WATERWORKS

OFFICIAL JOURNAL OF THE WATER INDUSTRY OPERATORS ASSOCIATION

JUNE 2002

WATERWORKS

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Contributions Wanted

WaterWorks welcomes the submission of articles relating to any operations area associated with the water industry. Articles can include brief accounts of one-off experiences or longer articles describing detailed studies or events. These can be e mailed to a member of the editorial committee or mailed to the above address in handwritten, typed or printed form. Longer articles may need to be copied to CD and mailed also.

Cover Photograph

The cover photograph shows Traralgon Water Treatment Plant Operator Keven Ward, assisted by Sandy McGregor, exiting a confined space. Entry to the space was necessary to allow removal of anthracite that had built up in a distribution channel.

Photograph Competition

WaterWorks requires photographs for its cover. If you have a photo showing an operational activity, why not send it to us. Any photo used on the cover will earn the photographer a free membership to WIOA for one year.

President's Prattle

Welcome to this the 2nd edition of *WaterWorks.* As you will have noticed on the front cover the Australian Water and Wastewater Operators Association (AWWOA) is now known as the Water Industry Operators Association (WIOA).

As times change, so too have the needs and expectations of our Members. The AWWOA has evolved over many years to cater to these needs. In the future, we intend to actively encourage water industry operators in all Australian States and Territories to enjoy the benefits that the AWWOA members have enjoyed for so long and so make WIOA a truly national body. The centre fold article outlines some of the things we do and some comments from Members.

Why not consider joining us??

Please enjoy this edition of *WaterWorks,* pass it on to someone else when you're finished with it and feel free to provide feed back to the editorial team.

Happy Operating

Russell Mack
WIOA President

Distribution Matters.....
Can You Help us ????

Well the six months since our first edition of *WaterWorks* has rolled around fairly quickly and we find ourselves producing the second edition. With the help of our publisher Peter Stirling from Hallmark we have worked to make this second edition of the magazine stand out a bit more. The magazine has a more distinctive cover and has been designed to be easily removed from the middle of the journal. We have done this to try to encourage wide readership and to facilitate distribution. One of the problems associated with developing the new magazine is to ensure the magazine gets as wide a circulation as possible. We all need to share experiences as widely as possible for the common good of our customers and to avoid rework. Wide circulation is important to achieve this.

To this end we ask everyone who reads this to help us. *Water* has a significant circulation but operational staff and field staff are not well represented. By having the magazine double stapled for this edition, it can be removed from the body of the journal and easily passed on to someone else. We are also endeavouring to reach as many people as possible around Australia by sending a few extra copies to operational managers from Water Authorities and Councils and asking them to distribute the copies to their operational staff.

Our request is simple. Can you help us by simply setting up to distribute the magazine as widely as possible. We thank you.

Peter Mosse
June 2002

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REPORT ON THE NEW ZEALAND WATER AND WASTES ASSOCIATION 2001 CONFERENCE

George Wall, Goulburn Valley Water

The NZWWA, through the Chairman of their Operators Group Murray Clayton, extended an invitation to the AWWOA to present the keynote address at their Operators conference held in September 2001. I was fortunate enough to get the nod from our Committee to perform this address and duly made plans to attend.

The opportunity of a bit of a holiday in NZ before the conference was too good to miss out on. We scraped up a few extra pennies so my wife could come as well, and departed for the airport. We had some second thoughts about flying only 3 days after the World Trade Centre incident. Thoughts of a well earned break overrode any fears, and we arrived at the airport on Friday morning the customary 2 hours prior to departure for an International flight. This was the start of a series of unforgettable events – our flight was cancelled. The plane we were supposed to be on was a United Airlines jumbo and it was still on the ground in the USA.

Our flight was rescheduled to Air New Zealand later in the arvo. We sat around a while killing time, then you guessed it, all hell broke loose due to the closure of Ansett. After queuing for hours and checking our luggage in a couple of times, all Air New Zealand flights were finally cancelled around 11pm. We were put up in a motel in Melbourne for the night and, after another long day in a queue at the airport, flew out Saturday evening. We finally got to Auckland at 1.00am on Sunday with 2 days of our short holiday lost in Tullamarine airport.

We hired a car and travelled south to Rotorua and did the usual touristy stuff. It really is an amazing place with steam and mud boiling out of the ground, right in the middle of the city. The smell of sulfur in the air was overpowering for a start but, like working at a wastewater plant, you quickly get used to it. We travelled around the east coast through the Bay of Plenty region and some of the scenery was just breathtaking. We returned to Auckland Tuesday, the wife flew home, and I went on to Wellington for the conference.

The conference was held at the Wellington football stadium, a lot like Colonial Stadium in Melbourne, a very impressive venue. The operators conference was staged in conjunction with the NZWWA conference (the same as our AWA Federal convention) although the conferences were separate events. Both groups had the same recesses and joined up regularly for meals and to look over the trade exhibition. It was surprising how many companies who had exhibited at the Victorian conference were also represented in NZ.

As part of my keynote address, I touched on how the AWWOA was formed, what we do and how we do it, and showed a number of photos. I also talked about the Victorian water industry, restructuring in general, and what it's like to work as an operator in Victoria and in particular for Goulburn Valley Water. There was a lot of interest in what we do and there were heaps of questions. The NZWWA very generously presented me with a carved timber jewellery box as a memento of the occasion.

The operator papers were interesting and a very high quality. I learned a great deal and was surprised at the differences in management of the water cycle between NZ and Oz. A number of the operators have their own companies and act as sub-contractors to the Councils in the operation of the plants – very different to here.

The NZ operator training system is also quite different to Australia. I understand our new NQF system is loosely based on the NZ's modular, competency based, system. In NZ, before any training is done a contract is signed by the employer, operator and the training body and the operator is given two years to complete the course. A large amount of the course is done "on the job" through worksheets and diaries, and this system encourages the operators to complete some study regularly. At the end of the course, the operator must sit a series of exams and be able to demonstrate a satisfactory level of competence over many fields. I understand there are hefty subsidies provided for the course, but it seems a good way to ensure that operators are adequately trained in a reasonably tight time frame. Sounds a lot like the old apprenticeship but without a lot of the red tape.

The conference had an "operators challenge" which was staged at a designated time and the whole crowd of around 400 people came to watch. As custom has it, any visitors or guests (me) must be compulsorily put into a team. I think this is so that everyone not involved in the competition has someone they can safely rubbish in the knowledge that they'll probably never see them again. Coming from a wastewater treatment background, I was pretty useless helping to do a water main tapping and changing "o" rings under pressure on a large valve assembly. I was able to help with calibration of some lab gear and sorted out some calculation problems, meaning that I wasn't a total liability to our team. Although we didn't win, we did earn a consolation prize for our efforts.

The operators dinner on the Thursday was a top night with some very funny, interactive entertainers. As in Oz it is common practice in NZ for someone to get the "Mickey" taken out of them on stage and this privilege was once again reserved for yours truly. At least a few of the Kiwis copped it as well. We had a great night but Murphy stepped in to make sure I didn't get home too late. The ATM I used to get some "nightcap" funds confiscated my credit card for security reasons. Just another way of getting even with us Aussies over Ansett I think. I sat in the bank foyer on Friday morning trying to get my card back all the while wondering what type of threat to National security my credit card posed. After an hour or more waiting, I thanked the girl for giving me such a comfortable chair to sit on and headed for the airport to get home, still minus the credit card.

As usual, some boofhead decided to do some last minute shopping and held the plane up for what seemed like about an hour. The wooden jewellery box presented as a thankyou came back to haunt me when I touched down in Melbourne. Being a timber product, it had to be declared to customs and I spent what seemed an eternity whilst some trainee AQIS person had a field day rummaging around in my luggage for other hidden objects. I eventually got home well after midnight and totally worn after my NZ adventure.

The big plus from the trip is that we have now forged some truly "International" alliances and there may be some opportunities to return the favour and invite some of the NZ guys to our conference. You never know what might happen in the future but hopefully the bond between our groups will strengthen as a result of this conference.

The Author

George Wall (georgew@gvwater.vic.gov.au) is Secretary of WIOA and Wastewater Systems Specialist at Goulburn Valley Water.

OPTIMISING BACKWASHING AT MOLENDINAR WATER TREATMENT PLANT

Frank James, Gold Coast Water

Molendinar Water Treatment Plant (WTP) is located on the Gold Coast in Queensland. The plant can be operated in conventional or direct filtration modes. It was recognised that the conventional mode capacity of 150 ML/Day was soon going to be insufficient to meet the growing demand on the Gold Coast. To address this, Council adopted a decision to increase the capacity of the plant by 30ML/Day through some minor modifications in the process design to allow the plant to run in direct filtration mode.

In conjunction with these changes Gold Coast Water also made the decision to adopt the HACCP food industry quality system for their Water Treatment plants. This meant changing several target parameters for the operation of our Water Treatment Plants. One of these, turbidity, which is familiar to us all, now has to remain below 0.2 NTU whereas prior to this the target was 0.8 NTU.

The plant has six, dual media filters with a surface area of 92m^2 each and a bed depth of approximately 1.2 m. Filter performance is determined by using Unit Filter Run Volumes which range between 120 - 240kL/m^2 at the plant.

