WATERWORKS

OFFICIAL JOURNAL OF THE WATER INDUSTRY OPERATORS ASSOCIATION

JUNE 2004


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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.

CONTENTS

Our Cover: **Transfield Mechanical Technician, Duane Kelly, checks the operation of a high lift pump at the Sale Water Treatment Plant. Pump condition testing forms an important part of any preventive maintenance program.**

HELP wanted. ONE article a year!!!

This is the sixth edition of *WaterWorks*. One of our original aims in publishing the magazine was to provide a day-to-day account of operations in the water industry, warts and all. As I look back over the previous issues I am pleased to see that this has well and truly been achieved. The magazine is full of informative and helpful articles from all areas of the water industry. The only thing that concerns me is that the magazine is dominated by articles from Victoria. As WIOA continues to move towards providing a truly national representation of operators in Australia, it has always been one of my objectives to source articles from all parts of Australia on a regular basis.

To help me achieve this I would like to appoint a subeditor in each State with the specific task of sourcing ONE article of a suitable standard to publish in WaterWorks each year. Not a big ask by any means! Think about it - six States means six articles. These would easily fill the June edition and we already have access to the best papers from the various Operators conferences which make up the main content of the December edition, with a few extras thrown in.

So is there anyone out there in Queensland, Tasmania, Western Australia, New South Wales, Northern Territory and South Australia who would be prepared to put their hand up? We need people who have contacts and know what is going on in their State to work with me to find ONE article per year for *WaterWorks*. Quite often operational staff don't realise that they have been doing something worth reporting and just need a small (sometimes a bit larger) push to write it.

WaterWorks will continue to be produced regardless of the response to this request but think how much better it will be with regular contributions from all States.

Contact me. (mossep@gippswater.com.au) or 0428 941 013.

Peter Mosse
June 2004

President's Message

Welcome to our first edition of *WaterWorks* for 2004. It is fair to say that our industry has undergone a great deal of change in the past few years and it seems there is even more on the way. When we now look at the high tech treatment plants controlled by PLCs, the more common use of SCADA and GIS networks, the myriad of new Regulations and Government policies relating to water and wastewater and the updated management systems being implemented, it is easy to wonder how we ever did the job in the past.

The reality is that we as operators have worked with and through these changes all our working lives and have continually met the challenges they posed head on. The old adage of "doing more with less" has never been more to the fore than at present but in some cases, the changes have put real pressure on our ability to remain productive. During this time though, we have expanded our knowledge and skills base enormously and the expectation from our employers is that this trend will continue. Operators must now have a holistic view and be able to react appropriately to anything that impacts on their working environment. This is a far cry from times not that long ago when operators were task focused.

Obtaining, using and being prepared to share knowledge and skills is an area where we can collectively help ourselves. Operator focused conferences are now being staged annually and in the coming months will be held in Victoria, Queensland, New South Wales and South Australia. Make sure that you find out about them, look through the papers to be presented and even better, put in an abstract to tell the industry about what you are doing at your workplace. The best and most interesting papers are nearly always done by people talking about real life experiences and not about rocket science.

If talking on stage isn't your cup of tea but you do get to attend a conference, make sure that you use your time proactively. Listen to the papers and take some notes, look over all the trade sites and not just the companies that you are familiar with and most importantly of all, make sure you meet and network with as many other operators as you can. This gives you contacts for the future and could help you to save many dollars from just a single phone call. The final tip is to write a report to your organisation outlining what you got out of attending the conference. This may encourage your employer to send you, or other staff, next year.

The other thing we'd like to encourage you to do is to join WIOA. There are a multitude of benefits awaiting you including access to quarterly newsletters, frequent notification of positions vacant through advertisements and access to our website along with the Corporate Members directory. You will also receive invitations to attend the numerous other activities we organise at various times throughout the year. If you look at the cost of being a member and the benefits you receive it really is excellent value. We think that it is so good that you should encourage all your work mates and other water industry acquaintances to join as well.

Until next time - "Happy Operating"

John Harris, WIOA President
June 2004

DID YOU HEAR THE ONE ABOUT...???

George Wall

I'm sure that anyone who has been involved in the operational side of the water industry for a reasonable amount of time has collected plenty of yarns to tell over a couple of beers. More often than not they involve the misfortune or stupidity of someone else as we rarely like to make ourselves the subject of such yarns - it is always a mate or acquaintance who cops it. In true Aussie spirit, just like a good fishing yarn, most of these stories tend to get better with time.

I've built up my own collection over the years with some of them the result of near misses which could, but fortunately didn't, have serious consequences and many others as a result of more light hearted incidents. In my time I've seen utes and trucks submerged in wastewater lagoons; tractors and backhoes stuck in precarious situations; countless stories of the mobile phones either left on the roof of the car then being run over or falling out of a top pocket and into a sewer pump station wet well; and of course numerous close encounters of the reptilian kind where the serpent gets a foot longer and 3 inches fatter every time the story is told. You know the ones!

It was with amusement, and indeed amazement, that I recently spent a day in the car looking over potential conference venues in Victoria with a doyen of the water industry, Mr Ron Bergmeier. Ron is the owner and a director of Australian Pollution Engineering, a company involved mainly in the management of biosolids. Ron has developed a reputation in the industry as a straight shooter but I've been around him often enough to witness another side of his dry and sometimes wicked sense of humour. Some incidents that Ron described that day were just too good to keep quiet and Ron has graciously agreed to let me relay some of them here.

Being in the biosolids game, Ron has numerous trucks, dredges, centrifuges and other heavy equipment in operation all the time. One such large machine - a floating weed cutter and harvester was to be used in Patterson Lakes, a feature lake in a residential suburb south of Melbourne. The semi trailer had been backed down to the edge of the water ready for the weed cutter to be offloaded by a large crane. The unloading was successful and the cutter was moved out to the middle of the lake for a trial run. After a while, Ron decided to it was time to move the now empty truck back up to the main road and hopped in. When he started it up there was a complete brake failure and the truck began rolling backwards towards the lake. There was no way to stop the runaway truck and it finally came to rest with the entire trailer submerged and the cabin about half full of water. A very red faced Ron had to make his way back to shore and call for a heavy salvage truck to come and pull the big rig out. Whilst awaiting the arrival of the salvage truck, a significant number of local residents arrived full of helpful advice - all of which Ron was in no mood to receive. When one chap raised his concerns about the oil slick on the water, probably due to leaking diesel, Ron replied "don't worry mate, we're going to pump all the water out of the lake so I can get my truck back". This wasn't quite the response the resident expected and he was last seen heading for a phone to call the local council - "we'll see about this". In the meantime, the salvage truck arrived and extricated the errant prime mover and trailer to allow the very expensive repair job to the motor and differential to be completed. A week or so later, Ron returned to the same spot with the now repaired truck to collect the weed cutter. Lo and behold, around 100 local residents arrived all with video camera in hand ready for action. Some just couldn't hide their disappointment when the job went totally to plan and Ron drove off into the distance without giving them an encore performance.

