WaterWorks

OFFICIAL JOURNAL OF THE WATER INDUSTRY OPERATORS ASSOCIATION OF AUSTRALIA

November 2013

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WATERWORKS
OFFICIAL JOURNAL OF THE WATER INDUSTRY OPERATORS ASSOCIATION OF AUSTRALIA

CONTENTS

THE TROUBLE WITH COMPLIANCE

Peter Mosse

Why should we spend any money on our WTPs?

We comply!

Why should we strive for best practice?

We comply with the Safe Drinking Water Act (or equivalent), don't we?

We comply with the ADWG, don't we?

And anyway, we have passed our audits so it must be OK. Why spend any more money?

Since we comply we can save money by getting the WTP operators to manage contractors at the plant.

But when was the last time a full filter inspection was carried out, or a jar test?

How many utilities still don't have individual turbidity meters on each filter and yet claim they **comply** with the ADWG?

It is quite surprising when asking water treatment and water quality groups how many people from these groups have actually read, word-for-word, the ADWG Framework for the Management of Drinking Water Quality, or have read Chapters 9 and 10 of the ADWG in their entirety. Typically, very few, if any, hands go up.

Compliance with the ADWG is often seen as simply compliance with the numbers in the back, which principally relate to chemical contaminants. These values have been in place a long time.

Only in the latest 2011 edition do we finally have targets set for turbidity as a surrogate for removing pathogens. The ADWG sets a target of less than 0.2 NTU, and a critical limit of 0.5 NTU, for individual filter performance. But how many utilities actually "comply" with this? Indeed, what does the turbidity guideline statement actually mean? In the absence of a specified % time for the target value, individual utilities and individual Departments of Health are interpreting the guideline statement differently.

At least one utility has set a number higher than 0.2 NTU, I guess thinking that it meets these criteria. And yet, research indicates that the turbidity of the water leaving the filters needs to be consistently below 0.2 NTU to ensure adequate removal of protozoan pathogens, particularly in an impacted catchment. Weekly grab samples analysed for turbidity, or daily composites, will not reveal whether a filter complies with the intent of the specified targets in the ADWG.

It is also interesting that water utilities would not consider supplying water that did not comply with, for example, the ADWG health-based guideline values for lead or arsenic, but adopt a flexible approach to complying with the turbidity requirements.

So what is wrong with the current approach to compliance? Nothing in particular, as long as the regulations or targets are adequate to protect public health and utilities actually assess their level of compliance with good, meaningful data analysis.

Concepts of "best practice" or benchmarking don't really come into it. There is sufficient knowledge available to clearly define requirements for the protection of public health, not just from contaminant chemicals, or from dental caries, but from pathogens, and yet we still don't see that reflected in Australian drinking water guidance documents. *(cont'd)*

OUR COVER

CLEAR VIEW FLOC SIZE CHARTS

Ever done a jar test and had trouble determining the size of the floc? Standard jar test floc size charts have been available for decades, but flicking backwards and forwards to a chart on the wall or in a book, and then back to the jar being assessed, is tricky.

I decided to cut up a chart and laminate the individual diagrams so that I could hold one or two of them next to the actual jar to help assess the floc size. I thought it worked well and used it for some time.

But lo and behold, while doing some jar testing at one of Gippsland Water's WTPs, Treatment Technician Wayne Shaw trumped my idea. He had experienced similar troubles in using the sheets and decided to photocopy them onto a clear plastic sheet so that he could see the floc in the jar ***through*** the sheet and make a direct comparison between the floc in the jar and the diagram on the sheet. Great idea. I copied it and tried it myself. Even better than mine!

We are so convinced of how good the idea is that WIOA will be sending out a sheet to all WIOA members and including one in the registration packs at the next few WIOA conferences. So look out for them and try them. I am sure, as Wayne and I have, you will find that it makes it a lot easier to estimate the floc size.

– Peter Mosse

Our colleagues in New Zealand, USA and Iceland have known this for years and their Standards and Rules reflect this.

The problem as I see it is that the current measures of compliance focus on an inappropriate set of measures of safe drinking water. This may be okay if the Guidelines, Regulations and Acts had been prepared to reflect current knowledge relating to public health and the operation of water supply systems. Simply relying on zero *E. coli* to judge the safety of drinking water reflects pre-protozoal knowledge. It is completely possible to operate a system that delivers 100% compliance with the requirement for zero *E. coli,* while at the same time failing to adequately remove protozoan pathogens such as *Cryptosporidium* and *Giardia.* These systems pose a significant risk \to consumers.

In the absence of clear and specific guidance and regulations designed to fully protect public health, compliance with less than adequate guidelines and regulations can, and does, lead to complacency in the operation of water supply systems. This is particularly evident when there are so many other factors competing for attention, such as financial sustainability, greenhouse gas emissions and environmental sustainability.

SE and EJ Hrudey, in their landmark book *Safe Drinking Water. Lessons from Recent Outbreaks in Affluent Nations* (2004), in addressing the risks associated with complacency, wrote:

If after reading about all of the other factors that have gone wrong to cause outbreaks in 15 different affluent nations you are truly certain that none of this could ever happen to you, then congratulations. To be justified in being certain, you must know your system very well and you must understand all of the ways that things can go wrong. You must have effective and well practiced plans in place for dealing with the many problems, large and small, that can happen if you are to be truly confident about avoiding a Walkerton style disaster. However we suspect that those of you most likely to avoid encountering such problems will be those who are willing to believe that Walkerton style problems could happen. The choice seems clear: unwarranted peace of mind or nervous confidence underlying the vigilance necessary to forestall appearance before a Walkerton like Inquiry.

Our overseas colleagues have been proactively managing things for a number of years and there is a real challenge for health regulators in Australia to recognise the deficiencies in our guidance documents and address the issue. At the same time, it is in the best interest of our industry and our customers for water utilities to recognise deficiencies in their own systems and risk management practices, and implement all the necessary levels of practice to ensure the protection of public health. This is not a matter of *gold plating,* it is just the minimum practice to, as Hrudey and Hrudey write, *achieve a nervous confidence in our ability to minimise illness in the communities to which we supply drinking water.*

CORRECTION

In the May 2013 edition of *WaterWorks*, there was an error with Table 1 in the paper titled "Optimise Chlorine Contact Tank Performance" by Church and Colton. We have corrected the error and posted an updated version of the paper on the WIOA website at www.wioa.org.au/publications/waterworks.htm

SOLAR BIOSOLIDS DRYING IN TOOWOOMBA: FIVE YEARS ON

James Coonan

Winner of Best Paper by an Operator and Best Paper Overall at the 2013 Queensland WIOA Conference

Figure 1. The solar drying halls.

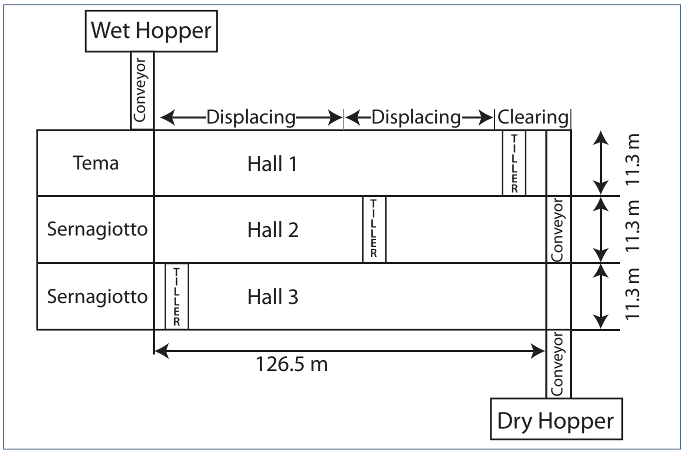

Figure 2. Summary of the programs used. Each hall is fed from an individual belt press (Sernagiotto or Tema).

The Wetalla Water Reclamation Facility was upgraded in 2006 with the provision of solar sludge drying halls (Figure 1) and additional belt press capacity. The solar hall, which has fully automated weather, controlled curtains and fans, uses air flow and solar radiation to dry the biosolids as they travel through the halls.

The commissioning began well, but eventually problems surfaced – not with the actual belt presses but with the associated processes. Over the last five years we have made several improvements on the initial design. While the system does run efficiently, there is still room for improvement and lessons to be applied in the design of future developments.

The pressed biosolids are placed in the halls and automatically moved down the halls via the operation of the tillers.

After trialling various tiller program combinations, it has now been decided that we need to use only two of the five available programs: Displacing and Clearing (Figure 2). The other three programs – Turning, Loading and Accumulating – are rarely used. The halls are worked in three sections each day:

- The first program is a displacing program used to remove the dried biosolids to make room for more to be added to the hall;
- The second program moves the biosolids down the hall to prepare a space for the next day's processing;
- The third program then moves the processed biosolids from the belt presses to fill the gap created by the second program.

The three programs are used as the tillers have a fixed rate of travel, allowing 12 passes per day, and if sludge is discharged for approximately two hours into one pile it becomes very hard to move and handle.

The clearing cycle is used at the discharge end of the hall to remove the dried biosolids to the discharge conveyor (Figure 3).

Normally we will clear out the last five metres of a hall; we then use the displacing cycle to make a space about midway down the hall so that the next day's production can be placed on the hall and moved along as it comes off the press.

The weather conditions influence the amount of biosolids that we can pass through the halls. In the warmer months we manage about 70% of the belt press sludge production down the hall, while in winter it can get as low as 30%.

The fully automated sludge process system came *without* an overall Operation Manual and it has been the operations staff that have developed an operation regime to best manage the operation of the facility. There was a detailed Operation Manual for the tillers, but nothing to tie it all together.

It has been said that the only time we experience 20-20 vision is in hindsight. Since 2006, when our solar hall was commissioned, we have learnt a lot from our daily usage, maintenance, and downtime due to these issues.

Our experience with this system has led to modifications to the original operation system that have resulted in cost savings and efficiency gains. Some of the points of improvement identified by operators working with this system are described on the next page.

Figure 3. The discharge conveyor.

The Automatic Curtain System

The solar hall has an automated weather protection system that uses complex technical weather detection (weather station) and automated weather curtains that deploy along both sides of the hall to prevent rain interfering with the drying (Figure 4).