While attempting to increase production at the Molendinar WTP a number of problems have occurred.

- Filters queuing for backwash.
  - Once a backwash is triggered, queued filters remain on line sometimes leading to turbidity breakthrough when headloss exceeds 3m. The normal operational maximum headloss at the plant is 2.25m.
- Leaky Inlet and Outlet Penstocks and Reject To Waste valves.
  - During normal operation the leaky Outlet Penstock and Reject To Waste valves allow water to leak out of the filter to the washwater recovery system. This increases the volume of water to be handled through our washwater recovery system, in turn holding up backwashes and in turn leading to potential water quality problems.
  - During backwashing itself, the leaky inlet penstock allows water into the filter thereby increasing filter drain down times.

Backwashing

The backwash sequence consists of a number of separate steps. These are listed in Table 1.

Washwater Recovery

There are two washwater recovery tanks for holding the backwash water. When a filter is backwashing the backwash water goes into the recovery tank. At the end of the backwash the backwash water settles and is raked for 55 minutes. Raking collects the settling sludge and passes it to the centre of the tank. Sludge is transferred for the final 13 minutes of the raking period into a sludge holding tank. After the sludge transfer period is over, the supernatant pumps transfer the rest of the water back into the inlet structure, which takes a further 65 minutes. Concentrated sludge from the sludge holding tank is discharged to sewer.

The following is a record of the changes made at the plant to reduce the backwash and washwater recovery times. The aim of these changes was to reduce filter queuing. This was done by

- reducing the backwash time without compromising water quality.
- reducing the washwater recovery period.

Changes Made to the Filter Backwash Sequence

Table 1 shows the times for each step in the backwash sequence and how they were changed. The changes are detailed below.

Change 1: The air scour and rising wash was reduced from 4.5 minutes to 1.5 minutes. This step is used to disturb the media surface before a 6 minute of air scouring only.

Saving of 3 minutes.

Change 2: Air scour only reduced from 7 minutes to 6 minutes.

Saving of 1 minute.

Change 3: Total backwash time was reduced from 10 minutes to 9 minutes

Saving of 1 minute.

Change 4: Total reject to waste before and after backwash reduced from 4 minutes to 1.5 minutes.

Saving of 2.5 minutes

Change 5: At the end of the backwash the Inlet Penstock opens. This is done using two opening steps and two delay periods. This two stage refill is to avoid filter inlet channel getting too low and restricting the flow to the remaining filters. Using the new two stage refill times has had no detrimental effects on operation of the plant.

Table 1. Summary of Backwash steps and the times for each step in the old cycle and new cycle.

Backwash Step	Old Backwash Cycle	New Backwash Cycle
Close Inlet Valve (mins)	2	2
Filter Drain Down (mins)	18	18
Close Flow Control Valve (mins)	0.5	0.5
Reject To Waste (mins)	2	0.5
Open Outlet Penstock (mins)	2	2
Combined Air Scour/Rising Wash (mins)	4.5	1.5
Air Scour (mins)	7	6
Backwash (mins)	10	9
Close Outlet Penstock (mins)	2	2
Open Inlet Penstock	8 mins 40 secs	3 mins 50 secs.
Reject to Waste (mins)	2	1
Open Flow Control Valve (mins)	0.5	0.5
Total (mins)	**59 mins 10 secs**	**46 mins 50 secs**

Inlet penstock 1st open timer increased from 20 seconds to 25 seconds.

Inlet next open delay reduced from 4 minutes to 1.5 minutes.

Inlet second open timer increased from 20 seconds to 25 seconds.

Inlet delay to fully open, reduced from 4 minutes to1.5 minutes.

Saving of 4 minutes 50 seconds.

Total time saved due to all the above changes is 12 minutes 20 seconds.

Changes made to the Washwater Recovery

- In response to the leakage from the valves, action was undertaken to minimise this by adjusting the Rotork actuator closing torque and limit settings. This resulted in a 12 minute (30%) reduction in supernatant return pumping time.
- The filter level probe was lowered. This reduced the amount of water rejected to waste. Instead of draining 600mm of water to the washwater recovery system, only 300 mm of water needed to be drained. This reduction in water in the washwater recovery system shortened the supernatant return pumping by an extra 4 minutes.
- All filter Inlet, Outlet and Reject To Waste valves and seals are to be replaced in the near future.

Outcome

All the changes described above have allowed a significant saving in time for the backwash and bachwash water recovery. Before the changes, around 17 backwashes were possible each day. After the changes around 20 backwashes are possible each day. This has significantly reduced the amount of filter queuing with no deteri–oration in the quality of the water produced at the plant.

The Author

Frank James is a Senior Operator with Gold Coast Water and can be contacted on (07) 5581 7014.

INNOVATIVE AERATION AT THE BEECHWORTH WASTE WATER TREATMENT PLANT

Mark Samblebe and Bob Malone, North East Water, Victoria

In Spring 2001 North East Water commenced de-sludging the primary lagoon at the Beechworth Wastewater Treatment Plant (WWTP). Throughout this process the raw effluent had to be diverted directly to the secondary facultative pond without any primary treatment. The de-sludging process took longer than expected to complete due to equipment breakdowns, which forced diversion of the raw influent to the secondary treatment system for longer than planned. It became apparent that the system was struggling to cope with the excess loads so investigation took place as to how to rectify the situation.

The Beechworth WWTP is a lagoon based system with no aeration facilities or even three phase power to connect to. Given the slope of the land and distance between the primary pond and the secondary treatment pond, Bob Malone, the plant operator developed an aeration system utilising 44-gallon drums and gravity to aerate the water, a concept that could save the community more than $150,000 if successful.

Figure 1. The gravity aerator at the Beechworth WWTP.

The pond system of wastewater treatment requires oxygen to be present in the water to allow the various bugs to live and feed on the waste material. That requirement means the water needs to be agitated in a certain way to allow oxygen to enter it, a task commonly performed by electrically driven mechanical aerators.

At Beechworth WWTP there is an elevation of around 30m between the primary and secondary ponds, a fact that Bob has put to good use. With gravity propelling the wastewater down the hill through a single pipe, its momentum is sufficient to be taken upwards at the end of its journey, and to pour into two 44-gallon drums sitting vertically, end to end (Figure 1) Inside the drums are several layers of mesh, which naturally aerate the water as it pours through. At the bottom the water enters two races filled with rocks, (Figure 2) which further aerate it before it enters the second pond.

In designing and building such a deceptively simple system, Bob has saved North East Water the need to connect to three-phase power (quoted by TXU as about $118,000), plus the $40,000 cost of installing electrical aerators. Add to that the savings of up to $13,000 a year in power costs, and you have an efficient, cost-effective and environmentally friendly answer to a common wastewater treatment problem.

For Bob, his efforts haven't gone unnoticed at North East Water: his natural aerator won the CEO's innovation award for last year, a big honour among authority employees.

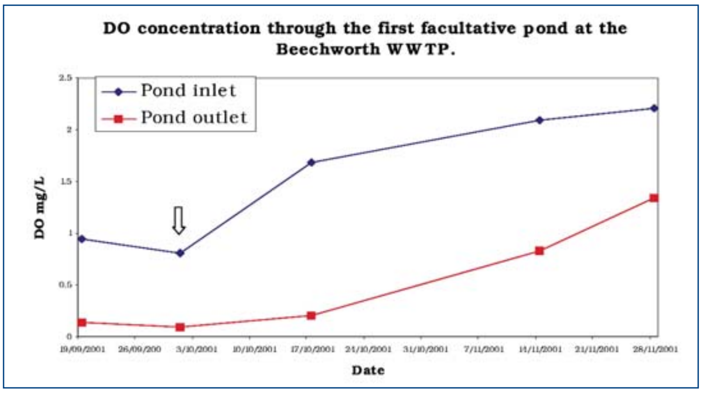

Figure 1. DO Concentration throughout the facultative pond at the Beechworth WWTP. The arrow shows the commencement of operation of the gravity aerator.

Preliminary results from the project are outlined below. Figure 1 shows the Dissolved Oxygen (DO) levels at the inlet to the pond after the installation of the aerator. DO levels increased from 0.1 mg/L to around 2 mg/L. Figure 2 shows the improvement in ammonia removal from the pond. For the month prior to the aerator being built no NH_3 removal was occurring, however within 3 weeks of the unit commencing

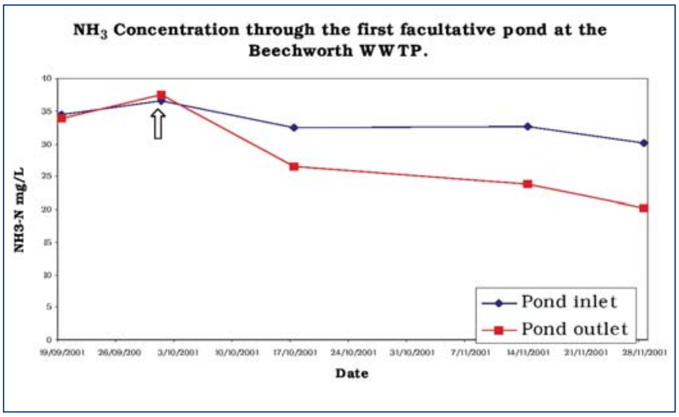

Figure 2. NH_3 concentration throughout the facultative pond at the Beechworth WWTP. The arrow shows the commencement of operation of the gravity aerator.