Another interesting story was actually quite serious and could have had disastrous consequences had events unfolded differently. The crew were working with a dredge and centrifuge on wastewater lagoons near Bankstown in Sydney. Ron was standing on top of the centrifuge and experienced the sensation that something was just above or near him. He looked up to the see the wheel of an aeroplane pass only about 5 metres over the top of his head. It turned out the light plane had an engine failure and the pilot was trying to make it back to the nearby Bankstown airport. When he realised that he couldn't get that far, the pilot decided it would be better to crash land into the lagoons than into someone's house and tried to land on the lagoon embankment. The plane narrowly missed the top of the dredge in the middle of the pond and hit the lagoon embankment ripping both wheels off in the process. The plane skidded down the bank and eventually ploughed into the cyclone perimeter fence surrounding the plant which acted like a big catch net. Fortunately the pilot escaped any serious injury and the dredge operator was oblivious to the fact that he had nearly been cleaned up by the powerless plane. It was interesting for Ron and his crew to watch the circus arrive including the police, fire brigade, Civil Aviation Authority, the Channel 7 chopper and what seemed to be every journalist on the eastern seaboard.

After about 20 interviews, each one of them an "exclusive", Ron ended up locking the poor pilot into his car to keep the rest of the journos away. The scene was investigated over and over and the plane was eventually dismantled piece by piece and taken away over the next week or so.

Obviously there are hazards attached to working in and around wastewater but not always the type that readily spring to mind. At a wastewater plant in Port Macquarie, the lagoons were being desludged, and alum was being added to increase the rate of flocc formation. This process gradually removed most of the dissolved oxygen from the water and after a few days on the job the guys came to work one morning to find a number of dead eels floating on top of the pond. Late in the afternoon, one of Ron's men was walking along the edge of the pond and got whacked in the back of the neck by something heavy. It turned out that some more eels had floated up during the day and a pelican had decided it was free feed time. The pelican had picked up the dead eel but obviously it was too heavy to carry all the way back to its nest. The pelican had dropped the eel mid flight and this is what hit Ron's bloke. From that point on, an OHS decree was made that all staff on the site had to wear suitable PPE at all times - a hard hat with the words "eel protection device" written of the front in black letters. It turned into a morning ritual for the guys to go around the pond and collect all the eels and bury them so that they wouldn't start stinking, but mainly to reduce the ammo available to the local birds who eagerly sat around the edge of the pond waiting for their next free meal to pop up.

Another hazard involving native fauna occurred at the Darwin wastewater plant. The guys from NT Power and Water who manage the facility advised Ron that they had just removed a big crocodile from the ponds. Being the first time that Ron had

worked there he thought they were joking and he and his blokes wandered around the banks on foot and puttered around the ponds all day in their little tinnie doing sludge surveys and collecting samples. They set up a pump to decant the water from the pond overnight and went back to town. They came back the next morning and noticed marks in the exposed sludge at the edge of the pond. It turned out a croc about 2 metres long lived in the pond and when the water level was lowered he couldn't get out. Ron's blokes found him near one of the control structures and one of them decided to do his best Steve Irwin impression and grabbed the croc by the tail. After all the obligatory photos were taken to sate the "disbelievers" in the southern States, they called the NRE people to come and get it out. It turns out that there are numerous crocs that call the lagoons home and any over 3 metres are routinely trapped and taken away. A special line item has now been added to the site specific risk assessment documentation outlining the dangers of crocodiles.

Driving large bulldozers and excavators inside partly dewatered lagoons can sometimes hold surprises. In Auckland NZ, Ron was working on air drying solids in the lagoons and in the process was giving the Kiwis a demonstration of how to do the job properly so that they could then take over. Most of the ponds had solid clay bases but being a volcanic area, some of the lagoons had areas of wet gooey clay. Whilst his demo was in full flight, Ron inadvertently drove the dozer into the wet stuff and it got bogged to the top of the tracks. A bit red faced, he explained this was all part of the service and tomorrow he'd show them how to get it out again!!. It turned out that on this job they "lost" 2 excavators when they sank down old volcanic gas vents. Luckily the operators were able to scramble out the air conditioner vent in the top of the cabin before the machine disappeared totally.

In a similar event, when Ron drove the dozer into a lagoon in Darwin it just kept going down once it reached the floor of the pond. It sank TOTALLY with the radiator cap about 300mm below the sludge level. It turned out the lagoon was constructed over an old mangrove swamp and didn't have solid clay base.

Travel for someone as busy as Ron can also lead to some interesting situations. Ron uses a broker to arrange his flights and basically tells him where he has to be and when and the broker then arranges the flights. He then faxes the details to Ron and assumes of course that Ron will read the fax. A few times Ron has been caught up in his work and not bothered to read the faxes assuming that the flight is happening when he wants it. This little trait has caused him to arrive at the airport anything from a day and a half early to 3 days late. Needless to say he pays full fare and the tickets get transferred regularly.

This all led into a story about Ron taking his family for a trip around Australia (in 2 weeks) to use up his frequent flyer points. They were in Broome having a great time at the beach swimming and drinking cocktails. They had great delight in laughing at all the poor people, suitcases in hand in the hot sun, walking along the beach. In those days there were only 2 commercial flights into and out of Broome each week and a few hours later they found out that all those people were heading off to the airport to catch the plane that Ron and Co were meant to be on as well. As the team had to be in Darwin the next day for business and to continue the tour, they had to charter a small plane to take them there. The cost of this exercise was $4,000 ($2,000 each way) and the flight was so rough that they were all airsick for most of the journey. It turned out that the "free" trip around Australia was much more expensive than originally anticipated.

Ron's dry sense of humour came to the fore on a trip from Bendigo to Sydney. Ron and two of his staff were sharing the cabin of the prime mover when one of the guys got a blood nose. Being blokes, hankies or tissues were not often packed and the poor guy ended up getting blood everywhere, including all over his face. The trio pulled up at a busy truck stop so he could clean himself up. You can imagine the looks the poor guy got when he stepped out of the truck with blood everywhere. Not one to let a chance go by, Ron waited until everyone was looking and then yelled at his guy at the top of voice "give me any more of your s**t and you'll cop another one". As you can imagine this freaked out the majority of the people there!