This system has never been effective due to the condition that requires the curtains to lift once wind speed is above 20km/h. Unfortunately the weather conditions in Toowoomba are such that much of our rainfall is storm-generated, and the curtains are in the raised position when this happens because of the wind speed. For the best use of the side curtains the automatic control system has been disabled and the curtains fixed about a third of the way down.

The automated curtain system is a highly technical response to a very simple problem. A simple extension of the alsynite roof beyond the wall line of the solar hall would be a possible effective substitution. As air flow is critical to the air-drying process it is important to not substantially restrict air flow, and equally important to allow solar radiation to facilitate the drying process. This solution would meet both these criteria in a cost-effective and maintenance-free manner.

Over the last few seasons the downtime of one hall due to weather conditions has been substantial. The shutdown time of one hall due solely to these weather conditions is estimated to be in the vicinity of six weeks per year.

Dry Out Loading Conveyer

The initial design incorporated a screw conveyer as the primary extraction method from the solar hall. This design was not successful and regularly resulted in blockages requiring manual intervention. Bobcats were required to remove biosolids during these outages.

Due to the original design specifications, the replacement of the screw conveyor with the horizontal conveyor was restricted in size to the original dimensions of the infrastructure. This has created a large bottleneck in the drying process due to plant outages and maintenance. Callouts for tiller outages require prompt attention because any delay can result in the next day's processing being discharged to the 'wet hopper' rather than being placed down the hall. This does not just affect the outloading process itself, but the entire process is slowed due to this bottleneck.

In considering the construction of a solar hall, the capacity of the final discharge conveyor plays a major role in the operation of the solar hall.

Figure 4. The solar halls with the curtains raised.

Figure 5. The cleated conveyor.

Currently, due to width restriction, our tiller clearing cycle must be run at least three times to reduce the likelihood of overloading the conveyor system, adding considerable time and expense to this process. The replacement belt can only handle a clearing depth of approximately three centimetres per clearing cycle, hence the need to cycle at different depths.

More consideration should be given to the volume and weight of biosolids this conveyer must be able to handle in future designs. Another option would be to have four halls. Hall length would be reduced from 126 metres to 95 metres long. With the same total drying area, better management of tillers would be possible due to shortened travel time.

Outloading the conveyer to the dry hopper

The primary concern of the initial design is the angle of elevation needed for the transfer of biosolids to the dry hopper. This inclined conveyor was originally a screw lift, but due to clogging issues it was replaced with a flat belt conveyor. The flat belt conveyer was then replaced with a ribbed conveyor to enable the dry biosolids to be raised to the dry hopper.

The original design has the dry hopper positioned quite high above and close to the solar hall to allow underpass access for semi-trailers. This has meant the angle of elevation is quite steep and has led to substantial problems with the transfer of biosolids along the conveyor. This change from screw to belt conveyor means we now have problems with belt slippage on the top roller, particularly during moist conditions when belt slippage is common.

A cleated conveyor (Figure 5) was needed, as a flat conveyor at this angle did not handle the load due to the biosolids rolling back on the incline conveyer belt and clogging at the bottom, causing conveyor failures.

The height of the dry hopper in relation to the solar hall is a major design factor that needs attention. Reducing the angle of the incline conveyor to the dry hopper would result in substantially fewer failures. Not only would the conveyor system itself be simplified, e.g. non-cleated, but the total product displacement would be substantially increased.

The costs of implementation of these design modifications from the start of a new project would surely be recovered quickly by the increased throughput and reduced downtime of the facility.

The Author

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NOT ALL PLASTICS ARE SUITABLE (FOR CHEMICAL DOSING SYSTEMS)!

Gary Dinse

There are many situations where local government and other organisations award contracts based on price. These are often awarded to inexperienced suppliers who have limited knowledge and experience when dealing with hazardous chemicals, and who utilise the wrong materials, designs and installation techniques.

This not only costs the customer considerable money due to failures, downtime, repair and replacement, but can cause significant damage to infrastructure, and pose serious health and safety risks to operational personnel and the public through over- or underdosing of chemicals. Environment pollution can also be a consequence.

Incorrect Material Selection

Figure 1 shows a standard polypropylene fitting procured from most hardware/irrigation shops and installed on a typical chlorination system for a bore water supply with a local government authority. This is typical of many similar installations around the country.

Unfortunately, the material selected is not compatible with sodium hypochlorite solution and gradually degrades internally over a period of approximately three months, finally failing and leaving a trail of destruction and an expensive repair bill for external damage created.

Figure 1. Damaged PP pipe nipple as a result of installation in a system using sodium hypochlorite.

The actual fitting cost was around $2.50. The approximate damage bill is detailed in Table 1. The control panel has been included in the cost because when the fitting broke, chlorine sprayed all over the electrical cabinet, which was stainless steel and was destroyed along with the contents. One such cabinet involved in another similar event cost $21,000 to replace. The water pump was also stainless steel and was destroyed. The figure for the penalties for non-conformance water was indicative only and could be much higher as the water was not disinfected, potentially causing illness.

Table 1. Approximate damage bill for use of inferior fitting.

Description of damaged item	Qty	Repair cost
Electrical control panel	1	$5,600.00
Water pump	1	$ 900.00
Penalties for non-conformance water supply	1	$ 3,500.00
Labour for mechanical and electrical repairs on site	1	$2,500.00
Medical bill for operational staff (loss of time)	1	$ 750.00
Repair/rectification bill	Total Cost	$ 13,250.00

Table 2. Approximate damage bill due to incorrect gluing technique.

Description of damaged item	Qty	Repair cost
Mag flow meter	1	$2,800.00
u-PVC fittings	1	$120.00
Labour for mechanical and electrical repairs on site	1	$2,500.00
Repair/rectification bill	Total Cost	$5,420.00

Inferior Solvent Application Techniques

Figure 2 shows a failed elbow joint. As can be seen from the photo, the pipe and fittings were not primed correctly, leading to ineffective solvent bonding, and the pipe was not inserted to the full length. The result was premature failure of the elbow.

As a result the joint slowly leaked, causing damage to a mag flow meter located directly below the fitting, requiring replacement of the mag flow meter. The approximate damage bill is detailed in Table 2.

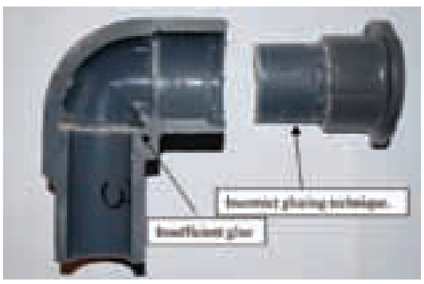

Figure 2. Faulty elbow and pipe.

Inferior Equipment Installation and Materials

Plumbers are usually the first port of call as they are generally held in high regard due to their expertise in the installation of pipe work and fittings for water and wastewater – but **not chemicals.** Nothing against plumbers, but we have found from experience they are great at what they do, but not so good when it comes to chemical dosing installations.

When it comes to chemical dosing, skilled tradespeople with specific training and understanding of the requirements for chemical dosing system assembly and installation are required. These skills, not generally taught in TAFE Colleges or learned from a text book, include solvent application, solvent selection, u-PVC pipe assembly, chemical compatabilty, material selection, system design and layout.

All aspects of the installation to ensure health and safety protection for all eventualities also need to be given full consideration. A sound understanding of the effects these chemicals can have on the environment, and how to protect it from spills and leaks, is also important.

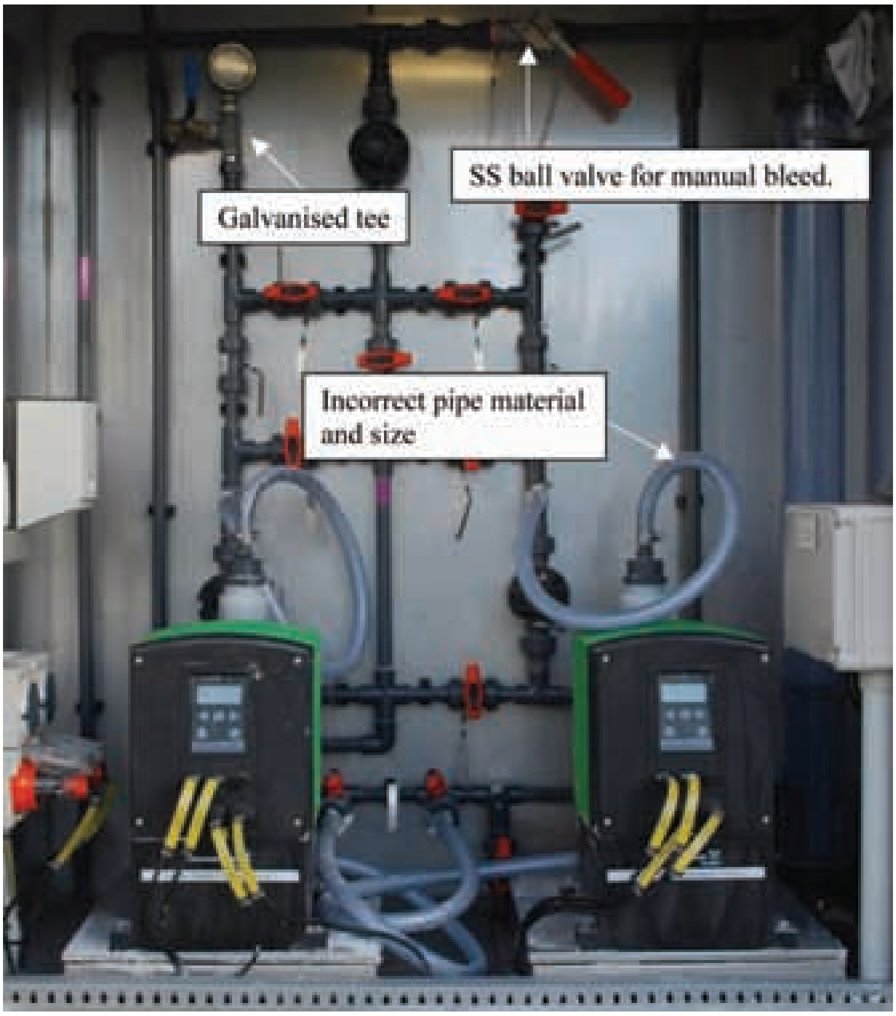

Figure 3. An example of substandard installation at a chlorine dosing facility.

The chemical handling industry should adopt a similiar practice as in the electrical industry. We all know how to wire a 3-pin plug, but there are dangers in allowing anyone to do this and this is why in industry only licenced people can carry out this activity. It is no different to allowing untrained people to work on chemical systems.