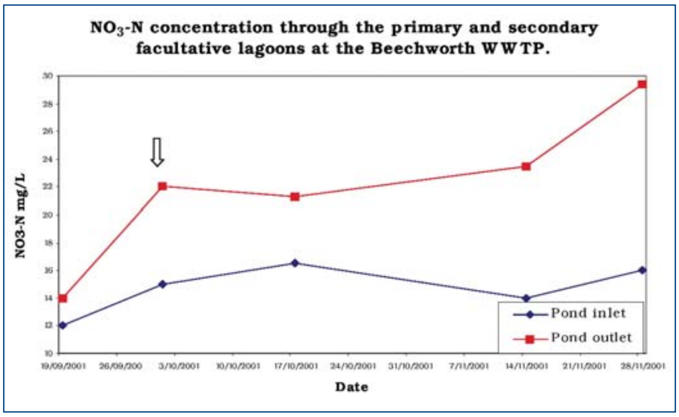

Figure 3. NO_3 concentration throughout the facultative pond at the Beechworth WWTP. The arrow shows the commencement of operation of the gravity aerator.

operation, the outlet NH_3 concentration was reduced by approximately 30%.

Coinciding with the decrease in NH_3 levels, the NO_2 and NO_3 levels increased slightly through the pond, indicating improved nitrification occurring.

No change in phosphorus concentrations or removal efficiencies have been observed so far throughout the trial.

A small generator powered electric aerator was used for short periods during the trial to supplement the gravity aeration and help 'kickstart' the system. Continued monitoring is underway to further clarify the effect of the unit on the treatment process.

The efficiency of the system throughout the colder winter months will also be of interest, as the results obtained thus far had the benefit of increasing water temperature assisting the process. We have little doubt that the system oxygenates the water sufficiently to provide an environment suitable for nitrifying bacteria, enhancing process performance, and hope that with more information the system can be modified to provide even better performance.

The Authors

Bob Malone is a Treatment Plant Operator at North East Water (03) 5728 2262, 0417 508 871 and **Mark Samblebe** (msamblebe@nerwa.vic.gov.au) is a Treatment Technologist at North East Water.

Figure 2. The rock filled races of the gravity aerator.

FILTER COVERS! A PICTORIAL TECHNICAL NOTE

Peter Mosse, Gippsland Water

Production of high quality drinking water requires attention to detail in all stages of the water treatment process. One of the critical points in the treatment process is that of filtration. Filters need to be adequately maintained and performance assessed regularly to ensure optimal performance. The advent of particle counters and extensive use of on line turbidity meters for individual filters has assisted this. This paper describes an additional approach to maintaining excellent filter function.

Water Treatment Plant (WTP) filters in Australia have traditionally consisted of open concrete formwork boxes. In many cases, inlet and outlet valves, and associated actuators and controls have also been exposed to the elements. In our experience, valve and control mechanisms, while suitably rated for outdoor use have shown deterioration of surface coatings and plastic covers and perhaps some impaired function of solenoid valves.

During filter inspections at Gippsland Water, several filters were observed with extensive algal mats growing on the surface of filter media, the filter walls and launder structures. During the replacement of media beds, a disturbing amount of "rubbish" was found in a number of the filters at various depths within the media. Items included rubbish bags, supermarket shopping bags, rope and a variety of leaves. Figure 1 shows a mixture of material isolated from a single filter cell at one WTP. The large flat objects tended to be oriented horizontally within the media thereby creating an impediment to water flow and potentially disrupting the structure of the media.

During an international trip in 1995 it became apparent that there was wide use of filter covers in many counties. The type of cover varied. In one large South African WTP, the filters were completely enclosed in a purpose built, darkened building, with carefully controlled light intensity. In England (Fig 2) and France (Fig3), "trampoline mat" or tent style covers were observed.

Figure 1. Rubbish isolated from a single filter cell during media replacement.

Figure 2. Filter covers at the Grafham WTP in England.

Figure 3. Filter covers at the Dijon WTP, France.

Figure 4. Temporary "tent" filter cover at a Gippsland Water WTP. Note the pooling of water on the covers.

Figure 5. Filter covers during construction at the Moe WTP.

Figure 6. Completed filter covers at the Moe WTP.

In 1997 Gippsland Water trialled a tent-like cover at one WTP (Fig 4). The cover was poorly accepted by the operators. The main objections were the poor access to the filter and the inability to view filter operation, particularly during backwashing. There were also problems associated with pooling of water on the surface (see Fig 4).

Six WTP's were identified for the construction of filter covers and expressions of interest sought from design drafting companies to design and manage the construction of the covers. Workshops were conducted with the treatment plant operators and other water treatment technical support staff to design covers that met all operational requirements. The

Figure 7. Filter covers during construction at the Sale WTP.

Figure 8. Construction of a complete cover at the Tyers package WTP. The plant consists of 3 identical stainless steel modules.

Figure 9. Sliding filter covers in place over the primary filters at the Traralgon WTP.

successful company then developed conceptual designs for the individual sites. The designs, once finalised, were contracted out to a construction firm.

In most cases the covers consisted of Colourbond sheds with aesthetically shaped rooflines. To provide protection from corrosion, hot dip galvanised steel section was used for the frames. Walls and rooves were lined with double-sided aluminium foil for insulation purposes. Colours were chosen to blend in with other elements of the WTP. At the larger plants these buildings covered just the filters (Figs 5, 6, 8) while at the smaller package WTP's they covered the entire plant (Fig 7). The buildings have been designed to be vermin and dust proof. Cost of construction varied between $300 and $530 per m^2.

A 2m by 2m, removable panel of roof sheeting has been included above each filter to facilitate media removal and replacement when necessary. Artificial lighting systems have also been installed to provide essentially shadow free operation. During unattended operation of the plant the lighting is left switched off.

Ventilation systems have been included to help control condensation. These consist of roof and wall vents at all sites and extraction fans at two of the sites. The extraction fans have been sized to provide eight changes of air per hour. At one site, where condensation proved to be a significant problem, fan operation is controlled via a humidity probe.

Figures 5 to 9 show a range of filter covers during and after construction.

Since the introduction of the filter covers there has been a large decrease in algal growth. Valves and actuators can be maintained dust free and are protected from further deterioration. Operational staff also report an improvement in the general working environment around the filters.

The Author

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Acknowledgements

The author wishes to acknowledge the assistance of Mr Piyal Gunaratne, Projects Engineer, during the implementation of this project.

KNOW YOUR FILTERS

Sandy McGregor, Gippsland Water

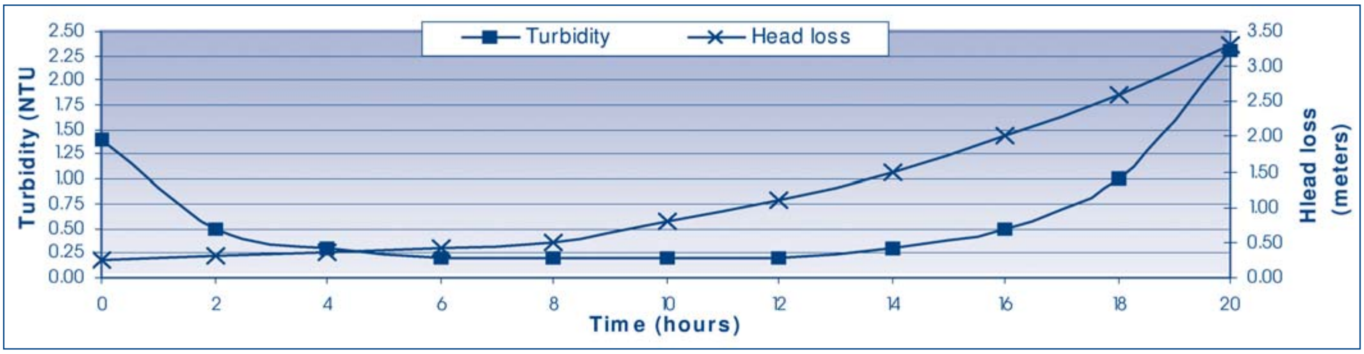


Figure 1: Turbidity & Head loss over Time

Filters play a vital role in the production of high quality drinking water. They provide a physical barrier to pathogens and are the final point at which turbidity and colour can be removed from clarified water.

Maintaining filter performance is therefore an essential step in ensuring reliable operation of a Water Treatment Plant, (WTP).

Normal Operation

A typical WTP filter operated under normal conditions should produce filtered water with a turbidity of less than 0.5 NTU most of the time, with an average of less than 0.3 NTU being desirable. Well-operated treatment plants with properly maintained filters, optimised chemical addition and process pH's can produce filtered water of less than 0.01 NTU.

Figure 1 shows the change in head loss and turbidity during a filter run. Eventually product quality deteriorates and backwashing of the filter is necessary. The backwashing process is used to bring the filter back to the desired level of operation and cleanliness. Filter run times can range between 8 and 96 hours, however both very short and very long filter runs can lead to high operating costs and or long term operational problems.