There were numerous other stories relayed that day which I'm quite sure the censor would be interested in if I were to elaborate on them in writing. For the protection of the innocent (in most cases not Ron) they won't be revealed here!!!

The Author

George Wall (GeorgeW@gvwater.vic. gov.au) is Secretary of WIOA and Wastewater Systems Specialist at Goulburn Valley Water. Ron Bergmeier owns and operates Australian Pollution Engineering.

WHAT THE CLEANER SAW!

Peter Norder, Neil Whitelaw, Craig Jones

What secrets are hidden away in the dark watery recesses of your clear water storages and tanks? Layers of silt, dead possums, wasps, rusted and corroded fittings, or failed baffle curtains?

Because of the continual demand on water supplies it is often very difficult to assess the inside of tanks, basins and reservoirs. One way of maintaining the supply of water to consumers and assessing the inside of water storages is to use divers. Divers should meet all necessary industrial competencies, qualifications and standards and they should also be in tune with the potable water industries increasing pressures to meet local and international standards in supplying high quality drinking water.

Data collected by the divers via written reports, digital photos and narrated video can supply useful information for the maintenance and planning departments.

Sometimes however the information retrieved is somewhat unusual and unexpected. The following are some accounts of unusual findings by the divers from inside water storages. Could this be what is inside yours???

Open tanks or basins encourage various types of flora to grow prosperously. Our team has literally had to chop through 4-meter high forests of weed and have found outlets blocked by long plumes of accumulated weeds.

Animal life can be a bug bear (pardon the pun) to operators in the water industry. It's very important to spend time plugging up all those little holes to prevent the little creepy crawlies from getting a free drink. Not only is it disturbing to have dead animals in your storage but they chew up disinfectants.

Common animals we have found in storages include birds, spiders, possums, worms, centipedes, wasps and even dogs. All these may be dead or alive! One tank in Adelaide had never had a chlorine residual until after divers had cleaned it. The floor was cleared of hundreds of thousands of centipedes.

In central Victoria a storage tank had 30% of the floor covered in wasps. They had nested in an upstream tank that was de-watered for maintenance. When the tank was re-commissioned the wasps were washed down to the next tank.

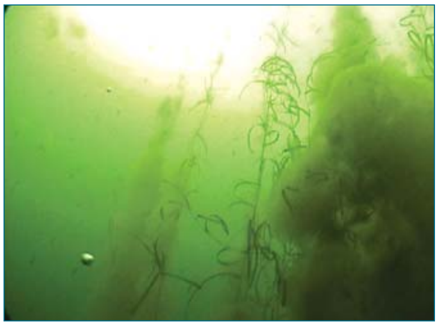
Crack in concrete

Corroded ladder

Another tank had what seemed to be the Victorian breeding grounds for rather large huntsman spiders. These are not the divers closest friends as they appear even bigger underwater. On one particular job the diver entered the tank to carry out his task. Within a minute or so he returned to the roof with a live huntsman that had settled inside his mask during set-up. He described the appearance of the spider as similar to the alien creature attacking Sigourney Weavor.


Holes in floor plate


Outlet pipe resting on roof


Weed forest


Sediment


Wasps


Weed in outlet

Most water storages have some sort of internal fittings. Internal steel fittings are in a harsh environment and difficult to monitor. We often find rungs of ladders crumble under our feet, stillage pipes have corroded away and some tanks appear to be only standing up because of a coat of paint.

Steel Rio within concrete columns can swell and break away large portions of concrete. Large deep cracks are often found in the floor and walls of old concrete tanks.

Aluminium fittings are often thought to solve corrosion problems. Poor insulation to other metals can allow the aluminium to corrode quickly. One particular tank in Adelaide looked like a shearers shed with the amount of corroded material on the floor.

Sometimes, old fittings that cannot be removed from the tank are left to corrode away within the tank. In one case an Aluminium boat was left in a tower to serve as a platform. The boat is now severely corroded and is completely unsafe to stand in. It can't be removed as it does not fit through the hatch and is 30m above ground!!!! Wonder what the Aluminium residual is? Any bets on greater than 0.2 mg/L???

An unusual find in a covered basin in southern Victoria was a 90meter HDPE outlet pipe that had fractured at the wall mount and was floating under the cover for an unknown period of time.

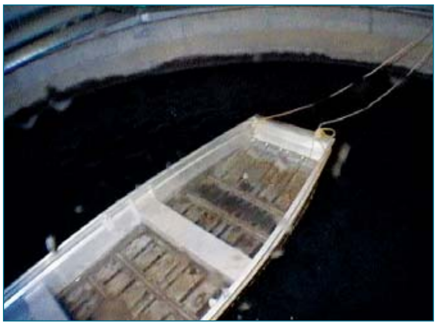
And then of course SEDIMENT. How much you say? As much as you could imagine and then some more. Some storages have not been cleaned for sometime. One basin measuring approximately 100m x 100m had up to 1.5m of sediment in it. This took 28 days to clean.

So what is it like to work at cleaning storages? Some jobs have required divers to endure extreme climatic changes. We have had to survive the 40+ degree heat of Cobar in central NSW and experienced the unique sensation of snow falling on us (or lack of sensation) in Hobart.

The Authors

Peter Norder (pnorder@bigpond.net.au) is owner and **Craig** and **Neil** are divers working for Nordical Diving Services (0409 380 511). The company is based in Gippsland and provides fully qualified potable water dive services to four states of Australia.

Corroded stillage pipe



Corroding boat

Dead possum

Fenceline rubbish

FILTER MEDIA MATTERS

Bruce Murray

Filter media specifications and analysis sheets include many terms that are not always clearly defined. This paper attempts to shed some light on this grey area.

1. Filter Media

Filters used in water treatment consist of several layers of media: from the various layers of coarse, medium and pea gravel at the bottom, to the coarse to medium layers of sand in the middle and the finer sand and/or filter coal used to carry out the bulk of the filtration, on the top of the filters.

Coarse gravel layers are sometimes replaced with garnet that is heavier and may therefore require fewer layers. Activated carbon would replace sand or filter coal in a granular activated carbon (GAC) or biological activated carbon (BAC) filter. Activated carbon can even be used as both a filter media and organics adsorbent in some cases.

The coarse gravel and sand layers support the main filter media and aid in the even distribution of air and water. Gravels are generally specified to be within a maximum and minimum size range. The top layer(s) of sand and/or filter coal are usually specified to have an effective size (ES) and uniformity coefficient (UC). All of this information is determined through sieving of the media.

In addition, various physical properties may be specified to ensure good quality, durable media.

Table 1. Example of Media Sieving Results.