The Outcome of Using Untrained Contractors Supplying Incorrect Materials

- Operation personnel are at great risk every time they enter a chemical installation, as leaks resulting from incorrect solvent application or material selection could occur at any given time, spraying chemical over the operator and equipment.
- Potential of over- and underdosing of chemical where system design has been compromised through lack of knowledge and understanding.
- We have all recently heard about the chemical plant explosion in Waco, Texas. This could happen very easily with the right combination of chemicals. Recently we had a discussion with a client where they were proposing to place two non-compatible chemicals, 98% Sulfuric Acid and 12% Sodium Hypochlorite solution in the same bund, which could have caused a serious incident should a leak have occurred with cross-contamination. The two mixed together create Chlorine Dioxide gas in solution, which is deadly and can be explosive in high concentrations.

Table 3. Approximate rectification bill due to incorrect material selection.

Description of damaged item	Qty	Repair cost
u-PVC fittings	1	$120.00
Labour for mechanical repairs on site	1	$1,200.00
Repair/rectification bill	Total Cost	$1,320.00

Financial Impact

- High costs for rectification and replacement that can be more expensive than the original capital costs.
- Downtime due to unreliable equipment.
- Possible penalties due to failure to meet contractual obligations. A number of treatment plants are operated by companies that are penalised for inferior water quality as they are under contract. These penalties can be significant.
- Equipment damage from chemical leaks due to inferior products and inferior installation.

Figure 3 shows an example of substandard installation of a dosing system.

- The hose and fittings are incorrectly sized, with very small reducers placing undue load on the dosing pump and hose. In an industrial application, hose should not have been utilised and should be rigidly plumbed to ensure integrity of the system.
- The use of galvanised fittings is also not appropriate. Galvanised fittings react with the chemical and will be degraded by the chemical and, in some cases, cause adverse chemical reactions. uPVC should be used for this application.
- A stainless steel valve has been used; this should have been uPVC as the metal fittings will degrade the concentration of the chlorine and will be corroded.

The cost of rectifying this dosing facility is shown in Table 3.

The problems described above appear to be getting worse due to experienced tradespeople either retiring or leaving the industry for other reasons. We now have a serious lack of expertise in this country and a massive gap between those with experience and those without.

Local government organisations and water utilities should always check the credentials and experience of the contractor before issuing a purchase order. The order should not be price-driven, as the end result can cost the consumer substantially more than the initial contract value.

The Author

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HOW TO TRAIN YOUR CENTRIFUGE

Jarrah Feather
Winner of Best Paper by an Operator at the 2013 Victorian WIOA Conference

The 20ML Woodglen WTP was constructed in 2009 to meet the increasing neeeds of the Bairnsdale and Lakes Entrance populations. The plant is operated by East Gippsland Water (EGW) in eastern Victoria.

The washwater system at the WTP comprises a 750kL washwater tank, three lamella clarifiers, a supernatant return tank and sludge tank, as detailed in Figure 1.

The sludge from the sludge tank is pumped through a centrifuge where it is dewatered and the cake deposited into a skip bin. The centrate is returned back through the washwater system or to a raw water storage (depending on quality) via the centrate tank and pumps, as detailed in Figure 2.

Washwater systems can often be temperamental and difficult to operate and the washwater system at the Woodglen WTP was no exception.

Warning Signs During Commissioning and Proof of Performance (POP) Testing

During the early stages of commissioning there were some indications that the centrifuge was going to be difficult to operate. Initially it was thought that the main factor causing operational problems was colloidal clay coming from a recently constructed raw water storage. This was confirmed as a contributing factor when raw water sources were changed and the centrifuge's operation became more stable.

Table 1. Staff time required to keep centrifuge operational (per week).

Normal work time hours spent (includes routine and reactive operations)	Overtime	Sludge Cake Shovelling	Estimated Total Cost to EGW
12–14 hrs	3–9 hrs	3–4 hrs	$645

However, there remained ongoing instances where the centrifuge was performing poorly, or partially blocking. After the completion of commissioning and POP testing came the operational handover from the contractor to EGW operations. It was at this point that it became apparent that the issues with the centrifuge were not going to go away.

It is worth noting that the POP plan for the new facility had a strong focus on the performance of the filters and less so on the washwater plant. The POP testing, as such, was unable to sufficiently capture the issues EGW staff were observing for rectification under the contract.

Post-Commissioning Problems and Time Analysis

For several months following handover, maintaining reliable centrifuge run cycles was problematic and the frequency of these issues was increasing. The issues ranged from poor centrate through to serious blockages that were costing significant downtime for not only the centrifuge, but the entire WTP. The WTP was shut down for short periods (no more than eight hours) to allow for the backlog of washwater to cycle through the system. This created significant pressure on operations as maintaining water storage levels during summer peaks was difficult, even with these short breaks in treatment.

An excessive amount of staff time was being expended in an effort to keep up. The washwater system was designed with the centrifuge able to operate at 3.5-4L/second for anywhere up to eight hours per day. EGW's operators were struggling to maintain 2.0-2.5L/second through the centrifuge and it was rare that the centrifuge could run continuously for the required eight hours without at least some intervention from an operator.

In addition to this, the sludge cake from the centrifuge fell directly into a skip bin, which had no means of distributing the cake out evenly, thus requiring an operator to physically enter the skip to spread out the cake. This created additional downtime with a requirement to isolate the centrifuge for safe access.

Table 1 details the average normal work time, overtime and estimated cost expended per week to keep the centrifuge operational the few months after handover.

The amount of time being allocated to the centrifuge, only one small part of the whole WTP, was beginning to have repercussions on the overall operation.

Figure 1. Woodglen WTP washwater system.

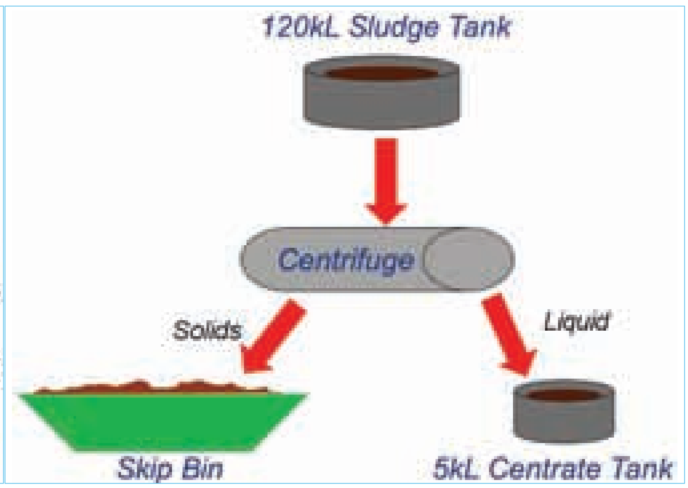

Figure 2. Woodglen WTP sludge handling system.

Table 2. Estimated savings (per week).

Chemical Savings	Normal Hours Saved	Overtime Hours Saved	Sludge Cake Shovelling	Power Saving (Reduced centrifuge runtime/Pumping etc.)	Estimated Total Cost Saving to EGW
>85%	8–10 hrs	3–9 hrs	3–4 hrs	>25%	$870

Other important areas of the water treatment process were becoming less of a focus and the constant battle to keep the system operational was taking its toll on the operational staff.

Post-Commissioning Optimisation

EGW operations and engineering staff began an investigation into the issues being experienced with the centrifuge operation and the causes. The centrifuge manufacturer's recommendations stated that 2% solids concentration was required for best performance. The current system was only capable of delivering an average 0.2–0.3% solids concentration. There were several design constraints that were leading to poor solids concentration in the feed sludge to the centrifuge, which were believed to be the major contributors to its lack of reliability. These included:

1. Lack of hydraulic capacity in the lamella clarifiers for sludge thickening;
2. Incorrect polymer dosing – high concentration and lack of control;
3. Ineffective desludging of lamella clarifiers due to a single desludge valve for double chambered lamella clarifiers.

There was little that could be done about the lamella clarifiers (Figure 3) themselves, apart from a complete replacement or major augmentation, which was not viable at the time. They are purpose-built to produce high-quality supernatant and were purchased for another treatment project and reused at the Woodglen WTP. The way they were operated was an area that could be improved and was the focus of some of the rectification works.

Modifications made to lamella clarifiers and the washwater system were as follows:

1. Installed pneumatic desludge valves on both lamella clarifier chambers;
2. Installed sight tubes for visual confirmation of optimal desludging;
3. Installed speed restriction devices on the desludge valves to reduce hydraulic shock;
4. Installed a floating pump on the sludge tank to remove excess water (i.e. converting the sludge mixing tank to a thickening process);
5. Removed every second plate from within the lamella clarifiers to prevent interplate clogging;
6. Increased the supernatant discharge pipe diameter;
7. Optimised polymer LT27 dose. This included reducing the concentration of polymer batch and reducing the dosage significantly from 100mg/L to 13mg/L;
8. Built a new sludge cake holding skip with spreading auger.

These changes resulted in the feed sludge to the centrifuge being around 1% on average. As a result we saw greater efficiency throughout the washwater system and considerable savings in power, chemical and staff time. The load on the centrifuge was reduced by >25% due to the better quality feed sludge, which took a great deal of pressure off operations staff. In addition to this, the new skip with a spreading auger removed the requirement for operations staff to manually spread the sludge cake and for shutdown periods for this work to occur. Table 2 outlines the estimated weekly cost savings as a result of these improvements.

Figure 3. Lamella clarifiers used to process washwater at Woodglen WTP.

Figure 4. Blocked centrifuge that led to a significant period of downtime for the Woodglen WTP washwater system.

Emergency Pumping and Inter-Corporation Networking

The improvements had obvious and significant impacts on cost and time, yet operators were still being frustrated by repetitive blockages and having to spend considerable amounts of normal work time and overtime nursing the centrifuge through its cycles. Soon after these rectification works were completed, a significant blockage occurred that was not able to be cleared (Figure 4). This led to an extended period of centrifuge downtime.

Due to this long period of downtime, a tanker truck was contracted indefinitely to remove the non-dewatered sludge from the sludge tank. The tanker ran on demand for over three months and cost in excess of $25K. The centrifuge supplier's service agent was employed to completely dismantle the centrifuge, unblock it and run a staff training session on how to get better and more reliable performance out of it.