Assessment of Filter Performance and Condition

The assessment of filter condition can and often is as simple as observing a backwash for effectiveness and or, trending the filtered water turbidity over time. These observations alone provide significant information on the performance of filters. A full assessment of filter condition however requires investigation and recording of additional parameters.

To gain the most out of an assessment, performance criteria need to be established. These form the reference point or the base line for the assessment. Table 1 lists some of the variables that Gippsland Water uses as assessment criteria in monitoring filter function.

Typically a performance assessment would involve searching records and checking the plant for design data (e.g. – tank sizes, flow rates), and determining the parameters to be assessed. The assessment should include observing the backwash routine and physically inspecting the media, taking media samples for observation and shake testing. As with all inspections, tests and or assessments, the findings should be documented and any outcomes or recommendations noted. An additional useful long term

Continued on page 14

Table 1: Typical filter performance criteria.

Parameter	Units	Objective	Maximum	Comment
Filtered water turbidity	NTU	< 0.1	0.5	Turbidity >0.5NTU increases the potential for poor disinfection by increased chlorine demand and shielding of bacteria.
Head loss	m	1 - 2	3	May be represented by outlet valve position or change in head depending on design.
Particle counts	counts/ml	<200	NA	Gippsland Water aims for <200 counts/ml in the 2 - 15 um size range 95% of the time.
Filtration rate	m/hr	8 - 12	15	Filtration rates are a function of the design and loading.
Backwash rate	m/h	36 - 46	50	This is usually determined by the filter media used and the height of the wash trough from the media.
Wash water turbidity at end of wash.	NTU	5	NA	The parameter is plant dependent.
Time to form clear patches during backwash	min	<8	10	Approximate values that should be determined by trials.
Media shake test result	%	<5	<10	See description below.
Residual Coagulant	mg/L	<0.1	0.2	Australian Drinking Water Guidelines 1996

Due to the variety of filter types and designs the information given is a guide only, and should be verified and determined by carrying out the filter performance tests discussed in this paper.

A·W·W·O·A Victorian Branch PROTECTION IN PURIFICATION

Water Industry Operators Association

W-I-O-A Australia EXCELLENCE IN OPERATIONS

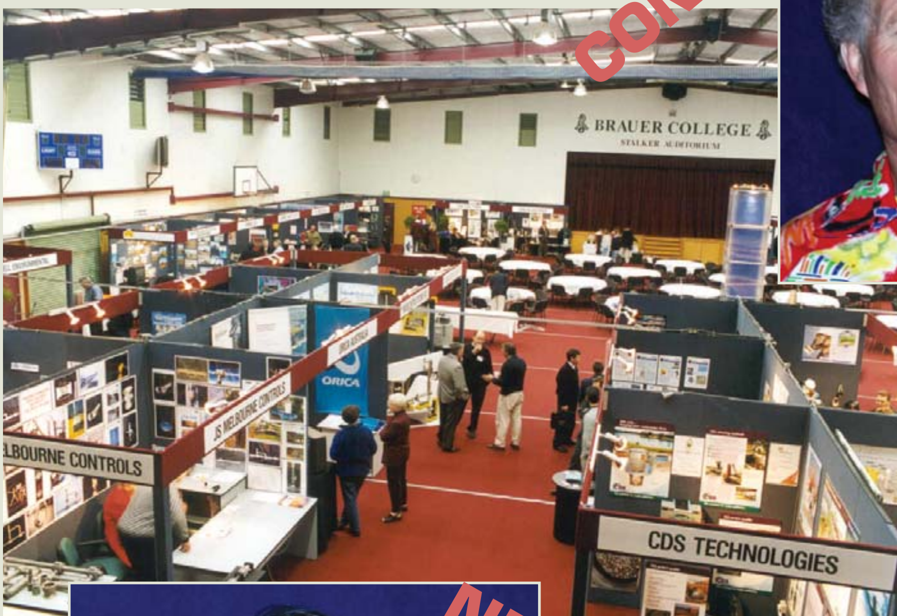
We have changed our Logo and Name
But the Services and Benefits will Remain!

As times change so too have the needs and expectations of our Members. The AWWOA has evolved over many years to cater for these needs. In the future, we intend to actively encourage water industry operators in all Australian States and Territories to enjoy the benefits that the AWWOA members have enjoyed for so long and so make WIOA a truly national body.

Operators and Engineers Conference

The conference provides up-to-date technical information, a comprehensive trade show and social events.

CONTACTS



Pat Davis
Superintendent of Operations
Riverina Water County Council, Wagga Wagga NSW
"I joined the Association to network and gain knowledge of what others do in the water industry. I'd love to see an Association like this in NSW in the future."

NETWORKING

Paper and Poster Presentations

Cynthia Lim
Engineering Sales
Flygt Pumps, Vic
"I love the opportunity to catch up with operators outside of the work situation and its great to be able to meet people and network at seminars, conferences and functions. Great bunch of people and being involved makes me feel that I am part of the water industry and that I can make a difference."

Barry Waddell
East Gippsland Water, Vic
Wastewater Management Facility Operator
"It's great to have the opportunity to meet water industry people from all levels and all parts of Australia. The changes in the industry have been immense and being an Association member has helped me keep up to date."

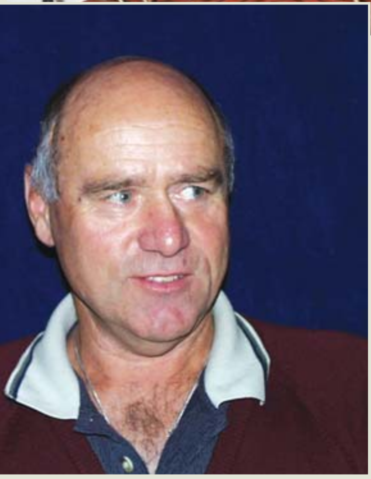
Week-end Seminars

KNOWLEDGE

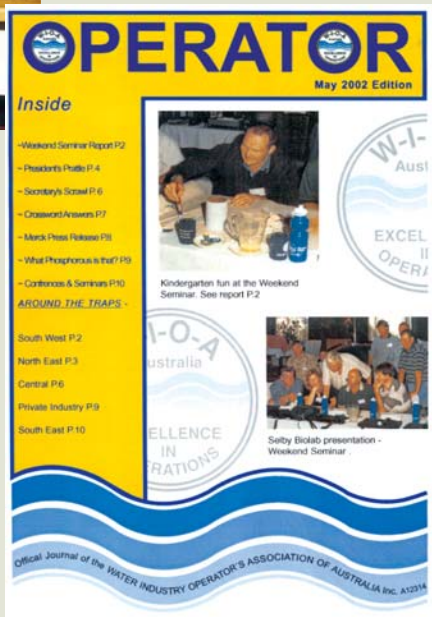
Operator Newsletter

Members receive a quarterly newsletter entitled *Operator* which contains news items and notification of events.

Bob Eden
Senior Public Health Engineer
Department Human Services Victoria (former Health Dept.)
"I enjoy meeting the broad spectrum of people at Association events. It is important for me to have a good rapport between the engineers and the operators. I've learnt as much from as operators as I hope they've learnt from me. The newsletters are a great resource."



Ray James
Training Officer
Gippsland Water, Vic
"I'm able to use the information from the Association and the knowledge of operators in training programs I run for Gippsland Water operators."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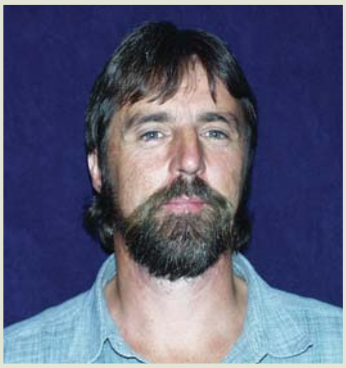

FRIENDSHIPS

Annual Water Industry Charity Golf Day

A social event that has grown in popularity and raised a considerable amount of money for charity.

Len Rochford
Reservoir Operator
Barwon Water, Vic
"I get to meet different people at the seminar and conference and its good to talk to others in the industry. Attitudes are laid back and people are easy to get along with. I enjoy receiving the Newsletters and being informed of water industry issues from time to time."

INFORMATION

Wes Wittick
Water Treatment Plant Operator
Western Water, Vic
"I enjoy being in the Association as I can meet and make contacts with people doing a similar job. I've met lots of operators over the 4 years and know that I can draw on their experience if I have problems with my plants. I can keep up with new products by attending seminars and conferences and through mailouts from the Association."

If you would like to join W.I.O.A or are looking for more information, check out our website!!!

Website: www.awwoa.org.au

Continued from page 11

monitoring tool is to record and graph the clean bed head loss measured just after backwashing. Any variation in this over time will give information about the quality of the filter media. In particular a sustained gradual increase indicates deterioration of the filter bed.

Long term monitoring may also be necessary for other measured parameters to determine whether they are changing and in what direction. Once a trend is established, investigation of the cause should follow particularly if the change is in an undesirable direction.

Observing the backwash

By observing the backwash it is possible to determine a lot about how healthy the filter is. Two of the most useful observations during a backwash are the fluidity of the media, and air scour pattern. Both of these observations tell us information about the condition of the filter bed. The fluidity can be determined by using a long handled probe which is sufficiently long to avoid the need for the operator to enter the filter. It needs to be long enough to reach the bottom of the filter bed. The probe should have sufficient end-on area to provide some resistance against the filter media, (A long handled metal garden rake is suitable.)

