Predicting the OptimumTime to Apply Monolayers to Irrigation Channels

A dissertation submitted by

Michelle Winter, Bachelor Engineering (Civil) (Honours)

For the award of

Masters of Engineering Research

2012

Predicting the Optimum Time to Apply Monolayers to Irrigation Channels

Michelle Winter

Modernisation, Goulburn-Murray Water

Abstract

The research project aimed to investigate the potential of using chemical monolayers on irrigation channels to reduce evaporation losses. Monolayers consist of a film one molecule thick that covers the entire water surface and reduces water evaporation. The effectiveness of monolayers at reducing evaporation from still water bodies has been widely studied, with the technology having been adopted by some irrigation authorities on storage dams. However, little research has been done into investigating the effectiveness of monolayers in reducing evaporation in flowing situations. Goulburn-Murray Water has an extensive network of irrigation channels of which evaporative losses are a major component of the total yearly water losses (approximately 70 GL/year). The purpose of this work was to establish a decision support system to predict under what situations it is most appropriate for Goulburn-Murray Water to apply monolayers to irrigation channels.

Closed and flowing channel trials were conducted by Goulburn Murray Water. The closed channel trials indicated that using monolayers on irrigation channels could result in potential savings of between 10% and 30%, while the flowing trials gave promising preliminary results into the ability of ES300 to pass a regulating structure and reform with surface pressure adequate to suppress evaporation.

Modelling the use of monolayers on irrigation channels has shown that the most critical barrier to the cost effectiveness of monolayers is the ability to pass culvert structures. Therefore, it is imperative that investigations are undertaken to determine whether a technique can be developed to allow monolayers to pass culvert structures. The model needed to take into consideration many variables including evaporation rates, wind impacts, material costs and channel dimensions.

Modelling also indicated that where monolayers are unable to pass culvert structures, cost effectiveness is increased if the flow of the monolayer down the channel can be slowed, thereby retaining the monolayer on the channel for longer and reducing the number of times it needs to be reapplied. Methods to achieve this include applying monolayer to the longer pools and applying when wind direction opposes channel flow.

If no technique can be found to allow monolayers to pass culvert structures then this technique remains a costly method of saving evaporation water due to the continual reapplication of product. Its main attractiveness for use is that it can be used when and where required without large capital investment and at times when the cost can be warranted by the value of water.

The model is specific to the Goulburn-Murray Water channel system, however flow charts have been developed to enable other irrigation authorities to characterise their irrigation network in order to apply the model to their situation. In order to use the model, Goulburn-Murray Water needs to set the maximum $/ML that it is willing to pay at that time and then review the model output to determine where to apply monolayers to achieve that result.

Depending on the drivers to save water, monolayers are most suited to application on the longest pools. Savings at well below $200/ML can be achieved by applying ES300 to the 1% longest carrier channels when evaporation is 4.5 mm/day or greater, however the total volume that could be expected to be saved under these conditions is only 70 ML or 0.1% of the current total losses due to channel evaporation. The total savings achieved and the average cost of achieving those savings are intrinsically related and an improvement in one will detrimentally affect the other.

Keywords:
Monolayer, irrigation, channel, Victoria, flow, agriculture, evaporation

Certification of Dissertation

I certify that the ideas, experimental work, results, analyses, software and conclusions reported in this dissertation are entirely my own effort, except where otherwise acknowledged. I also certify that the work is original and has not been previously submitted for any other award, except where otherwise acknowledged.

____________________________ ________________________

Signature of candidate Date

____________________________ ________________________

Signature of Supervisor Date

____________________________ ________________________

Signature of Supervisor Date

Acknowledgements

Name	Details
Bruce Albrecht	G-MW employee working on the evaporation mitigation project, provided guidance, review, field and laboratory results
Mark Bailey	G-MW manager, provided guidance
Matthew Davis	G-MW employee, provided review
Peter Egglestone	G-MW manager, provided review
Nigel Hancock	USQ supervisor
Fiona Nioa	G-MW manager, provided review
Jeremy Nolan	G-MW manager, provided review
Derek Poulton	Former G-MW employee & manager, provided guidance and review
Rod Smith	USQ supervisor
Willem Vlotman	Former G-MW employee & manager, provided guidance and review

Table of Contents