Once unblocked, the centrifuge was reassembled, tested, thoroughly flushed and switched off indefinitely. There was great hesitation and reluctance from all departments within EGW to restart the centrifuge until there was some certainty that it would not block again. It was at this point that operations came to the conclusion that external help from within the industry was needed. Accordingly, a call was made to colleagues at Gippsland Water.

A site visit was undertaken at a Gippsland Water plant that had a very similar washwater setup to Woodglen WTP. Lengthy discussions were held focusing on their experiences and opinions on possible improvements for our site. The ideas we came away with were:

1. That our centrifuge flushing was inadequate;
2. Our poly dose for the centrifuge was not close enough to the centrifuge inlet;
3. The solids concentration was still not high enough;
4. That our ability to monitor the centrifuge's performance was limited.

We already knew we were restricted with the solids concentration, as described earlier in the paper. The remaining three points were all very valid and became the focus of the next series of trials and investigations.

After several trials with alternative dosing points, the existing point appeared the most efficient, so no change was made regarding this point of advice. The flushing and performance monitoring, however, would prove to be the most valuable points of advice our colleagues had offered.

EGW invested in an analogue output device in the centrifuge's local control panel to allow the monitoring and trending of torque, differential speed and flow rate via the WTP's Citect control system. It also allowed remote adjustments of these parameters, which enabled after-hours monitoring and control. Being able to monitor these parameters is extremely important in managing instances where the centrifuge is running poorly and threatening to block. If the torque rises to a point where it appears a blockage is beginning to form, operators are able to intervene and run the centrifuge's flushing cycle and restart afresh, blockage-free.

The second point of advice, and the one that proved to be the most important, was the flushing of the centrifuge. As simple as it might sound, the flushing turned out to be the main cause of the centrifuge blockages. Prior to the visit to Gippsland Water, our flushing ran at 2.5L per second and was thought to be ample for the system.

Gippsland Water recommended that at least 3.5L per second or higher should be used for effective flushing. In addition, they advised that alterations should be made to the existing flushing regime to allow flexibility in the duration and initiation time of flushing, facilitating complete cleaning of the internals of the centrifuge after each run.

Following the completion of the initial optimisation works undertaken by EGW and the follow-up work completed as a result of meeting with Gippsland Water operators, there has been a significant reduction in cost and time expended on running the Woodglen WTP's centrifuge. Operators are now able to focus their attentions on monitoring and optimisation of the water treatment component of the WTP and now have a much reduced stress load.

Although the centrifuge may occasionally still run a little poorly, operators are now able to monitor its performance and intervene before the issue becomes one of a catastrophic nature. The information gained from a simple one-day visit to a colleague who had extensive knowledge of a system similar to EGW's turned out to be an invaluable exercise and should be the protocol for future issues that seem too difficult and costly to solve through trial and error.

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OPERATIONAL PERFORMANCE MONITORING AT VICTORIAN WTPS

Helen Oates & David Sheehan

The Victorian *Safe Drinking Water Regulations* were designed to protect public health by providing a framework for the treatment and supply of drinking water. Since their introduction they have achieved a risk management planning approach across the state – however, they do not encourage the proactive control of hazards at the earliest possible point in the supply process and may not always be designed or operated in a manner that would protect the public from viral and protozoan hazards in drinking water.

The current Regulations will sunset in 2015. Ahead of this time the Department of Health (Victoria) has commenced a review of the Regulations. A key consideration for future regulations is to strengthen the focus of risk management onto the performance of the barriers that are used to ensure the safety of drinking water. A central element of that focus is the use of operational performance monitoring to ensure the available water treatment barriers are performing to the required standard.

The measurements and observations that are used to assess barrier performance are called Operational Performance Monitoring (OPM). Properly designed OPM programs provide an effective measure of water quality, and protect against the production and distribution of unsafe drinking water.

To assess current industry practice to inform a discussion paper on future safe drinking water regulations, the Department of Health conducted a survey of OPM practices. This article describes the survey and selected findings. The survey report can be found on the department's website at www.health.vic.gov.au/water.

The survey was divided into four main themes: physical treatment, disinfection, control limits and catchment monitoring. The survey sought information on how the performance of treatment barriers is currently monitored, recorded, analysed and reported. The questions in the survey were designed to seek information about processes, rather than focusing on individual water treatment plants. For the purpose of this paper, discussion will focus on monitoring of coagulation/flocculation, media filtration and chlorination processes.

Sixteen water businesses completed the survey, providing data from 211 water treatment plants (WTPs). This represents 97% of the state's drinking water treatment plants.

Table 1 provides a breakdown of the types of physical treatment processes in use. Table 2 provides a breakdown of the types of disinfection in use.

The most common water treatment processes employed in Victoria are coagulation/flocculation, media filtration and chlorination, so called conventional treatment. The survey results for each of these processes are described in more detail.

Coagulation and Flocculation

The coagulation process data is represented in Figure 1. The results indicate that 99% of the plants monitor raw water turbidity (85% of plants monitor it online). The monitoring of raw water turbidity is important because periods of high turbidity often relate to periods of elevated risk. It also helps avoid water that cannot be treated being drawn into the WTP.

The results also indicate that 73% of surveyed drinking water treatment plants use coagulation and flocculation as a treatment process step. The efficiency of the coagulation and flocculation process is influenced by pH, as each coagulant has a narrow pH range within which it achieves optimal performance. Therefore, monitoring the pH of the coagulation process helps indicate how well the process is performing. Likewise, coagulant dose and turbidity are parameters that can act as indicators of process performance. In turn, effective coagulation will assist good flocculation.

While the overall monitoring rates shown in Figure 1 are high, significant improvements could be made through increased continuous online monitoring of these key parameters – in particular, the monitoring and control of the coagulant dose rate. Overall treatment plant performance

Table 1. Physical treatment processes used at the 211 WTPs included in the survey results.

Physical treatment process	Number of plants (%)
Coagulation/flocculation	155 (73%)
Media filtration	147 (69%)
Membrane filtration	24 (11%)
Reverse Osmosis	2 (<1%)

Table 2. Disinfection processes used at the 211 WTPs included in the survey results.

Disinfection process	Number of plants (%)
UV disinfection	22 (10%)
Chlorination	165 (78%)
Chloramination	39 (18%)
Chlorine Dioxide	1 (<1%)
Ozone	5 (2%)

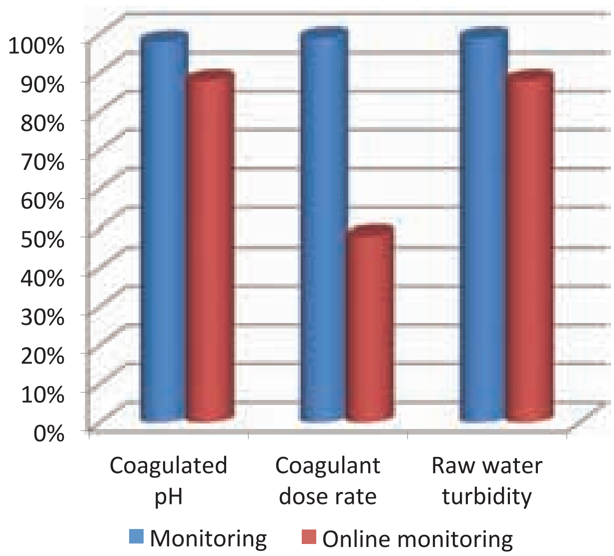

Figure 1. Monitoring of key parameters for coagulation flocculation process.

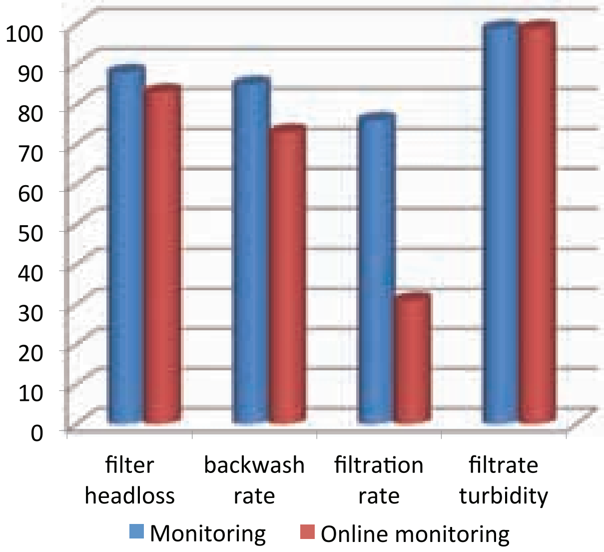

Figure 2. Monitoring of key operational parameters for media filtration.

would also be improved with consistent adoption of industry good practice (Murray and Mosse, 2008), which includes coagulation and flocculation monitoring regimes.

Media Filtration

The results indicated that media filtration is undertaken at 69% of the surveyed drinking water treatment plants, and that 63% of businesses have turbidity meters on individual filters.

Turbidity is the most widely used surrogate for the performance of media filters. In addition, backwashing and related activities, such as filter ripening, are also required to maintain good filtration.

The data collected for media filtration (Figure 2) demonstrates an overall high rate of operational monitoring, with variable levels of online monitoring. Even though high rates of monitoring (and continuous monitoring) for turbidity are undertaken, backwash monitoring is not. This is also critical for filter performance and the data suggests a consistent management approach for backwash water would be an opportunity for improvement. Another area for improvement is increased continuous online monitoring for other key parameters, such as filtration rate and filter head loss, as it is preferable to use a number of factors to determine the appropriate interval between backwashes.

While not shown in Figure 2, the qualitative data from the survey indicated other improvements could be achieved through the consistent application of filter-to-waste during the filter ripening period, and more consistent monitoring regimes, including continuous online monitoring of turbidity critical limits and reduced delays for the initiation of corrective actions in the event of a breach of a limit.

This improvement in continuous online monitoring is particular important given the relatively low percentage of individual filters that have online turbidity monitoring. The 2011 *Australian Drinking Water Guidelines* recommends online, continuously-reading turbidity meters should be installed on the outlet of each individual filter, in addition to any online turbidity meter that is installed on the combined filter outlet. This is to ensure that under-performing filters can be easily identified and rectified.

Chlorine Disinfection

Chlorine disinfection was the most common form of disinfection, with 78% of surveyed drinking water treatment plants using chlorination.