The resistance to the probe when being lowered into the filter during the washing is relative to the amount of fluidity. If the probe has to be pushed into the media then the backwash rate can be considered as inadequate or if localised, clogging of the bed may have occurred, which will require further physical inspection. Media boiling during the air scour or wash phase can indicate, media short circuiting, disturbed support media or damage to the under drain system, all of which are operationally unsustainable. Inconsistency of the air scour pattern, say large volcano type patches or very still areas can also indicate problems. Figure 2 shows the cause of a still area during air scouring. It was caused by excessive air scour pressure disturbing the support media and allowing the sand to migrate down and eventually block the under drain nozzle. Localised volcanic type explosions in the bed and still areas were observed so the filter was refurbished. Figure 3 shows a large still area during the air scouring. It was caused by sand and gravel blocking the under drains and nozzles. The still area was at the far end of the under drains and was the result of poor workmanship from previous modifications to the concrete structure. Figure 4 shows boiling of the sand as a result of short circuiting in the media. This developed over many years of operation resulting in an area where water jets up during the backwash.

Figure 2: Support gravel has been completely displaced. A still area in the air scour pattern was the first indication.

Figure 3: Still area during Air Scouring of a filter.

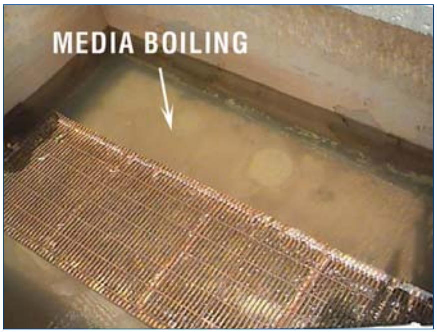

Figure 4: Media boiling during backwashing with water.

Figure 5: 50mm surface sludge layer clearly showing cracking.

Figure 6: Rubbish removed from a filter during refurbishment.

Figure 7: A mud ball found in a filter that had completely failed.

Physical inspection of the media

Inspecting the media is best carried out by entering the filter. This requires a confined space entry and must be done according to the Confined Space Entry requirements of your employer. **Note: Do not attempt to enter your filter without adequate safety equipment and supervision.**

In doing this you are able to determine the degree of sludge penetration into the media, detect foreign matter, media cracking, the presence of support media on the surface and determine the relative cleanliness of the media. The quantity of sludge retained before and after backwashing can be used in further optimisation of the backwash regime. By digging into the media you are also able to get an estimate of the degree of bed penetration of sludge and whether any mud balls are present. Figures 5 to 8 show a range of problems with filter media.

Figures 5, shows cracking of sludge layer on the surface of a filter. This cracking was contained in the top 100mm of media and sludge. Severe cracking can penetrate the whole bed depth. Figure 6, shows foreign matter trapped in the filter bed, most of which was sandwiched in the bottom layers and was only found during refurbishment. Figures 7, shows a large mud ball. Figure 8, shows how a trapped plastic bag can cover an underdrain nozzle.

Media shake test

During the physical inspection it is good practice to check the amount of sludge retained in the filter bed after backwash. This is achieved by taking a sample of the media for a shake test. Ideally samples from at least two locations and from two depths should be tested. With multi media beds, a sample from the interface layer (the point of change in media type) should be obtained if possible, so as to monitor for blinding and sludge build up at the interface.

The shake test is a simple procedure that can be completed by anyone. The test is done by taking a 500ml core sample and transferring it to a clear 1000ml stopper type measuring cylinder, (Acrylic is best).

Figure 8: A plastic bag covering an under drain nozzle.

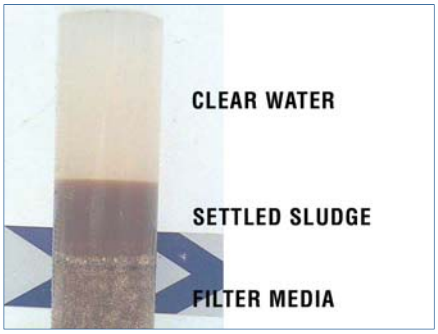

Figure 9: An example of a shake test. The three layers can clearly be seen.

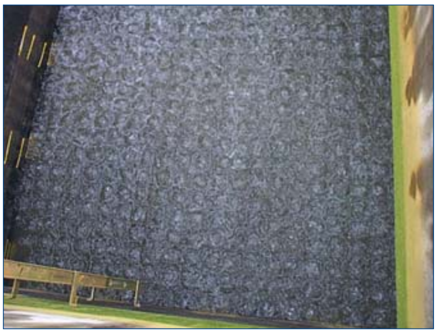

Figure 10: An example of a good air scour pattern during testing.

Figure 11: Uneven media surface, as a result of the filter inlet design.

Water is added until the 1000ml mark is reached and it is then vigorously shaken. The cylinder is allowed to stand for approximately 20 minutes. After standing, the percentage of settled sludge versus the volume of media can be determined. Figure 9, shows three layers, water, sludge and media. If the retained sludge result is greater than 15%, then the backwash regime should be investigated as this indicates poor backwashing. Values less than 8% are considered normal.

Air Scour pattern testing

During any rebuild, or prior to relaying the filter bed, the opportunity should be taken to check the air scour pattern while the filter is empty. This test is carried out by filling the empty filter with approximately 300mm of water and running the air blower. The test gives a clear indication of the distribution of the air pattern. If the air distribution is not correct, the filter will not backwash correctly. This will lead to long-term degradation in performance. Figure 10 shows an air scour test being carried out. Inconsistencies in the pattern will be quickly identified. The air scour test also provides a basis for comparing the air scour pattern after the bed has been laid.

Figure 12: As a result of a broken under drain nozzle, sand entered the backwash tank and was redistributed to other filters. This required significant work to remove the sand and resulted in other filter rebuilds.

Cause of Failures

Performance failures of filters can be attributed to problems with design, construction, and or operation.

Design failures are difficult to overcome, as they are often an integral part of the way in which a filter has been constructed and would require review of the design and rework. Figure 11 is an example of how a poorly designed inlet system can affect the filter bed by allowing the incoming water to spill over the surface of the media thereby disrupting the surface.

Construction failures generally relate to the way in which the media bed has been laid. These failures often become evident as sink holes in the media or boiling during backwashes, as quality workmanship has been neglected. In most cases the filter bed needs to be replaced, with the possibility of some construction rework.

Operational failures are probably the most common failure and range from minor to catastrophic. Failures of this type include, blinding of the media, mud ball formation, and high filtrate turbidity or unstable turbidity during the filter run. Figure 12 shows the result of an underdrain failure, which allowed sand to enter the backwash tank and be distributed to the remaining filters. This caused the progressive failure of these filters and necessitated rebuild of several filters.

Operational failures may require minor or major work to rectify them. Chemical washing, physical removal of offending material, or possible total replacement of some or all of the filter media may be required. Careful observation and monitoring by operational staff is the key to minimising the occurrence of these problems.

Remedial Action

Modifications and simple remedies are often the most common approaches to fixing filter problems. As in the example described below the remedial action to overcome the failure was simple. However, it may not always be so easy.

A polymer overdose blinded off the filters at a WTP to the point that it was necessary to chemically clean the filter by washing it with concentrated solutions of caustic soda. Vigorous backwashing had proved unsuccessful. (Other chemicals such as hypo, acids or detergents can also be used for similar problems) Filter performances were restored to between 60% and 100% of the original design. (This will depend on the cause and extent of the problem) The drawback from this is that you are left with very large quantities of contaminated water to dispose off. Chemical cleaning of the filter media can also be used to eliminate lime build up where lime is used as a coagulant and also for the removal of iron or manganese build up on media. Chemical cleaning can also be used for the treatment of algal build up in filters.

Practical example of remedial action

A fully automated treatment plant was designed based on data from several years of dry weather. The plant was commissioned with a backwash routine adequate for the plant loading under dry conditions. As time progressed the production rates were increased above design levels due to increasing demand. However the weather deteriorated, causing changes in the raw water quality and the necessary chemical dose rates applied. The plant's chemical dosing system was programmed to cope with this, but the backwash routine remained unchanged. As a result the filter was not backwashing as efficiently as it should have and eventually caused turbidity breakthrough and finally blinding of the media. A decision was made to "super chlorinate" (80kg in 25kl) the filters. This did the job for a while but eventually blinding occurred again. After numerous chemical washes and media replacement exercises the filter failed completely because the chlorine had destroyed the plastic media support system. At this point the operator suggested that the backwash regime be reassessed and optimised to handle the new operating conditions of the plant. The altered backwashing allowed the filters to function well.

Rebuilds and Modifications

Since filter rebuilds can be quite expensive, every effort should be made to prevent filter failures. Modifications to the way the plant operates can have considerable impact on the filter and can improve operation and prevent deterioration of the filter.