Sieve Aperture Size (mm)	ASTM Mesh No.	Weig ht Retained (g)	% Retained	% Passing
2	10	1.23	0.4	99.6
1.7	12	3.54	1.1	98.5
1.4	14	9.54	3.1	95.4
1.18	16	21.36	6.9	88.5
1.0	18	116.13	37.6	50.9
0.85	20	120.66	39.1	11.8
0.71	25	17.19	5.6	6.2
PAN		19.26	6.2	0
Total		**308.91**		

2. Media Sieving

To determine the size characteristics of any filter media, a weighed quantity of the media is shaken through a stack of sieves. The sieves are stacked with the coarsest sieve on top down to the finest at the bottom. A pan placed at the bottom of the stack collects any fine media passing through all of the sieves. The smallest and largest sizes can correspond to the limiting sizes specified. The quantity of media retained in the pan and in each sieve is collected and weighed.

2.1. Mesh Number

Many suppliers quote media as a size range in mesh numbers. Mesh number is the number of openings per lineal inch in a sieve measured from centre to centre of the wires. However the aperture size depends on the wire thickness and thus sieves with thicker wires have smaller apertures. The standard sieves used by the supplier(usually US or British) and the relevant aperture size used should be checked with the supplier.

The test method commonly used is the American ASTM - C136. Mesh Numbers and corresponding grain sizes are given for the example media in Table 1.

2.2. Percent Retained

The amount of media retained on each sieve (% retained) can be calculated as follows:

% retained = (Weight of media retained on each sieve x 100) / (Total weight of media tested).

2.3. Percent Passing

The cumulative percentage of media passing any sieve is the sum of all of the media below that particular sieve and can be calculated as follows:

Bags of filter media being lifted during a filter rebuild.

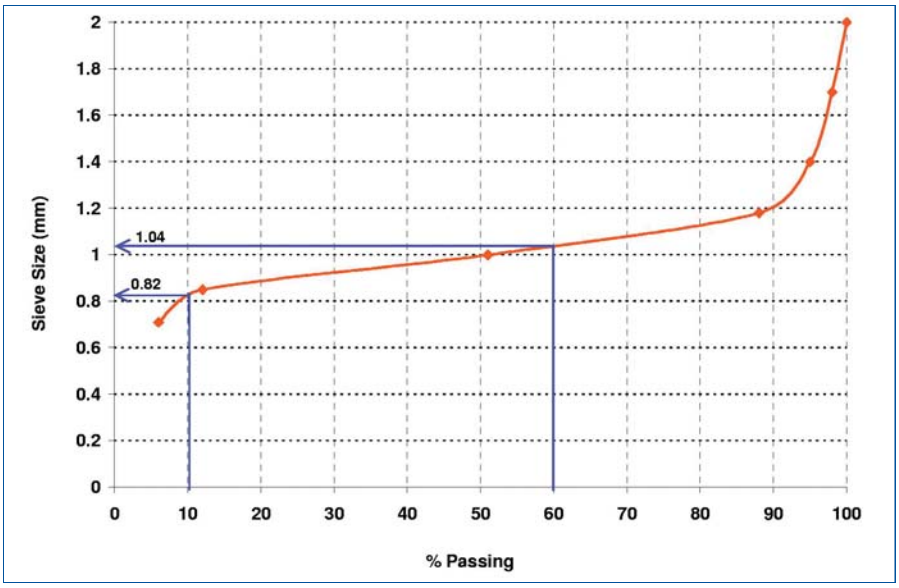


Figure 1. Plot of Filter Media Sieve Analysis.

% passing = (Sum of % of material retained on all lower sieves) + (% of material retained on pan).

An example media is analysed in Table 1.

Thus 0.4% of this media is larger than 2 mm in size and 6.2% is finer than 0.71 mm. 93.4% of the media is within the size range 0.71 to 2 mm.

This data is plotted in Figure 1.

2.4. Effective Size

The effective size (ES) of a media represents the sieve size (mm) for which 10% of the media passes. This is referred to as d10 and is a measure of almost the smallest size of the media - only 10% of the media is smaller than this size. The ES is determined from the plot of sieve size (mm) versus the cumulative percentage passing each sieve size (Figure 1).

In the example above the effective size of this media is 0.82 mm.

2.5. Uniformity Coefficient

The uniformity coefficient (UC) is determined by dividing the size for which 60% of the media passes by the size for which 10% passes. That is the ratio (d_{60}/d_{10}). The UC is a measure of how uniform in size a particular media is but ignores the largest particles in the media.

From the example above, the uniformity coefficient is 1.27 (1.04 ÷ 0.82).

The lower the UC the more washed and uniform the media. However, the lower the UC the higher the cost of the media. A high quality, well-washed filter media generally has a UC of around 1.3. Most media is specified to have a UC of less than 1.5 and preferably less than 1.3. Granular activated carbon however is usually specified to have a higher UC (less than 1.8 or 2) unless it is being installed within a conventional filter. Higher UCs indicate that more fines are present in the media.

Table 2. Filter Coal Requirements.

Parameter	Typical Values	Test Method
Specific Gravity	1.4 to 1.6	AS 1289.3.5.1
Acid Solubility (1:1 HCl)	1 to 5% max	AWWA B100-01
Hardgrove Grindability Index (HGI)	50 MAX	AS 1038 Part 20
Bulk Density	0.65 to 0.75 t/m^3	AS 3899-91

Table 3. Filter Sand Requirements.

Parameter	Value	Test Method
Specific gravity	2.6 to 2.7	AS 1141.40
Acid Solubility (20 % HCl)	2% MAX	AWWA B100-01
Friability	< 10 % @1500 strokes	Degremont Friability
Quartz Content	98% MIN	
Impurities (fines) (<75 μm)	< 0.2 %	ASTM C117
Bulk Density	1.5 to 1.7 t/m^3	AS 1141.4

3. Physical Properties

3.1. Filter Coal

Filter coal supplied for dual media filters should be hard, durable cubic grains, free of clay, shale and other foreign matter and with a very low fines content. Filter coal is usually specified to be in accordance with the US standard AWWA (American Water and Wastewater Association) B100-01 except that the material available in Australia is bituminous coal (not anthracite).

Fines appear as a powdery black material that floats when the media is first covered with water. They are largely removed through initial backwashing but can remain suspended in the waste wash water passing through lagoons and leading to the discharge of black water in the supernatant.

Apart from effective size and uniformity coefficient the following parameters are usually specified for filter coal.