All drinking water supplies need to be disinfected with an adequate disinfection residual and sufficient time needs to be allowed for the disinfectant to react with the water in order to achieve the required chemical contact time (Ct). This is necessary to ensure adequate inactivation of any chlorine-sensitive pathogens that may be present.

For chemical disinfection, such as chlorination, an important operational monitoring parameter is the chlorine concentration at a point representing the end of the contact period – that is, at the point where the required Ct has been achieved (Department of Health, 2013). Additionally, the monitoring of temperature is important because the effectiveness of the disinfectant is reduced at lower temperatures. It is, therefore, important these parameters (Ct, disinfection residual and temperature) that influence disinfection efficiency are monitored sufficiently.

The efficiency of chemical disinfection is also influenced by pH and turbidity. The effectiveness of chlorine varies with pH, so maintaining pH in the proper range is important. Elevated turbidity also interferes with the effectiveness of the disinfection process. Ideally, to be effective, chlorination should not occur at a turbidity of greater than 1 NTU.

Figure 3 shows the monitoring of these parameters at the surveyed water treatment plants that undertake chlorination.

Analysis of the collected survey data in relation to chlorination indicates significant improvements could be made to current operational monitoring practices through increased online monitoring of Ct and temperature. Given that turbidity and pH can also have a major impact on the inactivation and removal of pathogens by disinfection, a greater emphasis on the online monitoring of these parameters would also improve chemical disinfection treatment performance.

Using the Data Generated By Operational Performance Monitoring

While this was beyond the scope of the survey, it is worth mentioning the importance of using the data generated by OPM to inform operational and management decisions at the WTP. As described in Chapter 10 of the 2011 *Australian Drinking Water Guidelines*, in the short term monitoring results should be reviewed promptly to assess performance

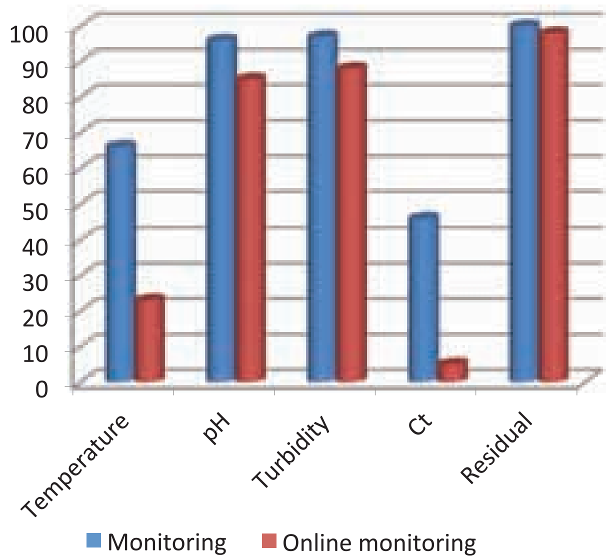

Figure 3. Monitoring of key parameters for chlorine disinfection.

against target criteria and critical limits. Where results indicate that established criteria, such as critical limits, have been breached, or control over of a treatment process has been lost, immediate corrective action is required.

Over the long term, monitoring data should be reviewed to look at overall system performance in order to enhance understanding of recognised problems, identify any emerging problems and trends, and evaluate the risk to public health and the need for water quality improvement projects.

The long-term evaluation of monitoring data can also provide confirmation of the hazard identification and risk assessment process, and it assists in supporting or modifying the assumptions made in the previous risk assessment, as well as increasing system knowledge. It also serves an important due diligence function with respect to protecting public health, and it contributes to consumer and stakeholder confidence. There is no point in collecting data if it is not going to be used to inform improvements in drinking water quality.

Conclusion

The survey results confirm all surveyed water businesses undertake OPM in some form, with a high level of monitoring of most key parameters. The results also indicate the different rates of online monitoring currently undertaken.

As well as identifying the parameters monitored for drinking water treatment processes, the data indicates where more consistent approaches could be applied. In particular, the percentage of online monitoring of various parameters for coagulation/flocculation, media filtration, including individual filters, and chemical disinfection demonstrated a high level of variability.

Ensuring treatment processes are operating effectively to prevent microbial hazards in drinking water requires good operational control over coagulation/flocculation, filtration and disinfection.

This can be achieved when processes are optimised, and the continuous monitoring of key process parameters helps ensure safe water is produced and managed prior to supply to customers.

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ONLY 52!!!

Adam Panozzo

With the tightening of the ADWG requirements for filtered water turbidity and the increased focus on *Protozoan* removal from drinking water, filter inspections have become an important part of assessing the condition and capability of Water Treatment Plants (WTPs) to assure the production of safe drinking water.

Prior to 2012 there was no systematic approach to carrying out filter inspections within North East Water (NEW) in Victoria. Some operators and work groups carried out filter inspections intermittently, but they typically were carried out as a reactive measure.

The Systems Optimisation Group within NEW was assigned the task of implementing and co-ordinating a process and filter inspection program in 2012. Given the large number of WTPs operated by NEW with a total of some 52 filters it was decided to initially tackle six WTPs a year (Figure 1).

Planning which filters to inspect first needed to take into account the risk of the WTP having a Drinking Water Quality (DWQ) exceedance, summer demand on the WTP (time window for carrying out works), the age and type of WTP and previous water quality history of both the raw and treated water.

The program was kicked off when a number of operators and treatment technicians attended a filter inspection course run by Peter Mosse in conjunction with WIOA. This enabled the operators and technicians to get their heads around how to carry out a filter inspection and what to look for before going out into the field. This training was of great benefit to the people who attended and set the scene for what was to come.

NEW identified a fundamental requirement that at least one operator from the WTP would be present during the assessment, along with the area team leader (if possible), so that any issues with the system could be captured. Utilising the reference manual, *A Practical Guide to the Operation and Optimisation of Media Filters* by Mosse and Murray, including the inspection template (Appendix 6) at the rear of the publication, a modified plant assessment sheet was developed to suit our assessment requirements. All the information gathered during the assessments was captured on this Process and Filter Inspection Report template.

On arrival at the site, water quality and OHS-based Job Safety Analyses (JSAs) were completed. The aim of the water quality JSA was to ensure that there was minimal impact on the operation of the water supply system during the inspections.

The assessment starts with a "walk through" of the system from the raw water supply to the reticulation system. Along the way, any issues and concerns (e.g. asset age, pipework configurations) are noted, along with any parts of the process that work well.

The plant operating manuals are also utilised for obtaining design specifications including filter dimensions, as well as filter and backwash flow rates to compare against actual measurements taken as part of the assessment. The general operation and operating history of the system is also considered as part of this "walk through", which includes items such as operating set points, Citect trends, flows, capacities and water quality results.

Key activities during the filter inspection component typically include:

- Calculation of pre- and post-backwash filtration rates;
- Visual observation of the backwash process;
- Calculating drain down and backwash (rise) rates;
- Measuring bed fluidisation;
- Visual observation of filter media surface, troughs and walls;
- Excavation and observation of media layers and sub-surface media;
- Media solids retention tests;
- Backwash turbidity profiling;
- Observation of the filter ripening period;
- Head loss trending characteristics of each filter (if head loss is available).

Figure 1. A bank of filters just waiting to be inspected.

Figure 2. An operator working inside the shoring box (top); and the exposed media and nozzles at the bottom of the shoring box.

The data obtained from the field is then transferred to an electronic copy of the Process and Filter Inspection Report. A recommendation summary is then prepared outlining suggested improvements to the system being assessed. The recommendations are then prioritised based on factors such as criticality, time, cost, availability of resources and predicted gains for that particular recommendation. Some of these recommendations may be delegated to operations staff or project engineers.

A number of lessons were learnt during the first series of process and filter inspections:

- The cooler months from May to September were the most suitable times for conducting the assessments, as water demand was typically lower so that there was sufficient time to take the plant offline during the inspections. The only downside to this was that it could take a number of days of plant operation to get the filters to have carried out a full filter run (potentially 20+ hours) prior to being put into backwash for assessment. In the case of plants having more than one filter it meant having to return a few days later to carry out subsequent filter inspections. For a large WTP, for example Wodonga WTP with seven filters, this may require a number of weeks based on filter run times to carry out inspections on all filter cells.
- Have a plan of who is doing what during the filter backwash, as there will be a number of measurements, calculations and samples that need to be carried out at the same time during the actual backwash. This may require three or four people to carry out the required tasks and gather all the necessary information.
- Different treatment processes may require different approaches to carrying out inspections. For example, enclosed pressure filters can create access issues in regard to inspecting the media, by not being easily able to check media below the media surface. Package plants that have dual processes such as up-flow clarification required the buoyant bead media to be removed, so that the plates and rivets and media could be inspected closely.
- A full process "walk through" was a good way of finding out whether processes worked the way they were intended, and for all involved to gain a better understanding of the system's strengths and weaknesses.
- In some cases, process improvements can be made immediately, with little or no financial or resources cost (following a risk assessment), which benefit the process.
- Taking photos is a good way to assist written documentation of the assessment and the photos themselves are useful records.
- A "shoring box" is a handy piece of equipment for use on filters with deeper media, not only for OHS reasons but also because it allows you to dig down towards the filter floor much more easily (Figure 2). This box is made of three aluminium sections each about 600mm deep, 1m wide and about 1.5m long that can lock together on top of one another, and is relatively easy to lower and move around in filter cells. So far it has been used in media with a depth of 1100mm with good results.
- Even if a filter is performing well in regards to filtered water turbidity, it doesn't mean there are no underlying issues or problems. For example, Filter 2 at Wodonga WTP was observed to have a small number of "boils" in the air scour pattern when in backwash. A subsequent filter inspection showed that numerous layers of media had become intermixed, with the formation of thick, anaerobic mud along the filter walls between the wall and the first nozzle on the floor (Figure 3). This filter and three others at Wodonga WTP have been earmarked for media replacement and a closer inspection of the filter structure once the media is removed.

The biggest challenge so far in these assessments is the task of implementing the recommendations, as some of these assessments have generated a large number of potential works ranging from fixes that can be carried out immediately or at little or no cost, through to items that require capital projects to address them over a longer period of time. Factors that can affect how these recommendations are implemented can include:

- Time (both time of year and time to undertake works);
- Resources (e.g. treatment technicians, operators, maintenance crews and contractors);
- Finances (many projects competing for a finite amount of funds);

Figure 3. A close view of exposed nozzles, intermixed media and mud build-up along the filter wall in one of the filters at Wodonga WTP.