For example- At a small Gippsland Water WTP an air scour system and backwash pump VSD were installed. This was done to improve the backwashing of the filter. The installation of a blower meant that air scouring could be employed and the installation of the VSD allowed controlled ramping of the wash water rate. Controlled ramping of the wash water removed the risk of the support media being disturbed due to sudden surges of water and allowed the use of combined air, water backwashing at low wash rates. This helped to extend the filters run duration from 8 to 16 hours with no turbidity breakthrough.

At another small WTP it was noticed that during the filter run turbidity spikes occurred. This was investigated using a particle counter. The cause of the turbidity spikes was attributed to the way the filter outlet valve was operated. For example, when the plant started a backwash, the filter outlet valves would open to about 80% to allow the filter to drain. This increased the flow through the filter to a point that allowed turbidity breakthrough to occur. The problem was rectified by restricting the extent of opening of the filter outlet valve to only 10% above the last operating position. The reduced valve opening slowed the flow through the filter and stopped the turbidity spike. Although this alteration to the PLC program removed the turbidity spike, two additional problems remained. Firstly, the ripening period for the backwashed filter was quite long, and secondly, whenever a filter went off line the other filters experienced turbidity breakthrough. The cause of both these problems was a poorly tuned level control loop, which resulted in the filter outlet valve swinging wildly while trying to maintain level set point. To rectify this, the valve operation was slowed and the control loop re-tuned. This resulted in much-improved water quality throughout the filter run.

Re-establishment of performance criteria

After a filter has been modified or rebuilt, it is good practice to re-determine its performance. This will provide new reference data for comparison in the future. A performance trial is also used to verify the effectiveness of a modification.

Conclusion

Well-operated and maintained filters are essential for the production of high quality drinking water. A filter that is in poor operational condition or is being operated poorly, increases the chance of compromising the quality of the product water delivered to our customers.

The operator's knowledge of filter performance and how to monitor and improve it is important too, as most of the time it is the operator who is responsible for the operation and maintenance of the site. It is also the operator who most often has to determine what is happening when the plant performance is not up to scratch and what to do about it. *"And as we all know, this often happens when we least need problems."* Therefore it is important that operators have a good understanding of the water treatment process and an inquisitive nature that draws them to observe their plant closely. References and design texts are ideal for gaining additional knowledge. Some useful texts are listed under 'References'. However it is the "getting your hands dirty" experience that reinforces the text book knowledge, as you get to see aspects of filtration and plant performance required to ensure that plants are running at their optimum.

The monitoring of filter performance and integrity may not bring dividends in the short term, but will enable you to avoid water quality and health incidents. It will also keep your plant ahead of the changing and more stringent regulations of the future.

Acknowledgements

The author wishes to thank Dr Peter Mosse for actively encouraging the preparation of this report.

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LOW-ALKALINITY MEASUREMENT USING THE GRAN PLOT TECHNIQUE

Peter Gebbie, Earth Tech

Many water treatment plant Operators routinely determine the alkalinity of raw or treated water samples using a titrimetric method with a coloured indicator.

In Australia, many raw and treated surface water supplies have low alkalinities, often 20 - 50 mg/L, and at these levels there is considerable room for error in analyses due to the following:

- very small volumes of titrant acid are required,
- large sample volumes are required, and
- difficulties in detecting the titration end-point with commonly used colour indicators, again made difficult when analysing low-alkalinity water samples.

I don't know about you, but I have real trouble picking the colour change at the end-point of alkalinity titrations, especially when using the bromcresol green/methyl red "powder pillows" or "foils" available from a well-known chemical supply company.

Straight bromcresol green isn't much better: the colour changes from light blue to a pale yellow.

Bromphenol blue, provided in Alkalinity Test Kits another well-known chemical supply company seems to change colour at a pH lower than the often-suggested end-point pH of 4.6-4.9, giving a high result.

Standard Methods recommends a potentiometric method for low alkalinity water samples (less than 20 mg/L) using: a pH meter, 0.02N H_2SO_4 titrant, a 200ml sample and a 10ml microburet. (By the way, the strength of the titrant acid (hydrochloric or sulphuric) you use should not be less than 0.02N to get reproducible results).

This method has recently been adopted by the US EPA as part of SOP # 560 for analysis of low-alkalinity samples. It involves titration to a known pH less than 4.7 and then continuing the titration to second pH, 0.3 units lower than the first. However, it is very easy to overshoot the second end-point even when using a microburet, especially for very low-alkalinity water samples (< 10 mg/L).

Vt, mL	pH	F_1
0.00	6.97	0.0000
0.54	6.66	0.0000
0.94	6.33	0.0001
1.36	5.97	0.0002
1.74	5.47	0.0007
2.25	4.56	0.0058
2.37	4.43	0.0078

Figure 1

So, how to overcome the above difficulties? Easy! Use a Gran Plot!

The Gran Plot method is straightforward but does involve time initially setting up an Excel spreadsheet and plotting a graph. Here's what you do:

1. Note and record the initial pH of your sample before any acid is added.
2. Titrate a 100 mL water sample with standardized 0.02N HCl or H_2SO_4 using a 150 or 200 mL beaker and a magnetic stirrer. If possible, use a 10 mL microburet. Use a buret stand and clamp to hold the microburet and the pH probe.
3. Record the volume of titrant added (V_t) and measure the pH of your sample using a calibrated pH meter. Make sure you add the acid drop-by-drop and allow time for the pH meter to equilibrate before recording the result and proceeding with the titration.
4. Set up a table with your recorded observations on an Excel spreadsheet, as illustrated in Figure 1:
5. You can titrate past the normal pH 4.5 end-point and in fact, the lower the pH you end up with, the more reliable the result.
6. Calculate F_1 for each set of titrant volume and pH observations from Equation 1:

$$F_1 = (V_o + V_t).10^{-pH} \qquad -(1)$$

where:

V_o = sample volume, (typically 100mL),

V_t = titrant volume, mL

pH = pH of sample

Enter the results into the above spreadsheet.

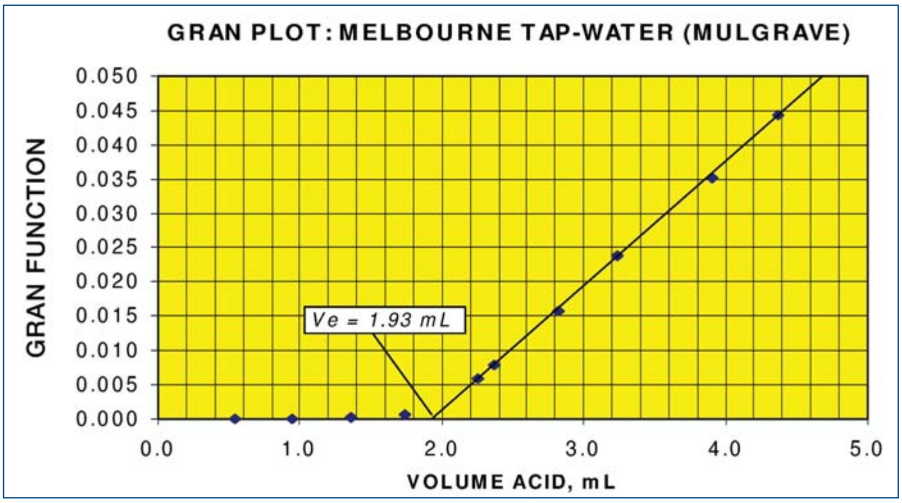

Figure 2

7. Next, plot F_1 (called a Gran Function) versus V_t, the volume of acid titrant added, using the Chart Wizard feature in Excel. You'll end up with a graph similar to one shown in Figure 2, which is based on a sample alkalinity titration using Melbourne tap water (at Mulgrave).

8. Then, you extrapolate to find V_e, where the plot strikes the Vt axis. This is the volume of titrant required to reach the equivalence or the titrant end-point.

9. Finally, calculate the alkalinity of the sample from Equation 2:

ALKALINITY,
mg/L $CaCO_3 = N.V_e.50045/V_o$ -(2)

where:

N = normality of acid titrant,

V_e = volume of acid to reach equivalence point, determined from the Gran Plot, and,

V_o = volume of sample (100 mL).

By way of comparison, I determined the alkalinity of Melbourne tap water at Mulgrave using the Gran Plot and compared it to other techniques, shown in Table 1.

Note the high result obtained when using bromphenol blue indicator.

So, if accurate measurement of alkalinity is important to your process or for your record- keeping, next time try the Gran Plot technique. Once you've got the spreadsheet set up, it's pretty easy, and... it's accurate! No more wondering if you've reached the end-point or not!

In closing, it should be noted that the US Geologic Survey Office has now adopted the Gran Plot technique for determination of alkalinity of surface and aquatic water samples.

So, throw away your indicators and get out your pH meter!

The Author

Peter Gebbie (peterg@fisherstewart.com.au) is Senior Engineer (Process Design) with Earth Tech Engineering Pty Ltd.