The specific gravity (or relative density) relates the density of each grain of media to that of water (at 4°C) whereas the bulk density is the apparent density of a quantity of the media as it naturally packs (including air gaps). For example, coal with a specific gravity of 1.5 (Table 2) means that the individual grains of filter coal are 1.5 times as dense as water and will thus sink. A typical filter coal has a bulk density of 0.7 t/m^3 which simply means that 1 m^3 of the supplied media will weigh 700 kg.

Acid solubility is measured to ensure that most of the material is actually coal and does not include significant quantities of

Bags of filter coal stacked ready for use.

Table 4. Coarse Sand and Filter Gravel Requirements.

PARAMETER	VALUE	TEST METHOD
Specific gravity	2.6 to 2.7	AS 1141.4
Acid Solubility (1:1 HCl)	Gravel: 1% MAX	
Sand: 2% MAX	AWWA B100-96	
Impurities (fines) (<75 μm)	< 0.2 %	ASTM C117
Bulk Density	1.5 to 1.7 t/m^3	AS 1141.4

Table 5. Granular Activated Carbon Requirements.

PARAMETER	VALUE	TEST METHOD
Iodine number	900-1300 mg/g carbon	ASTM D4607-94
Moisture content	3 - 8%	ASTM D2867-99
Abrasion resistance	Greater than 70%	ANSI/AWWA B604 Section 5.2.6.3
Bulk Density	0.25 to 0.6 t/m^3	AS 3899
Ash content:	3-15%	
Water soluble ash content	4% maximum	

acid soluble impurities. A caustic solubility test can also be carried out in 1% NaOH at 88ºC. For this test a 2% maximum is recommended.

The HGI tests the toughness of the coal which is important since a soft coal can break down during repeated backwashing in a filter. In the HGI test a prepared sample of coal is pulverised in a ball mill. The pulverised coal is sieved and its size compared with those of standard coals. There is also a Mohs' scale of hardness test but this is not as good a measure of durability.

3.2. Filter Sand for Dual or Single Media Filters

Filter sand used in dual or mono-media filters is usually specified to be natural river sand from quarries or dunes that has been suitably washed, calibrated and evenly ground.

Filter sand should be clean, hard, rounded and consist of durable particles in accordance with US standard AWWA B100-01. It is usually specified to be of the highest grade pure quartz (SiO_2 > 98%)

and should be free of all mica, clay, shale and other foreign matter.

The following physical parameters are usually specified.

Again, the specific gravity relates the density of each grain of media to that of water and the bulk density is the apparent density of a quantity of the media as it naturally packs. Note that the specific gravity for the sand (2.6 - 2.7) is much higher than the specific gravity for the filter coal (1.4 - 1.6). Thus in a dual media filter the sand sinks more rapidly than the filter coal after mixing during air scouring (alone or with water washing) and thus the layers of media are reformed during the water washing phase.

Acid solubility and impurities are measured to ensure that most of the material is actually sand and does not include significant quantities of acid soluble or other impurities. The quartz content is measured to ensure that the sand is of the highest purity. Some other minerals found in some sands can break down in the abrasive environment of a filter backwash.

Friability is also a measure of how easily sand fractures or crumbles. For the friability test, the sand is placed inside a Degremont apparatus that repeatedly impacts the sand. After 1500 impacts it is preferred that less than 10% of the sand has broken down, however the test method states that 15-20% friability is satisfactory for filtration.

3.3. Coarse Sand and Filter Gravel

The coarse sand supplied as support layers for the primary media should be suitably washed, calibrated and evenly ground. It should also be comprised of clean, hard, rounded and durable grains of high grade pure quartz and should be free of all mica, clay, shale and other foreign matter (also refer to AWWA B100-01).

Filter gravel should be clean, hard, rounded stones and tend toward a generally spherical or even shape. The gravel should possess sufficient strength and hardness to resist degradation during handling and use and should be free of impurities such as coal, roots or twigs.

The coarse sand and filter gravel should comply with the following requirements:

3.4. Granular Activated Carbon

Granular activated carbon (GAC) is employed in filters to adsorb organic contaminants such as tastes and odours, algal toxins and pesticides. With ozonation up front, the GAC filter becomes biological (BAC) providing a longer life for the GAC. Coal, wood and coconut-based activated carbons are most commonly used in these applications and each has different characteristics.

GAC should be in accordance with ANSI (American National Standards Institute) / AWWA Standard B604-96 and comply with the following requirements.

The particle size distribution should be 5 to 15% maximum on the upper sieve (specified maximum size) and 5% maximum through lower sieve (specified minimum size).

Effective sizes of GAC are typically 0.6-1.2 mm, with a maximum uniformity coefficient (UC) generally specified to be 1.8 to 2. Lower UC may be specified where the GAC is also to double as filter media.

The iodine number gives a measure of the adsorptive capacity of activated carbon. The higher the better (see Table 5). The methylene blue number or molasses number can also be used.

Abrasion resistance is measured through the Ro-Tap abrasion test. It is a measure of the percentage retention of the original average particle size after the media has been subjected to the action of steel balls in a Ro-Tap machine.

Water soluble impurities such as phosphorus, manganese and iron may also be present in the carbon and are usually specified to have a maximum concentration of around 5 mg/kg to minimise leaching after installation. Because higher aluminium concentrations are found in many coals and because aluminium is usually less of a problem during commissioning, a maximum concentration of 25 mg/kg is usually specified for aluminium.

In some carbons, significant flotation of the carbon may occur in the wetting phase. This material is removed and disposed of. The floatable component of the GAC should be as low as possible (0 to 10%).

Fines are backwashed out, as for filter coal, over several initial backwashes.

4. Filter Media Selection and Design

Traditionally, filter design was based on the use of fine grained media to polish clarified water. Over recent decades the role of the filter and the design of the filter media have changed. By increasing the depth of the filter bed and the size of the filter media, greater storage space is provided within the filters and there is less flow resistance. Higher filtration rates can thus be employed leading to filters with a smaller cross sectional area (footprint). The higher potential for turbidity breakthrough of such filters may be controlled by using filter aids (polyacrylamides) to improve adsorption of the floc to the filter media. A second layer of finer sand beneath a coarser layer of filter coal (dual media filter) also assists by providing a polishing filter layer beneath the bulk floc filtering layer.

Finer media that achieves mostly surface straining is usually 0.6 to 1 mm ES, whereas larger media that allow greater bed penetration can be up to 2 mm in ES. Most deep bed coarse media filters are between 1.2 and 1.7 mm ES. The depth of media used is preferably 1000 times the effective size (or more), thus a 1.7 mm filter coal or sand filter will have an effective depth of approximately 1.7 m. With dual media filters the lower sand layer is also included in the calculation.