- Criticality (how important to this process/system is this recommendation).

The recommendations generated are entered into the Drinking Water Quality Action Tracker Register for that particular system. This enables the monitoring and tracking of these recommendations. Also, Works Order Forms (WOFs) are created for each recommendation that requires financial and/or engineering support. These WOFs determine the allocation of resources and funding based on the above factors.

Some of the works that have been carried out as a result of the plant inspections include:

- Additional chlorine residual monitoring for preventing loss of disinfection occurrences;
- Filter refurbishments, including media replacements;
- Dosing system upgrades;
- Filter to waste pipe-work installation or modifications;
- Flow pacing of dosing systems;
- General process optimisation including alterations to flow rates, chemical dosing, filter run times and backwash rates.

Once the summer demand period ends, a reduction of demand at the majority of our WTPs occurs, which will allow commencement of the next round of inspections. Using the experience gained conducting the initial assessments will assist in carrying out future assessments in a more streamlined manner.

Only 38 filters to go!!!!!

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WESTERN WATER'S BIG BREAK

Fiona Robertson

Every year across the Victorian water industry there are over 13,500 burst main repairs conducted (ESC Annual Report). This results in a similar number of possible public health consequences for our customers via mains contamination during repairs.

This paper discusses a burst main event that could have resulted in contamination if disinfection procedures had not been followed.

The Incident

The incident was caused by failure of a bend (Figure 1) in a large 525mm transfer main from a 3ML tank to a critical 20ML tank required for supply to Gisborne, Macedon, Mt Macedon and Riddells Creek. The timing of the failure (late at night) and a subsequent alarm system failure caused the tank to empty. Over 25ML of water was estimated to be lost.

The tank took three hours to completely drain, with the large volumes of water causing significant damage to a semi-rural property (Figure 2).

Western Water's response to significant mains break is to isolate the main as quickly as possible. An incident team was established to evaluate the situation and return the main to operation in the shortest possible time because the 20ML tank was empty.

Figure 1. The bend shifted rather than burst.

The potential for extra stresses on water resources in the coming days was high given the incoming hot weather, high expected demand and bushfire risk. To be without 20ML of storage in these circumstances was not ideal.

So the first action was to reroute water through the reticulation network. This allowed the system to continue to operate and begin the refilling of the 20ML tank.

The repair took two days (Figure 3). The cause appeared to be a lack of support for

Figure 2. Damage caused by the break.

Figure 3. The repair underway – a 90^0 bend separated from 525mm pipe.

the bend. A bluestone thrust block was present but not tied into rock foundations. There was also a tree above the main, which may have caused the earth to shift around the pipe, exacerbating the problem.

Due to time delays in delivery of a tapping band (a requirement for the installation of an air valve at the top of the main in order to recharge while isolated), the incident team had time to consider the recommissioning of the main.

The Risk Assessment

The usual protocol for disinfecting after a burst main with a low risk of microbial contamination is to flush until the upstream residuals were achieved downstream of the break site. Where risks are high or there are known microbial contaminants, the main would be super-chlorinated and the water held for a detention time to achieve a Ct of 300, and customers would be put on a boil water notice.

In this case there was no clear evidence of microbial contamination, so under the usual protocol the main could be flushed until the upstream residuals were achieved downstream of the break site. However, the 525mm main was large, the system was chloraminated and the land use (a hobby farm around the burst site) presented increased pathogen risk.

The vital information in this risk assessment hinged around whether or not positive pressure had been maintained during the repair. This was crucial because there was pooling of water around the break and, thus, a failure to maintain positive pressure could allow for contamination of the main.

Assessment of the flow and visual inspection of the break site indicated that positive pressure wasn't maintained and, therefore, it was necessary to disinfect the main. In this case, Western Water identified that due to the lower pathogen risk and pressing need to reinstate the main that super-chlorination, i.e. dosing at 10mg/L or above, was not necessary.

Disinfection Plan

The aim was to dose the main to 2mg/L and hold the chlorinated water for a minimum of one hour, achieving a Ct of 120mg.min/L. The water in the main would then be pumped into the 20ML tank where any excess residual would be absorbed by the water already in the tank, thus avoiding customer impacts.

To achieve this, the site crew dosed sodium hypochlorite into the main at the 3ML tank end, utilising the flow meter at a nearby water pump station, with residuals monitored via a sample point approximately 50m from the dose point (Figure 4).

The calculated volume of the pipe was 660KL; based on this volume, it was determined that it would take around seven hours to dose the entire length of the main.

Implementing the Disinfection Plan

Western Water has two modes of mobile disinfection. One method involves using liquid sodium hypochlorite and is trailer-mounted for spot dosing tanks; and the other involves a portable unit that consists of a tapping, a dose pump and a drum of hypo (25L). The latter unit had been adequate during past events where the mains were smaller.

This situation was different because of the size of the main and the identified need to reinstate it as soon as possible without compromising public health. The volume of water that was calculated to be dosed proved too large to consider capture or discharge to either stormwater or sewer, so the aim was to achieve sufficient Ct but also keep the residual low enough to be able to allow the dosed water to remain in supply once sufficient contact time was achieved.

Once in the field, the dosing was occurring relatively smoothly, and adjustments were being made to the dose rate based on residual being obtained from the sample point 50m downstream. Unfortunately the pump was constantly drifting; therefore, we were constantly adjusting it in an attempt to keep it around 2mg/L.

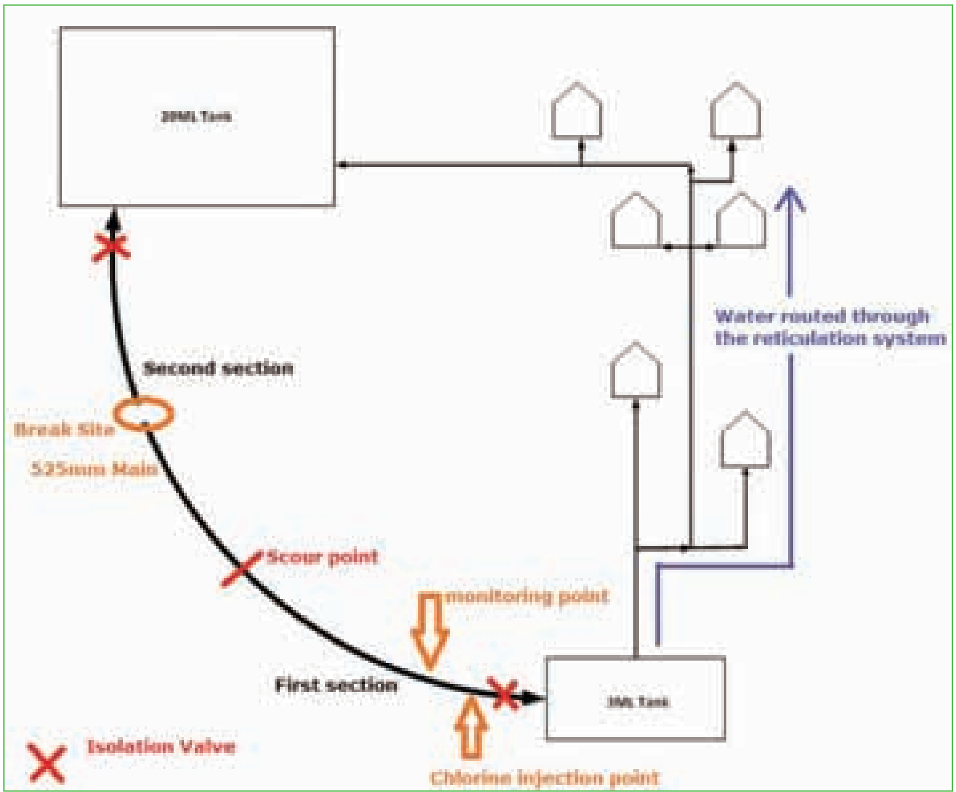

Figure 4. Schematic of the incident.

After only three hours of dosing the call came that the water had made it to the end of the main, but there was no residual in that water. The implication of this was that only a portion of the main had received chlorinated water. The site crew was able to verify this, as a scour point at the halfway point allowed us to test the residual on both sides. The section of pipe from the 3ML tank to the scour point had a residual of 2mg/L, while the remainder had no residual at all.

Plan A, despite it first appearing sound, had for reasons unknown failed. As a result the incident team developed Plan B.

Due to the late hour of the day it was decided to hold the water as currently dosed in the main overnight. The main was divided into two sections utilising valves. The following morning, chlorine residuals were taken from section 1 and then section 2. The chlorine remained at 2mg/L in section 1, meaning Ct was well and truly achieved at 1560mg.min/L, but was still negligible in section 2.

Section 2 was where the burst had occurred, so getting chlorine into that section was essential to the success of the disinfection.

Chlorine dosing into section 2 began, but this time dosing from the 20ML end. Issues the team now faced were the absence of a flow meter and an appropriate monitoring point downstream. The only monitoring point available was at the scour valve. The pump remained set from the previous day, but we were aware of the problem of it drifting. Despite these issues it still remained necessary to follow through with complete disinfection.

While dosing was occurring, chlorine residuals were being monitored at the scour point. The dosing was stopped once adequate residuals were obtained. The aim was 2mg/L, but without the flow and sampling opportunities close to the dosing point, the chlorine residual reached 4mg/L. At this time dosing ceased, and the main was isolated for the hour required to obtain adequate contact time. Ct achieved for section 2 was 240mg.min/L.

The 660KL of disinfected water in the main was then pumped up into the 20ML tank, which had 14ML of chloraminated water in it. Chlorine residuals were monitored exiting the 20ML tank over the following hours. The nearest pump station after the tank was also monitored closely for any chlorine spikes. No further issues resulted.

The Debrief

Was this disinfection a success? I believe it was as we achieved our target dose with no impact on customers. Subsequent reticulation sampling and analysis did not detect any contamination.

The key learning from this incident is that each burst must be given due process in terms of a risk assessment. Better equipment and procedures were also required as there was significant improvisation due to the location and size of this main.

Disinfecting is one of those tasks that if done incorrectly can have the opposite effect of what we initially set out to achieve. The task is fraught with issues that must be considered, including OH&S, environmental and public safety.

The incident debrief highlighted how well the Western Water team, from senior management to field staff, worked as a whole.

