The disillusionment of several agencies with the performance of rigid lining materials and the need to re-establish the effectiveness of canals currently ‘lined’ with rigid materials offers a unique opportunity for effective and durable lining techniques such as geosynthetics, therefore improving agriculture, energy or other sector requiring the transport of water over large distances.


Figure 1. deteriorated rigid (concrete) veneer liner


Figure 2: Installation of concrete on a geomembrane