Support layers of sand and gravel usually start with a bottom layer of coarse gravel (eg 12 to 20 mm) and work up through layers of medium 6 - 12 mm and pea gravel 3-6 mm to a coarse sand (1.5 to 3 mm) and then possibly a medium sand layer (depending on the size ranges of the effective filter media layer(s) above). The size range of each layer of gravel and sand should overlap with the size range of the layers both above and below to maximise the stratification of the bed. The gravel and sand layers require a minimum depth of 100 mm but a depth of 150 mm or more is preferred to minimise disruption of the layers and for ease of installation. The size selection and depth of gravel depend on the filter underdrain design.

GAC selection depends on organic contamination types and concentrations. Typical design parameters are based on achieving an empty bed contact time (EBCT) of anywhere between 5 and 25 minutes. The EBCT is the contact time that the water being treated has within the actual activated carbon bed at design flow rate.

The preferred media selection depends on raw water characteristics, targeted water quality, and water treatment plant (WTP) design and can be evaluated by setting up pilot columns of media or through trials in existing plants or from experience with similar waters in similar WTPs.

The Author

Bruce Murray (bruce@citywater.com.au) owns and manages City Water Technology (www.citywater.com.au) a company of specialist water engineers, working in all aspects of water treatment and operating since 1990.

SUCCESSFUL FILTER REBUILDS - A PRACTICAL GUIDE

Michelle Colwell

Introduction

Murphy's Law seems to make its way into the business of Water Treatment, and every now and again, the time will come when inadequate operational procedures and/or structural or other design faults will adversely affect a filter's performance, to the point where it may need to have its underdrain system inspected and repaired, and its media replaced or topped up.

This article aims to describe the steps that need to be taken in order to ensure that a filter is rebuilt successfully, with minimal operational disruption, minimal stress, and optimal use of hired plant and labour resources.

The First Step

1. Filter Monitoring Program

The first step in the filter rebuilding process should have occurred many months before any actual works were undertaken. In an ideal world, the filter in question would have been thoroughly inspected as part of a routine filter monitoring program, and its state of health will have been assessed in relation to other filters within the organisation. The filter in question will have been selected for rebuilding based on a series of organisational priorities. These priorities will include, but not be limited to: the number of customers supplied by the water treatment plant, the age of the filter, the ease of completing a rebuild (e.g. can the unit be taken off line for an extended period of time, and can the site be readily accessed by heavy plant and equipment), the severity of the problem, and the risk and consequences of catastrophic failure. The timing of the rebuild will have been chosen carefully to ensure that security of water supply is not adversely affected (cooler months) and sufficient resources are available to complete the task (e.g. full staff complement on deck).

In the real world, sometimes filters fail unexpectedly. A filter failure could be detected as violent explosive regions or dead spots in the filter during air scour or backwashing. The filter may have blinded off for some reason (usually inadequate operating procedures), the media may have cracked away from the walls, or it may be experiencing constant turbidity breakthrough. This usually happens at the most inconvenient time (when demand for water is highest, staffing resources are lowest, and suppliers are difficult to reach (does Christmas/New Year ring a bell for anyone???)). Rebuilding a filter under these conditions is extremely stressful for everyone involved, disrupts normal operations and incurs considerable financial costs to the organisation.

The principles of filter rebuilds are the same under both sets of circumstances, but are much easier to manage when carefully planned as part of a preventative maintenance program, rather than as reactive maintenance due to an emergency situation.

2. Budget Provision

Filter rebuilds are expensive exercises, and budgets need to be carefully planned more than twelve months in advance to allow the works to proceed in a timely, safe and efficient manner. Ideally, the budget will have been prepared as a direct result of the findings of previous filter inspections as part of an ongoing filter monitoring program.

Preparing to Start

3. Media assessment, selection and ordering

Refer to as-constructed drawings of your filters as a starting point to determine your media requirements. If your filter has lost media over time, remedial action may be as simple as adding new media to top up what has been lost.

At treatment plants that have more than one filter, it is best to try and match the new media as closely as possible to the original media. This will minimise dramatic performance discrepancies between new and existing filters once the new filter comes back on line. However, if you discover that the original media specifications are not adequate to produce the desired filtration performance, this may be an excellent opportunity to reassess the filter media design in an attempt to get better performance out of the filter.

4. Selection of Appropriate Media Grades

Optimum filtration performance is achieved when all things are correctly designed, specified, acquired, installed and tuned. Filter media is no different. A lot of time and effort needs to go into determining the optimum depth, type and grading (particle size and material type) of filter media.

Text books and engineering conventions usually specify filter media size and range by stating an effective size (ES) and uniformity coefficient (UC). The ES is at the bottom end of the size range for that media. It is the size of the grain in millimetres, such that 10% by weight of all media in the sample are smaller than that size (d10). Finer media that achieves mostly surface straining is 0.6 to 1 mm ES, whereas larger media that allow greater bed penetration can be up to 2 mm in ES. The UC is the ratio (d60/d10) where d60 is the grain size where 60% of the media is finer than that size. The UC is a measure of how uniform in size a particular media is. A UC of 1 indicates a media of all one size. Most media is specified to have a UC of less than 1.5 and preferably less than 1.3.

However, the majority of suppliers quote materials in 'Mesh size' or size range. When viewing the typical analysis it is often difficult to convert Mesh size back to ES and UC. ES and UC can be determined from a sieve analysis of the media and plotting % passing versus mesh hole size. Mesh number is the number of holes per square inch in a sieve.

Our experience shows that when carrying out refurbishments of filters, what you require is not always what is readily available from suppliers. Older filters tend to be constructed of high quality materials with very tight tolerances, and neither the materials nor the tight tolerances are currently manufactured on a routine basis. For example, most of the older filters that we have refurbished have high quality crushed quartz as the support gravel. Crushed river stone is more commonly supplied today but crushed river stone is less consistent in material type and often has a lot of foreign material in it.

You may have to shop around, pay more for further processing or as an absolute last resort, modify the original design specification. Extreme caution must be exercised if you choose to modify the original design specification, as there are very specific design parameters to follow in determining gravel and sand layers and they depend on the design of the underdrains. Unorthodox gravel layers can lead to multiple problems within a filter, and all sorts of other problems can be created if the complete design is not carried out carefully.

For more technical information regarding the selection of appropriate media for your filters, refer to Kawamura (1991).

5. Media Quantities

Be sure to order at least 10% more of each grade of gravel or sand (or filter coal), and clearly state the units of calculation. As operators, we will usually state our requirements in m^3, but suppliers will quote in tonnes. Given that the different media grades have varying packing densities, you can be caught short if you do not carefully check your order against the supplier's quotation. Ordering extra sand is especially important, as the majority of this extra sand will be lost as fines when the filter is first backwashed and fines skimmed prior to bringing it into service.

