Distribution system impact control for blended desalinated and surface water case study

Control model enables consistent quality from blended water

WATER SERVICES
ASSOCIATION OF AUSTRALIA

To better secure future water supply, water from Adelaide's Desalination Plant will be blended with treated water from Happy Valley Water Treatment Plant. This required establishment of reliable disinfection methods when blending different source waters, to maintain the desired characteristics of finished drinking water. Laboratory and field studies by SA Water Treatment and the Australian Water Quality Centre working with the University of South Australia developed disinfection decay models so Allwater can apply management systems to avoid water quality changes while blending high quality desalinated and existing system water in the ADP/Happy Valley supply.

ENSURING ENOUGH WATER WITH MINIMUM DISRUPTION TO THE DRINKING WATER CUSTOMER

A desalinated water supply for SA Water was implemented to better secure future water supply for Adelaide. Water from the new Adelaide Desalination Plant (ADP) supply will be blended with the current treated water from Happy Valley Water Treatment Plant (WTP), in different proportions dependent upon demand. However the blending of these two supplies, with significant differences in underlying water quality, can potentially impact upon a range of characteristics that are important to maintain in finished drinking water. The important anticipated changes include the maintenance of correct disinfection with chlorine, the formation of by-products and biofilms, and possible aesthetic issues for customers in the water distribution network.

CONSIDERING THE ALL-IMPORTANT EXPERIENCE AT THE TAP

Aesthetic water quality issues may result from variable chlorine residual at the customer tap. Detachment of biofilms may affect taste, odour and coloration, and may result in customer complaints. Biofilms may detach in areas where chlorine residual is higher than normally encountered. It was identified early on in planning for the ADP supply that there needed to be awareness of the potential issues that could arise with disinfection under different chlorine decay characteristics when blending high quality ADP water into the existing system. This project set out to investigate the risks

and develop management systems to avoid water quality changes.

COOPERATION WITH EXPERTISE PRODUCES DESIRED RESULT

Staff from SA Water Treatment group and the Australian Water Quality Centre undertook laboratory and field studies and worked with staff from the University of South Australia to develop disinfection decay models. The developed strategies are now being implemented by Allwater to assist with distribution system management of the ADP/Happy Valley supply.

The initial laboratory work commenced in late 2009.

Some aspects of the project are still in progress. Implementation of the control strategies currently being utilized with the introduction of ADP water began at higher volumes in June 2012.

These control strategies will improve operation and management of the distribution system by the WTP operators and in management of the distribution system to improve water quality, maintain constant chlorine and minimize customer complaints. This will benefit SA Water and the community.

THOROUGH INVESTIGATION

This project investigated a range of blending of different source waters. It also examined characteristics of biofilm in the network and developed a model to predict chlorine decay and on-line monitoring to assist with controlling potential chlorine issues in the circumstances where blended water occurs.

The study showed that, based on Happy Valley water quality in 2009, improved water quality resulted by blending ADP water with Happy Valley WTP product water. The improvement included lower DOC concentration, chlorine dose, DBP formation and favourable taste panel results. This work identified that higher levels of treatment of Reverse Osmosis (RO) water were not required based on water quality considerations and that the greatest water quality challenge will be controlling disinfection of the resultant blended water to avoid aesthetic water quality issues. A chlorine decay model has been developed by UniSA in conjunction

with AWQC to predict chlorine decay in Happy Valley conventionally treated waters and those blended with RO waters. This provides a practical model that enables prediction of chlorine residuals. This allows for informed dose control at the WTP to achieve desired chlorine residual within the Happy Valley distribution system with varied desalinated water content. The model was presented to Allwater in September 2011.

The evaluation of the use of a simple parameter, monitored by an on-line monitoring system, to predict chlorine residual within the distribution system has also been undertaken. This indicates that a state of the art on–line feed forward control of chlorine dosing is feasible and would improve management of chlorine residual in the distribution system. It would also minimise chlorine residual fluctuations, and eliminate or significantly reduce customer impact and complaints.

| Reference parameter	Value
Cl dose (mg/L)	6.02
Clapham Cl residual (mg/L)	1.62
HRT (hrs)	40
% blend	0
Prediction Parameter	Value
Clapham Cl residual (mg/L)	1.7
HRT (hrs)	40
% blend	37
Cl dose prediction (mg/L)	5.36
Actual Cl dose (mg/L)	5.33

Validation of chlorine decay model – example of model prediction for an increase in blend ratio of 0% to 40% desalinated water

AIMING FOR CONTINUOUS IMPROVEMENT

An investigation using a range of novel analytical tools, including measurement of bacterial numbers, has confirmed the presence of biofilm in one section of a regional distribution system where biofilm is known to be present. However the natural variation in bacterial numbers leaving the Happy Valley WTP, coupled with higher chlorine residuals, make detection more difficult in that system. Additional studies have been undertaken to

obtain further data within the distribution system on a longer term basis. This will help to determine whether trends emerge that are indicative of potential biofilm growth or a better indicator of water quality and more useful for management of distribution system quality.

The chlorine dose model has been calibrated using the limited available chlorine data from the distribution system but still requires further validation once desalinated water is introduced into the Happy Valley distribution system. The on-line monitoring system has been trialed at Happy Valley WTP for 18 months and is currently being assessed for operational implementation by Allwater. Further monitoring using a range of tools has provided background data prior to introduction of ADP water and is now being used to assess changes within the system following ADP input.
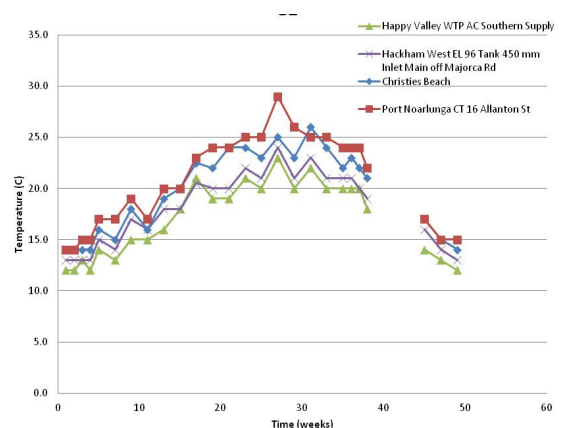
Using temperature changes as novel indicator to trace water quality change on passage through distribution system.

SA WATER

SA Water is the water utility wholly owned by the government of South Australia. It delivers water and sewerage services to almost 1.5 million people across the State.