One important conclusion from this event is that no matter how hard the job, the water industry must develop and resource effective and efficient means for operational staff to disinfect water mains after bursts or repairs.

This not only includes the equipment, but also the training, standard operating procedures and the time during the burst to effectively mitigate any potential contamination event.

Western Water is actively reviewing a number of alternatives to improve reactive disinfection of mains in the event of a break and hopes to use the lessons learned from this event to develop a more robust procedure.

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TELECOMMUNICATIONS VS WATER: NATURE STRIP CONGESTION

Leigh Trevaskis

Winner of Best Paper by an Operator at the 2013 New South Wales WIOA Conference

Over the last decade, nature strip congestion has become a serious problem in Wagga Wagga for Riverina Water County Council. This congestion is primarily due to the numerous telecommunication carriers with an optic fibre network in the city, of which there are currently six.

Over the past 25 years, we have seen a significant change in the way utility providers cooperate. Each utility generally had a large, local workforce with a good knowledge of their assets in all the major centres throughout Australia. On-site locations were a common and free service provided by all utilities to identify and protect their assets. This is no longer the case. The deregulation of the telecommunications industry in the 1990s has resulted in new companies entering the market, a drop in construction standards, a knowledge drain due to retrenchments and the loss of local on-site assistance.

Since the introduction of optic fibre cable and the decrease in utility cooperation, construction times and costs have increased significantly. This is having a major impact on the capital works budgets at organisations such as Riverina Water.

A number of recent incidents and conflict with optic fibre resulted in staff questioning our Director of Engineering about what approach Riverina Water would like to take when working in the vicinity of this cable. We asked why we lose the right to mechanically excavate on our asset (which may have been in place for 50 years) because an optic fibre cable has been installed in the nature strip.

With the existing networks in Wagga and the NBN rollout beginning, we could see a time in the not-too-distant future when we would lose our right to mechanically excavate around a large percentage of our water mains throughout Wagga. We also wanted to see if others were experiencing the same problems as us with regard to telcos, or if it was a more localised problem we were experiencing.

Another major concern is the quality and accuracy of information supplied by telcos through the "Dial Before You Dig" service. We have found the information to be inaccurate and not at all representative of what has been constructed. Considering the fines and jail terms indicated on the Duty of Care responses from the telcos, they should have a responsibility to supply accurate information through this service. As the responsibility for locating cable falls entirely on the person doing the excavation, they should be able to rely on the information supplied as being correct. We are finding this is not the case.

Riverina Water feels there is an obligation on all utilities in regard to construction, identification and location of their assets. Utilities should be constructing their assets to a measureable standard, including alignment, depth, locations, markings and clearances from other utilities' assets. As the nature strip is a shared corridor to be used by all utilities, there should be a mutual agreement to respect others who have to work in this confined zone.

Riverina Water went searching to see what standards Telcos such as NBN Co. were constructing their asset to. Sorting through legislation of the *Telecommunications Act 1997*, the Australian Communications & Media Authority, the Telecommunications Ombudsman and the Communications Alliance led to the conclusion that no standards apply, unless an individual telco chooses to enforce one on itself. Recent communication with the Technical Regulation Development Section of the AMCA stated that: "there is no enforceable consumer code which deals with this type of cabling. There is an industry code but it has not been registered and is therefore not enforceable. Even if it was, most of the provisions include the term 'should' which does not mean must".

Although the telcos all say they are constructing assets to a standard, this is not what we are finding throughout Wagga. The following points are the critical areas that need to be addressed to ensure the nature strip remains a viable asset corridor for all utilities, not just telcos.

Fibre optic cables not in conduits.

Alignment

All utilities within the Wagga Wagga Local Government Area have an allocation on which to construct their asset, with communications having two. The problem Riverina Water is experiencing is that cables aren't being installed in the correct allocation and they constantly change alignment. There are numerous new fibre installations throughout Wagga where the cable has been directionally bored, and as these are not installed with copper cable they are untraceable using traditional location devices. Due to the lack of construction standards and the vagueness of plans, it is very time consuming and costly to hand-dig or pothole the entire nature strip to locate a fibre cable.

Depth

The inconsistent depths at which cables are installed also create significant problems for staff when working in the nature strip. We are finding cable at both ends of the spectrum. One case in Wagga was a cable that was so shallow it was encased in the concrete footpath only 40mm deep. We intended to remove the slab, then hand-dig to locate the cable, but when cutting the slab for removal, we damaged the cable. When a damage bill was received from Telstra and we questioned our responsibility for the damage, they stated that as we knew the cable was there, we should have broken the concrete into small pieces by hand before removing it to ensure the cable

Fibre optic cable installed along the edge of a water main.

wasn't in the concrete. At the other end of the scale are the extremely deep cables that have been directionally bored.

Optic fibre should be installed within stipulated depth guidelines, and anything outside this guideline should be recorded and available through "Dial Before You Dig" requests. It would make locating cable so much easier if we knew at what depth to start looking.

Clearance Standards

Telcos are happy to list minimum clearance standards on their Duty of Care responses when working near their asset, but this standard doesn't seem to apply when they construct near anyone else. We recently discovered a conduit under a 450mm AC water main that had been directionally bored. It had been installed in the sand bedding hard against the bottom of the pipe, and all of the collars were damaged by the bore head as it followed our trench. No-one was willing to admit responsibility for this conduit.

Another recent case was an optic fibre cable that had been directionally bored inside a sewer main. The end result was the telco stating that they wouldn't be replacing the cable; the sewer main would have to be replaced. This is another example of the power of the Telecommunications Act.

The minimum clearance standards stipulated by telcos are unreasonable and add substantial cost to the final total of a construction job. The standards state that when boring parallel to a fibre cable, the cable must be exposed every five metres.

We recently had to bore a 400m section of 250mm main in Wagga next to a fibre cable installed under the footpath. By these guidelines, Riverina Water has to remove the concrete footpath every five metres and expose the cable, with all the costs associated with the removal and restoration of the footpath being borne by Riverina Water.

Unless telcos can develop a means to accurately locate their cable or install something with their cable to allow traditional location techniques, it is completely unreasonable to expect a company such as Riverina Water to follow these unreasonable guidelines, as the financial cost would total many hundred thousand dollars each year.

Dial Before You Dig

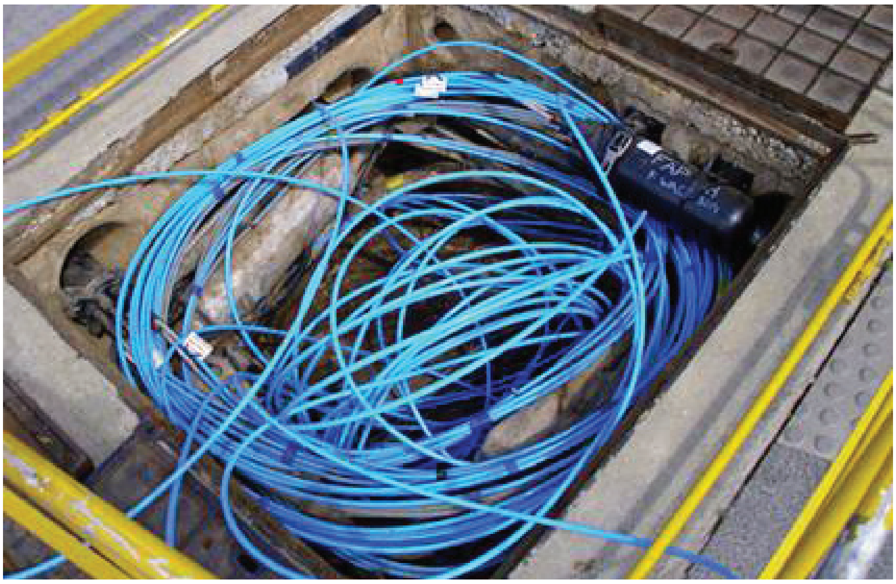
Telecommunications carriers have a responsibility to ensure that their plans supplied through the "Dial Before You Dig" service contain accurate and informative information. Telstra is happy to supply a list of technical detail on the cables, but nothing in relation to depth and alignment, the two critical pieces of information required when trying to locate a cable.

The first page of the Duty of Care responses sent with the plans all state that "*exact cover and alignment cannot be provided*" and that "*plans are provided as a guide only and information contained cannot be guaranteed*".

These statements go against the reason the service was established in the first place, which was to supply helpful information to assist in the identification of utility assets. We have had numerous examples recently where the plans have been totally inaccurate, some cases resulting in damage to cables through no fault of our own.

A recent example was when a fibre cable was damaged during a horizontal bore under a busy street in Wagga. Two sets of plans both showed the cable in existing conduits. These conduits were exposed and boring commenced. While back-reaming the bore, the cable was cut as it had been directionally bored underneath the existing conduits, a point missed by two separate companies.

In another case, while planning for a water main renewal, Optus plans were supplied showing a fibre cable running the length of the street. Usually, Riverina Water staff would then go and locate this cable. As we had a number of problems with telcos recently, we decided to contact Optus and see how long it would take to get some on-site assistance. Optus stated that it would take about a week to get someone there, but three days later we received a call from their representative stating that there is no cable in the street, as it never got past the planning stage. They have sent out information for a cable that doesn't exist,



Inside a services manhole.

"Spaghetti" in the nature strip.

and unless we contacted them, we could have potentially been there for days looking for a cable that was never installed.

Finally, during realignment of a 450mm main at Charles Sturt University, plans showed one 100mm conduit containing all the Telstra cables, plus the new NBN fibre cable. As we knew the contractor who installed the NBN cable and knew that it wasn't in the Telstra conduit, we contacted NBN Co. to see their response to the incorrect information supplied and what assistance they would offer to resolve the problem.

They were quite surprised by our request to help locate their cable and said they had no process in place for this. They finally decided an engineer would have to come from Sydney, but this would take two weeks. Two days later they called back, stating that they would not be sending anyone, and no further assistance would be offered. Their response was: "try some of the guys who do work for Telstra and see if they can help you".

These are just a few of the many recent examples we have experienced in Wagga during the last couple of months of 2012 of incorrect information supplied through "Dial Before You Dig". We have no confidence in the plans being supplied, as we are finding that very few of the plans received are either helpful or accurate.