6. Media Transport, Packaging and Lead Times

Most bulk media suppliers will provide filter media in 2t bulky bags. Experience shows that these bags are cumbersome to manoeuvre into tight spaces, are difficult to open (a knife must be used that quickly becomes blunt) and it is very difficult to control the rate of emptying the bag once it has been slashed open. Bag fragments also end up mixed in with the filter media, and this should be avoided where possible to maintain the integrity of the newly laid filter bed. A much more serviceable arrangement is to request the supplier to provide the media in 1t chute bottom bags. You will have twice as many empty bags to dispose of after the job is complete, but you will save yourself a lot of time and worry by using the smaller chute bottom bags.

Also take into consideration the ease of handling the bags when they arrive on your site. It is much easier to remove bags from an open topped semi trailer with a suitably sized forklift (which may need to be all terrain type) or crane than it is to try and extract bags from an enclosed roof taut liner trailer.

Media may need to be transported to your site from interstate, and delivered by drivers who are unfamiliar with the local area. It is far better to order the media to arrive at least 3 days prior to the commencement of the filter rebuild job, than it is to try and co-ordinate more than one activity involving heavy vehicles on site at any one time. Also take into consideration site access arrangements. Semi trailers can usually access most sites, but B-double trucks often cannot negotiate residential streets or narrow unsealed roads, and require large open areas to use as turning circles. Make sure that you clearly explain site access limitations to the company that will be transporting the media to avoid unnecessary hiccups or delays with respect to unloading.

Figure 1. Lowering bags of media into filter cell.

7. Laying out the Media

Where possible, when unloading the truck, organise the bags of media to be lined up in groups according to the media grade and the order that the bags will need to be placed into the filters. Spray paint the layer number (e.g No 1 for the most coarse gravel layer) onto the outside of the bags in fluoro paint. Doing this before the crane and dogman arrive, and explaining what the numbers are for to the crane driver and dogman will save you a whole lot of stress and worry on the day of relaying the media. Doing this also allows you to double check that the right bags are on the hook, before they are opened, when they are suspended over the filter cavity.

Dismantling The Filter

8. Confined Space Entry - Permits, Risk Assessments and Emergency Plans

In most cases, filters will be classified as confined spaces. It is therefore vital that appropriate Confined Space Entry Procedures be followed, and all associated protective and safety equipment is available for use. Prior to entering the filter, a thorough risk assessment of all the tasks that will be undertaken as part of the job must be carried out and documented, and appropriate steps taken to avoid or minimise any hazards associated with working in the confined space. An emergency plan should also be completed. The content of these documents must be made known and thoroughly understood by all members of the workgroup. A work permit must also be used to ensure that all necessary physical, mechanical and electrical isolations have been satisfactorily completed.

9. Removing the Existing Filter Media

To reduce manual handling injuries, and to speed up the rate of dismantling the old filter, the use of a **well maintained** suction truck is recommended. It is important to request that the suction hoses are cleaned and disinfected prior to your job to avoid contamination of your filters from residual sewage. It is also important to ensure that all the equipment in use is in good repair. Sand and gravel are very heavy and abrasive. Poorly maintained equipment will quickly block or have holes worn in it that will reduce suction efficiency. Using substandard equipment could add an entire day to your refurbishment job, and cost you more money than you budgeted for.

Remember too that most contractors start charging you from the moment that they leave their depot, and stop once they return. To minimise the payment of penalty rates, it may work out to be cheaper to hire the truck for two days even though you estimate that the job will take only one. It is much easier to cancel equipment that you finish using early than it is to try and extend the use of equipment that is usually heavily booked in advance.

10. Disposal of Existing Filter Media

Transporting the waste contents of the suction truck to an appropriate disposal site, dumping the media, then returning the truck to the work site is extremely time consuming, and is effectively "dead time" with respect to removing the media from the filters. Do your cost / benefit calculations (time versus money). It may work out quicker and cheaper to hire a large waste skip and front end loader / mini excavator and dispose of the skip contents later than to incur the travel down time associated with transporting the waste to an off site dumping point. Also make sure that you have enough people on site to complete the suction exercise without having to stop the truck. To minimise fatigue, rotate the staff controlling the suction hose frequently, and ensure labourers have frequent staggered refreshment breaks to keep their energy and fluid levels up.

11. Recycling Media

In my experience, recycling media by segregating it for later return to the filters is more hassle than it is worth, and it brings with it the uncertainty of whether the returned media is contaminated, because the suction action may have removed non-uniform layers of media. If you wish to recycle media rather than dump it in landfill, approach local garden suppliers and/or schools and kindergartens. Garden suppliers tend to like the larger gravels, and schools and kinders may want to top up their sandpits. However, if you decide to do this, you must bear in mind that kinders and schools are unlikely to allow the truck on site during school hours, and this will impact upon how the dumping is organised. It is also important to ensure that the media is clean and possibly disinfected prior to removal from the filters for this application.

12. Exposing Air Scour and/or Backwash Laterals

Vacuuming will become difficult once you get down to the level of any air scour or backwash pipe work. To avoid damaging structures, you may need to use large pieces of plywood to evenly distribute your weight. Sometimes it may be necessary to sacrifice a few laterals by removing them (by whatever means possible) to allow a large enough space for the vacuum hose end to work in. Make sure that you have sufficient spare pipe lengths and pipe fittings on site to repair any breakages. The underdrains are also a crucial part of the filter and must be restored exactly as per the design (level and with appropriate sized holes or nozzles at precise spacings). The sooner you make the repairs, the longer the time that any glue will have to cure before the filter is refilled.

13. Removing all Traces of Sand

It is essential that all sand is removed from the filter cell, so pay particular attention to removing all traces of the sand.

Figure 2. Emptying sand out of suction truck.

You will need to feel around with your bare hands to see if there is any leftover grit lying on the bottom of the filter. Use a hose to flush the grit to an area where the vacuum can pick it up.

14. Repairing Air Scour Laterals

It is vital to ensure that there is no sand trapped inside the air scour laterals. Many filter failures can be attributed to this. Unblocking air scour laterals and flushing them clean is a tedious and boring task, but it must be done properly to ensure that the filter functions correctly once placed back on line. Once again, refer to drawings where possible, and ensure that sufficient spare pipe fittings (barrel unions, O-rings, joiners, glue, correct diameter pipe, end caps etc) are available to ensure that completing these repairs exactly to the design does not impede the progress of the filter rebuild.