Table 1

ALKALINITY OF MELBOURNE TAP WATER	
TECHNIQUE	**RESULT, mg/L $CaCO_3$**
• Titration, bromphenol blue indicator	15.4
• Titration, bromcresol green indicator	11.3
• Titration, pH 4.5 end-point using pH meter	11.8
• Titration, 0.3 pH Difference Method *(Standard Methods* 2320 (4d))	10.1
• Titration, Inflection Point Method using pH meter	11.5
• **GRAN PLOT METHOD**	**10.1**

PRACTICAL EXPERIENCES WITH ONLINE NUTRIENT ANALYSERS

Paul Keating, Gippsland Water Operator

During 1995 and 1996 the Moe Sewage Treatment Plant (STP) was upgraded from a trickling filter, anaerobic digester, lagoon plant to a three cell Intermittently Decanted Extended Aeration (IDEA) plant. Over the last three years online nutrient analysers have been used to optimise nutrient removal. During this time I have gained considerable experience in the operation and maintenance of these instruments. Two types of analyser have been used at the plant.

Firstly a cabinet type supplied by Bran & Luebbe and secondly a STIP floating buoy type supplied by DCM Process Controls.

Figure 1. The Bran and Luebbe analyser system and membrane filters located in the Treatment Plant building.

Cabinet Type

The cabinet types are an Ammonia (NH_4) analyser, and a Phosphorus (PO_4) analyser. The system consists of a submersible pump at the point of sampling and membrane filters in a duty / standby configuration. A small pump takes a sample of filtrate from the filters and passes it to the analyser. The analyser consists of electronic controllers, chemical storage containers (5 L each), solenoid valves, peristaltic pumps, mixing chamber, and in the NH_4 analyser a heating bath and membrane probe, and in the PO_4 a light source and measuring cell.

The cabinets housing these analysers and the filters were mounted in the STP control building (Figure 1), which placed them remote from the sample points. This creates a lag time from time of sample to time of analysis, which must be taken into account when interpreting the data. In our situation this is approximately 15 minutes. The sample supply pump is submerged to a depth of two metres into the IDEA cell. This is roughly half the depth of the cell. An advantage of this setup is that the pump may be raised, lowered, or relocated without having to move all the other components with it.

Since we were monitoring mixed liquor, filters were required to remove solids prior to analysis. The membrane filters last in service from 3 weeks , when operating at a MLSS of 4000mg/L to 7-8 weeks at a MLSS of 2000mg/L. Another aspect that can prolong filter operation is the flow rate of the sample supply pump. Too low a flow rate will not scour off the internal filter surface, resulting in the need for more frequent filter rotation and cleaning. The used filter is filled with a Hypo solution and allowed to stand until it is required for service.

Figure 2. The STIP analyser system located on a safety rail with the buoy in the cell.

Floating Buoy Type

STIP floating buoy analysers for Ammonia (NH_4) and Nitrate (NO_3) have been used. These consist of a cabinet housing the electronic controls and a small air compressor, and a floatation buoy. The buoy supports the two analysers and raises and lowers them with the rise and fall of the liquid at the sample site, thereby keeping the analysers submerged at the same fixed level. In each analyser there is a settling chamber, a measuring chamber, two chemical storage tanks, (1 L each), solenoid valves, measuring probes and sensors. The electronic cabinet which is weather proof is usually mounted close to the sample point on a suitable structure, such as a safety hand rail (Figure 2).

All of the STIP components are located at the point of sample. The analysers, which are located in the sample liquid, are connected to the electronics cubicle by a heavy cable, and the air from the compressor is used to positively displace the chemicals and purge the sample from the measuring chamber.

With this type of analyser the sample is analysed at the sample site, but is limited to sampling in the top 400mm of the sample media. To sample an alternative site the entire instrument has to be relocated.

OH&S

All Material Safety Data Sheets need to be available so that operators are fully aware of the chemicals they are handling and the appropriate personal protective equipment necessary. For the Bran & Luebbe instruments we carry in stock

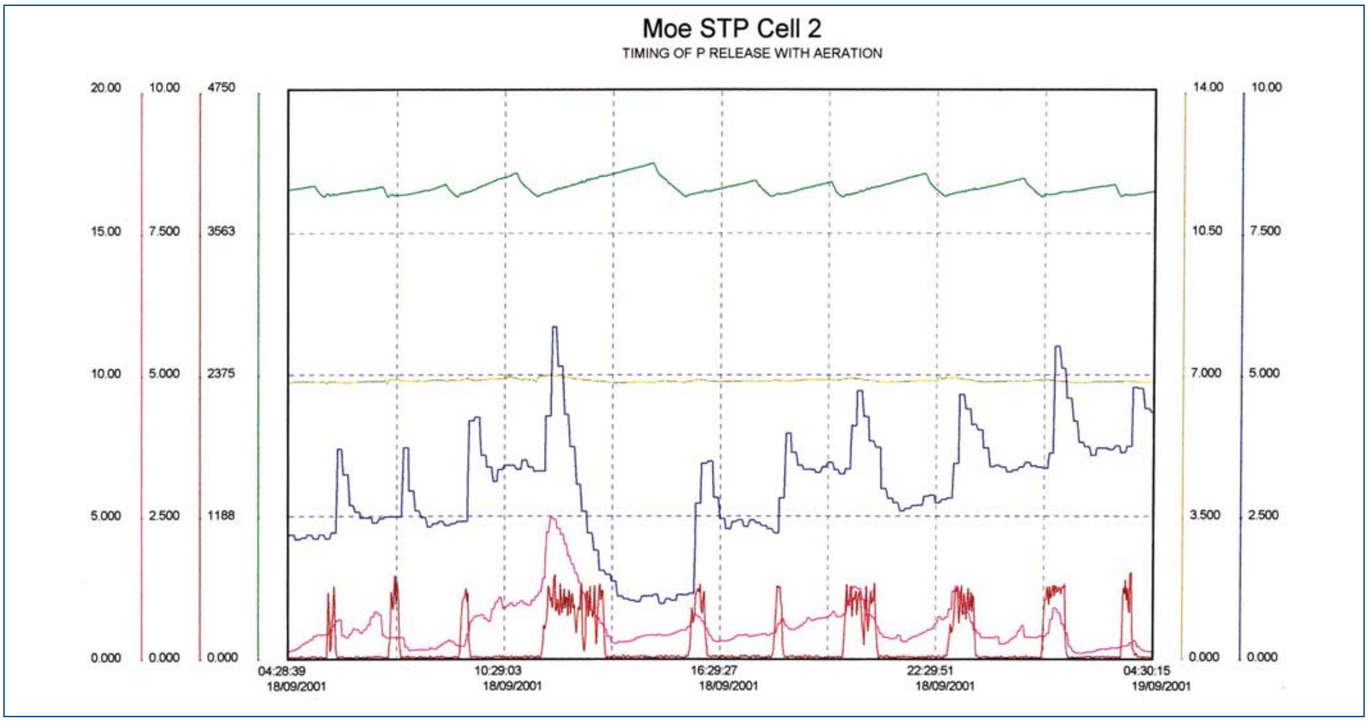

Figure 3. 24 hour trend showing cell level, cell pH, phosphate, ammonia and DO. Individual decants from the cell can be identified by the periodic decrease in cell level. At the end of each decant there is an aeration period of variable length shown by the DO trend. Phosphate and ammonia levels vary during the cycles but are lowest during the decants.

eight different chemicals, and for the STIP we carry six different chemicals, all in varying amounts.

The installation is also very important. The buoy types are awkward to handle, and in our situation when in their measuring position they are at arms reach which makes them difficult to retrieve and install. In the case of the Bran & Luebbe analysers, the submersible pump weighs 63kg, so you would have to look at ways of handling for raising , lowering, and for maintenance.

Important Requirements

To keep the analysers working and for their use to be successful, some important requirements are,

- **A competent operator**. Someone who is interested in the analysers and the information obtained from them.
- **A good maintenance program**. Follow the routine calibration and short term maintenance as recommended in the operation manuals. Both companies have put a lot of time and effort into their recommendations, and in my experience these are appropriate.
- **Understand how your instrument works**. Spend some time reading the manuals and try to understand your instruments mode of operation. Be sure to read only the sections relevant to your specific instrument.
- **Spot checks**. Carry out spot checks on reliability of the signal output and trending display. Continued confirmation needs to be made that the values on the SCADA reflect values from the analysers and that the values shown on the analysers agree with laboratory measurements.
- **Consumable needs**. Work out your consumable needs and have them ordered or in stock before you need them, as you can be waiting on average two to four weeks and possibly even longer. Chemicals can be purchased from the suppliers, or as they are quite happy to hand over the recipes, you could have the solutions prepared by a certified laboratory closer to you.
- **Critical spares**. Determine what critical spares are needed and maintain these on site. This can be decided by reading the manuals and talking to the suppliers. Ask about "service kits", which I found to be a very economical way of purchasing most of the spares I deemed necessary.
- **Set up parameters**. It is very important to record the instrument set up parameters for your installation. If you experience a severe power outage or you have to carry out a factory reset, you will be very pleased you did, as not only will you upset your instrument technician you will lose a lot of time trying to set up the parameters again.
- **Stable power supply**. A stable power supply is very important, as a lot of grief can be caused by an unstable supply. You can wind up with poor signal output, memory loss, scrambled brains, burnt out solenoids and switches or other components, so a UPS unit and surge protection are a good investment when setting up an installation. Protection of the other equipment must also be considered. At our site the submersible sample supply pump to the Bran & Luebbe units, was powered by plugging into a 3 phase GPO. After melting two pumps in three weeks we had to look at protection. Ideally protection via the phase failure relay and PLC would have been the way to go, but I did not have that luxury so we came up with some hard wiring options for pump protection and auto restart.