Locating Optic Fibre Cable

As optic fibre cable is not traceable using traditional location devices; an alternative means of reliably detecting optic fibre needs to be developed. When Riverina Water installs PVC or PE water mains in rural areas, we also put a 2.5mm earth wire in the trench. This allows us to accurately trace these lines for others when we are doing an on-site location. If this was done on direct buried fibre cable or in conduits where there is no copper cable, it would make locating cables so much easier.

When working parallel to a direct buried fibre cable in a rural area, telcos state that if you are within 10m of that cable, you must pothole the cable every five metres for the length of the job. As Riverina Water covers an area of over 15,000 square kms, we have hundreds of kilometres of rural pipelines running next to fibre cable. If we were to replace a 5km section of main, Riverina Water is responsible for the cost of 1000 potholes along that cable.

Conclusion

As a work supervisor responsible for running four construction crews, I approached management at Riverina Water to voice my concerns over the problems we are dealing with daily in regard to the telecommunications carriers, and particularly with the optic fibre network. The uncooperative response I received from NBN Co. when trying to identify their asset was the final straw for me.

Upon researching the Telecommunications Act and going on site to see first-hand what crews have to deal with, and the quality of the material supplied through "Dial Before You Dig", the Director of Engineering at Riverina Water, Mr Greg Finlayson, was quite astounded. Through Mr Finlayson's contacts and effort, Riverina Water hopes to get a dialogue started that will look at the powers of the telecommunications carriers and the standards by which they operate.

As the NBN rollout expands throughout Australia, we would like to see them held to similar standards to those under which we operate. As noted earlier, unless telcos are constructing to a standard, then the nature strip will become unworkable for a water utility such as Riverina Water. NBN Co. states that the fibre network will bring Australia into the 21st century. This may well be the case for communications, but it is going to send us back to the 19th century, when pipelines were constructed with a pick and shovel.

The way the situation is with telcos at the moment, it is not a matter of what happens if we damage an optic fibre cable; it is a matter of how often we are going to damage one. Riverina Water staff do their very best to ensure that communication assets aren't damaged during the construction of water mains. We would like the telcos to show the same commitment by constructing to a standard and supplying relevant and accurate information.

At Riverina Water, we are aware that it is impossible to address these problems on existing infrastructure, but by airing our concerns into an open forum, we are hoping that these same mistakes don't reoccur during the NBN rollout. Unless the mistakes of the past are addressed, then the nature strip will no longer be a viable corridor for water main construction in the future.

The Author

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AERATOR HISTORY AT COWES WWTP

Chris West

The Cowes Wastewater Treatment Plant (WWTP) on Phillip Island in Victoria began operation in 1981. Figure 1 shows the three basins that made up the original plant, the bioreactor, the effluent or flow balancing storage and the aerobic digester.

The bioreactor was fitted with two 22kw surface aerators with paddle type rotors, surface DO monitoring and basic on-off time clock control. At this stage the plant was very difficult to operate for several reasons. With connections to sewer being slow, our initial flows were very low (100 to 200kL) and the bioreactor had no level control. It was a gravity outlet at the top of the tank into the clarifier holding 4ML in the bioreactor, therefore our detention time was out the gate.

With the load on the plant being so low there were very long off periods on the aerators, meaning the solids would settle and we would be sending supernatant to the clarifier instead of mixed liquor, which gave us poor settling. The same applied to the DO monitor; when the aerators shut off the solids would settle and the surface DO would increase, giving us a false indication. We eventually installed mixers that solved both these issues, but we had big problems with ragging. We only had course screening and grit removal at the pump station prior to the plant and the mixers were constantly clogging.

As the flows and oxygen demand increased, the aerators began to struggle to keep up and did not meet their design specs. On investigation with

Figure 1. The original Cowes Wastewater Treatment Plant.

the manufacturer we found they had been running backwards since installation. This is why commissioning procedures are important on any plant or equipment. This is equally important during maintenance and repositioning of aerators. Generally the rotors and gearboxes are designed to run in one direction!

With flows and oxygen demand still increasing, the second bioreactor was brought online and required aeration. We found the 22kw aerators to be very efficient and reliable but we had several issues with their stability in water, having two of them capsize, one with a leaking pontoon and the other with a broken mooring cable while trying to board it for maintenance.

Both times there was great risk to staff, with one injury and one near drowning. **Do not board** a pontoon style aerator unless it has its four mooring cables securely attached. Management instructed us not to board the aerators for any reason and to operate them to failure and move to the more stable tripod-style aerator (Figure 2).

Figure 2. A tripod-style surface aerator.

Diffused air was considered, but ruled out because of the sloped angle of the tanks and the cost. We then purchased three 35kW tripod aerators with conical style open-vane rotors. These aerators were mechanically reliable with good mixing and oxygen dispersion. They were also very stable in the water. Unfortunately, over a period of time rags would begin to collect on the centre of the rotor and build up to a large wad, causing a large drop-off in efficiency as well as balance issues.

A crane would be hired to lift out the aerator to de-rag the rotor and the wad would drop off as soon as it was lifted. As soon as the aerator was returned to service it would immediately pick up the same wad. Very frustrating. Several modifications were made to the rotors by the manufacturer, which made some improvement but did not alleviate the problem.

High-speed aerators were also trialled over a 12-month period and found not to be suitable for this plant. They produce good amounts of oxygen with the fine droplets they achieve but they are not very efficient; they have to run at 100% speed and cannot be controlled by a VSD. So we were back to an on-off control for DO level and had settling issues again.

There were also problems with the motor-mounting bolts collecting rags that built up to a point where they would foul on the rotor and trip out on overload. So it was regular cleaning using the boat, which was undesirable. They were made of stainless steel and with the constant flexing of the frame the steel would harden and eventually crack, so after a long period of operation we experienced a large amount of structural cracking and a hefty repair bill. I have heard from other operators of total failure so I would not recommend stainless steel for surface aerators. We retained a 30kW high-speed aerator (Figure 3, next page) as an oxygen booster for the summer peak periods. It doesn't run for long periods and suits our system well.

We then purchased three 45kW aerators (Figure 4, next page) with a fibreglass spiral-type rotor, which are very efficient and do not clog at all.

These turned out to be very good aerators. Initially we had to modify the

Figure 3. One of the 30kW high-speed aerators.

Figure 4. A 45kW aerator showing the rotor.

Figure 5. A rotor-style aerator with the rotor adjusted for maximum rotor efficiency.

adjustment mechanism on the rotor height. This controls the rotor efficiency: shallow for less efficiency and deeper for more, and most rotors of this type set the top of the rotor at water level for maximum efficiency (Figure 5). We have all our aerators set at maximum and control their speed by variable speed drives (VSD).

Unfortunately after about eight years of operation one by one the gearboxes became noisy. A noisy gearbox can normally be heard lower in the unit and is generally a growling or whirring noise. An electric motor bearing is normally heard higher up in the unit and is generally a rumbling noise. Another less serious noise to be aware of is the top motor shroud or cover touching the cooling fan. This normally happens when they become rusted and start to break down. It sounds drastic but is only a minor repair. One of the gearboxes actually failed so we had them all upgraded to a bigger and better quality. They are all still in operation today and are a good asset.

Our final purchase to meet the growing oxygen demand was two 55kW tripod surface aerators (Figure 6). These are the pride of our fleet. They are very steady in the water, have a very strong steel construction built to last, good quality heavy mechanicals, a large maintenance platform with good ladder access and a very efficient non-clogging rotor.

The Author

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Figure 6. A 55kW tripod aerator.

Figure 7. The non-clogging rotor.

WIOA OPERATOR CERTIFICATION SCHEME – 12 MONTHS IN

Kathy Northcott

December 14 2013 will be the first anniversary of the official launch of the WIOA Certification Scheme. The launch of the Certification Scheme was held at the Victorian Department of Health offices in Melbourne. It marked a crucial step towards the implementation of the "Victorian Framework for Water Treatment Operator Competencies – Best Practice Guidelines" (the Guidelines). The Guidelines define the minimum training, qualification and competency standards that operators must achieve in order to operate drinking water treatment facilities in Victoria.

The upcoming anniversary of this event provides an opportunity to reflect on:

- The changes the Guidelines and Certification Scheme have had on operator training and competency; and
- The way operators perceive their roles and responsibilities.

Kelvin Growcott receives his certification and his new title "James Bond".

The significance of certification on our team in Bendigo was highlighted in a presentation ceremony in August this year, held for Kelvin Growcott, the fifth Veolia operator to be certified by WIOA.

Kel's achievement epitomises the benefits that the Guidelines and certification have brought to the water treatment operator profession. Kel started his working life in various roles in the agricultural sector. He commenced work in the water industry in 1999 as a Wastewater Treatment Operator at the Castlemaine Water Reclamation Plant. He quickly gained a reputation as the man who could fix anything, earning him the nickname "MacGyver". After 10 years in wastewater treatment, where he had established himself as our team BNR operational specialist, Kel was ready for a change of scene.

Three years ago he switched to drinking water treatment operations. In spite of his capabilities as an operator he had never completed his water industry qualifications. The advent of the Guidelines and the Certification Scheme breathed new life into Veolia's operator training programs.

We launched into a major regional training project in 2011 to achieve certification of our operators. As a result, Kel received his Certificate III in Water Industry Operations in March 2012 and followed this up with his operator certification in August 2013. By happy coincidence Kel was awarded certification number 007 (actually 0007, but what's an extra zero between friends?), earning him a new and deserving nickname, "James Bond".

Since the launch of the Certification Scheme our team has seen a dramatic change in the attitudes towards professional development and recognition of skills and competency both by management and operators. The implementation of the Guidelines and certification has given many operators the ability to confidently grow into their role as water treatment professionals and custodians of public health. Operators have commented that they are proud that being a drinking water operator is finally recognised as a career, not just another job.

Achieving Certified status has taken some effort by our organisation and the operators themselves. Some key challenges have been:

- Delivering appropriate training for a range of treatment plants and processes across Central Victoria;
- Getting the most effective outcome from available training budgets for the competency requirements necessary to achieve certification under the Guidelines;
- Managing rosters to cover operators who are away on training.

However, the results have made it all worthwhile and provided some unforeseen benefits to our business:

- Greater exposure to training projects and initiatives being developed by government agencies, water associations and water businesses;
- Significant improvements to our in-house training management and delivery capabilities;
- Enhanced reputation in the industry for operator competency and professional development.

We look forward to implementation of the national scheme and encourage all employers and water businesses to get on board.

The Author

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