Both instruments have the ability to output results and alarms. The STIP analysers have their own local display, with limited trending, while the Bran & Luebbe analysers only have local display. Whether you use data loggers or some form of SCADA, is up to you. In our case we trended results through our SCADA CITECT system which gave us a better trend display and a lot more flexibility. It enabled use to superimpose other plant trends and better understand what was happening, especially when we were not there (Figure 3). Due to limitations of our plant PLC we were unable to utilize the alarm features.

When ordering an analyser, think ahead and possibly buy the unit already preprogrammed to accommodate future expansion.

The Bran & Luebbe units require the input of time, chemicals and replacement parts to be kept in an operating condition. On a daily basis there needs to be a visual inspection of general condition, and chemical levels. Calibration limits should be recorded to allow fault diagnosis and monitoring the probe condition.

Chemicals are added as necessary. These units hold 5 litre containers which, depending on the chemical, last between 18 to 437 days.

The STIP units require daily inspection of condition and operation. Recording of calibration limits is not necessary as the unit stores these itself. Cleaning every two weeks, and chemical filling as required, these units hold 1 litre containers and depending on the chemical last from between 12 to 90 days.

With both type of instruments, the maintenance requirements are spread over a 3 month cycle, with the third month requiring the input of more time and effort than the other two. Tables 1 shows a breakdown of costs associated with the operation of the analysers over a three month period. The figures for labour are stated as in-house labour, costed at $30 per hour. If you have a service provider then it may be more expensive.

Although the per litre cost of chemicals is similar for both types of analysers, the Bran & Luebbe is more expensive to operate as it uses a larger volume of chemicals.

When looking at parts the Bran & Luebbe is more expensive to operate mainly due to the need to replace pump tubes every 3 months.

Table 1. A comparison of operating costs for the analysers used at the Moe STP.

BRAN & LUEBBE	NH4 AMMONIA			
	LABOUR	CHEMICALS	PARTS	TOTALS
1st MONTH	$110.10	$133.80	$10.00	$253.90
2nd MONTH	$110.10	$133.80	$10.00	$253.90
3rd MONTH	$132.60	$133.80	$230.00	$496.40
			TOTAL	$1,004.20

BRAN & LUEBBE	PO4 PHOSPHORUS			
	LABOUR	CHEMICALS	PARTS	TOTALS
1st MONTH	$110.10	$133.80	$10.00	$253.90
2nd MONTH	$110.10	$133.80	$10.00	$253.90
3rd MONTH	$132.60	$133.80	$340.00	$606.40
			TOTAL	$1,114.20

STIP	NH4 AMMONIA			
	LABOUR	CHEMICALS	PARTS	TOTALS
1st MONTH	$105.00	$80.00	$5.00	$190.00
2nd MONTH	$120.00	$80.00	$5.00	$205.00
3rd MONTH	$135.00	$80.00	$5.00	$220.00
			TOTAL	$615.00

STIP	NO3 NITRATE			
	LABOUR	CHEMICALS	PARTS	TOTALS
1st MONTH	$90.00	$23.33	$5.00	$118.34
2nd MONTH	$105.00	$23.33	$5.00	$132.33
3rd MONTH	$135.00	$23.34	$5.00	$162.33
			TOTAL	$415.00

A Comparison of the Analysers

• **Programming/operation**. Even though parameter access is very limited with the STIP unit , it is more user friendly to operate.

• **Access for maintenance**. The Bran & Luebbe unit is very open in design and access is good. The STIP unit is very compact and can be difficult for certain work.

• **Filling of chemicals**. The Bran & Luebbe, being open in design, it is very easy to see the chemicals and when they need to be topped up. The STIP being a closed unit means you need a good chemical usage history or wait for the instrument to fail due to lack of chemical.

• **Calibration**. The Bran & Luebbe unit carries out its own calibration daily, with no further input required. The STIP also carries out a daily calibration

• **Reliability**. Even though the two units are different in design and mode of operation, their reliability would equal.

• **Operational & Maintenance costs**. Due to design with more components to fail the Bran & Luebbe instruments would probably be more expensive long term. With using more chemical per month the Bran & Luebbe would also be more expensive to operate.

• **Supplier support**. Both companies are willing to help over the phone, but this can be a difficult way to diagnose faults. When they have to seek advice from their parent supplier, take into account time differences and language barriers when expecting a response.

The final decision comes down to personal preference and sample location, keeping in mind that any one analyser may be more suited to a sample site than an other analyser.

In our experience both analyser types gave consistent and reliable information and have enabled us to better understand and improve nutrient removal at our plant. We have been able to control the plant using the on line ammonia analyzer and achieve ammonia levels less than or equal to 1.5 mg/L in all decants. The phosphorus levels on discharge have been reduced from an average of about 6.6 mg/L to around 2.8 mg/L.

The Author

Paul Keating (keatingp@gippswater. com.au) is a Sewage Treatment Plant Operator at Gippsland Water and has operated the Moe STP for 5 years.

BOOK REVIEW

Urban Rivers. Our Inheritance and Future. **Edited by Petts, Heathcote and Martin. ISBN 1900222221. IWA Publishing 2002. Available AWA by email bookshop@awa.asn.au Price $64 plus p. & h.**

Urban renewal is a subject dear to the heart of royalty (Prince Charles), politicians (Peter Garrett and Bob Carr) and ardent souls interested in heritage and urban renewal. It has been said also that the urban rivers and streams of today are equally in need of revival and restoration. Indeed, the degradation of rivers, deteriorating water quality, declines in fish numbers, increased flooding and the loss of ecological resources would seem to have worsened with increases in human settlement, industry and related development.

Urban Rivers begins by tracing this history of rivers principally using UK examples and leads into a focus on the way modern societies today use rivers with the resultant problems. Throughout the book are a series of special case studies based on issues that have arisen. These include problems of groundwater depletion and rebound like those that have arisen in Birmingham, Liverpool and London as a result of urban areas being situated over aquifers and the associated resultant water abstraction to satisfy urban and industrial demands. Issues with introduced plant species, the intrusion of waterweeds, and the invasion of fish species which predate native marine life are illustrated by examining the effect of North American crayfish in the UK and of new pathogens and parasites in the decline of native species numbers in central England.

The book investigates the social, legal and administrative opportunities for finding an integrated approach to reviving urban waterways. Technological and scientific solutions are also advanced. This is a nice little book, an unusual shape, well illustrated with pictures of rural England without the tourists. Softcover.

Diane Wiesner
AWA snr scientist

BRAIN TEASER 2

This time a brain teaser primarily for the Sewage Treatment Plant operators.

NEERIM NUMBERS

An underloaded STP has a very slow biomass growth rate but gives every indication that good treatment can be achieved at long sludge ages. The following data was collected.

Date	MLSS (mg/L)
23/7/99	1500
3/8/99	1700
10/8/99	1850
20/8/99	1960
31/8/99	2000
3/9/99	2150
10/9/99	2320

There will clearly be a need to waste but at a low rate. Given the following information what wasting rate should be established.

Reactor Volume 375 m^3

WAS pump rate 5.1 L/s

Assume a reactor MLSS 2000 mg/L and that wasting occurs from a fully mixed reactor.

The wasting (WAS) control system is set in minutes per 4 hour cycle. How many minutes per cycle should the control be set for?

Answer in the next volume of WaterWorks.

ANSWER TO BRAIN TEASER 1

1\. 3% hypo = 3g/100ml
= 30 g/L.

If the flow is 80 L/s

Weight of hypo required to achieve 0.6 mg/L residual is

80 L/s X 0.6 mg/L
= 48 mg/s
= 48 mg/s X 60 s/min
= 2880 mg/min
= 2.88 g/min.

The volume of 3% hypo required to achieve this dose is

2.88 g/min
30 g/L
= 0.096 L/min
= 96 ml/min

2\. At 96 ml/min for 12 hours the total volume required is
0.096 L/min x 60 min/hr x 12 hours
69.1 L.

3\. Volume of water in the main.
3.14 x radius^2 x length
3.14 x .375m x .375m x 2000m
883 m^3
883,000 L
At a flow rate of 80L/s it will take
883,000L
80 L/sec
= 11038 sec
= 184 mins
= 3hrs 4 minutes

CROSSWORD SOLUTION 1 (from previous edition)

1 F	L	2 O	3 C	4 C	U	5 L	A	6 T	E	■
L	■	7 P	O	O	■	I	■	R	■	8 R
9 O	10 T	■	11 D	A	F	F	■	E	■	E
12 W	E	T	■	G	■	13 T	O	A	S	T
■	L	■	14 M	U	G	■	■	T	■	I
15 L	E	V	E	L	■	16 M	17 I	M	I	C
■	M	■	18 S	A	L	I	N	E	■	U
19 L	E	A	S	T	■	N	■	20 N	I	L
■	T	■	■	E	■	21 D	22 O	T	■	A
23 T	E	Y	■	■	■	■	A	■	24 I	T
■	Y	■	25 F	L	U	O	R	I	D	E


CASE


CAT


AUSTRALIAN POLLUTION
ENGINEERING
BENDIGO
(054) 488.317
Dewatering Unit