15. Repairing Internal Structures

When the filter is bare, it is often a good opportunity to complete maintenance on underwater fittings / seals that have not been attended to since installation. Loose Chemset bolts can be replaced, nuts and bolts can be tightened, and any welding repairs can be done. Use a Hot Work Permit if welding or grinding is required, and ensure that any plastic fittings are shielded from sparks.

16. Checking the Air Scour Pattern

After replacing the air scour laterals, and BEFORE any new media is added to the filter, it is important to check that the air scour pattern is even. It is much easier to facilitate remedial action at this stage, rather then when the filter has been rebuilt. To check the air scour pattern, fill the empty filter cell with water to a level approximately 150mm above the level of the air scour laterals. Run the air blower,

Figure 3. Exposed air scour laterals.

and observe the pattern. The air should be evenly distributed throughout the cell, and should appear in all sections of the filter at roughly the same time. There should not be any "wave action" associated with the air scour.

Backwashing should also be checked for satisfactory performance prior to the installation of media.

Rebuilding The Filter

17. Relaying the Gravel in the Filter Bed

Careful relaying of the filter bed will ensure a successful rebuild. Careless relaying of the bed by not paying attention to the small details will result in a dodgy job and you will have wasted lots of time, energy and money. Before adding any new media, use a level and paint to mark the walls with each of the media layers. Make your lines about 25mm thick if possible. Experience shows that making the top of the line the top of the media will make it easier to get the media layers level (within 15mm).

It is very important that the media is laid uniformly, with no areas of increased compression. After levelling the coarsest gravel layer, (a concreting screed is a useful tool, but ensure that the screed length does not interfere with internal fixtures in the filter cell), use plywood boards to stand on to evenly distribute your body weight. This will prevent footprints in subsequent finer gravel layers. Walking directly on the gravel will create areas of localised disturbance where gravel layers may accidentally become mixed and these spots will also be more compressed than other areas of the filter. This may cause problems with the even distribution of air and / or water once the filter comes back on line, so it is better to take the extra time and care to lay the filter bed properly.

To avoid disturbing the surface of the media when adding subsequent media layers, lay a light piece of plywood onto the media surface and gently open the chute of the media bag to allow a slow controlled release of a small amount of media. When a small pile has formed, gently remove the sheet of plywood, and use the pile to cushion the impact of subsequent additions of media. You will need hearing protection when adding the gravel layers, and you should wear respiratory protection at all times when adding media to avoid inhaling silica dust.

Laying the gravel correctly is the most important part of relaying the filter bed, and this must be done with extreme care and attention to detail. This will take quite some time, and labourers will be reluctant to comply with the level of detail and care required, but persevere and be prepared to cop a bit of ribbing for being so pedantic. It will pay off in the long run.

Figure 4. Relaying the first gravel layer.

18. Relaying the Sand in the Filter Bed

Commence laying the sand as you would the gravel, but once a significant pile has developed, you may abandon the plywood boards and stand directly on the sand. It is OK to stand on a reasonable depth of sand because the sand layer will fluidise during backwashing and will evenly redistribute itself in the filter. The sand layer need not be screeded. Rough levelling is all that is required.

19. Soaking, Disinfecting and Air Scouring the Media

After all the careful work relaying the filter bed, the last thing you want to do is disrupt the bed. Therefore, take extreme care when introducing water back into the filter cell. Slowly and carefully introduce the water into the filter via the backwash laterals. Where possible, throttle the backwash pump so that it is operating as slowly as possible. Allow the water to slowly percolate to the upper surface of the media and continue to fill the filter to the level that it usually drains down to prior to backwashing.

As the filter fills, add sodium hypochlorite solution to disinfect the filter. The sand will initially exhibit a high chlorine demand, so adding roughly half to one 25L carboy of hypo will service most filter sizes. A chlorine residual of 1 mg/L is usually targeted and an initial chlorine dose of 5 to 10 mg/l is usually required to achieve this.

To thoroughly mix in the hypo, carefully air scour the filter. As with the introduction of water, the initial introduction of the air must be as gentle as possible. Throttle the air blower and run the air into the filter as softly as possible. Once the air scour pattern has stabilised, the air scour rate can

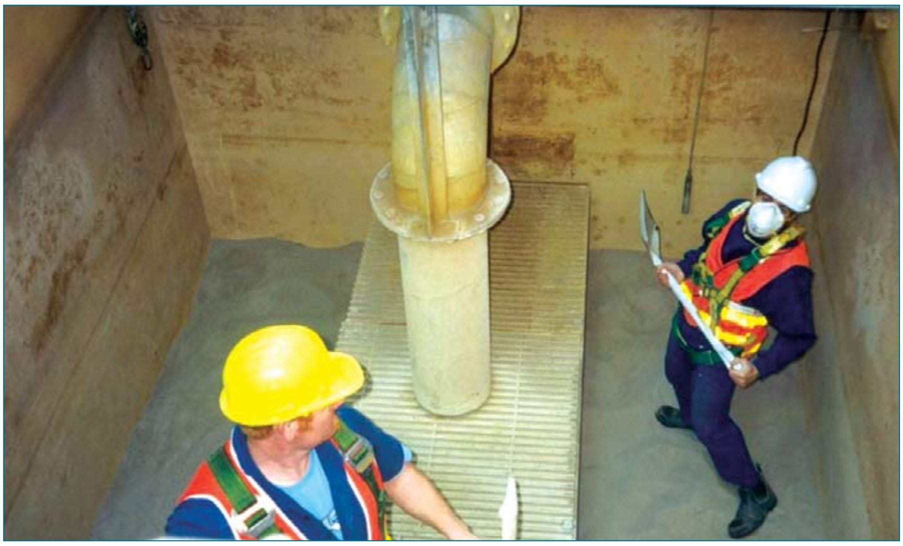


Figure 5. Roughly levelling sand layer.

slowly be increased to normal operational levels, then turn off the air and leave the filter to soak overnight if possible.

20. Backwashing Away the Sand Fines

After allowing the filter to soak, repeat the air scour routine mentioned above. At the end of the air scour period, gently introduce backwash water to the filter. As the backwash progresses, you may slowly increase the backwash rate to normal operational levels. Backwash the filter for as long a time a possible to remove as many sand fines as possible. This may require you to drain down your wastewater storage prior to the commencement of the backwash.

21. Scraping Away any Remaining Sand Fines

When the backwash is complete, allow the filter to drain down. Taking into consideration any Confined Space Entry requirements, if safe to do so, enter the filter and scrape off the top fines layer, usually 15-25mm of sand.

22. Adding Filter Coal

Adding filter coal is messy if the coal is not well washed. Fine black dust will coat everything that it settles on. Make sure that you are wearing respiratory protection when adding the coal, and wear dark coloured protective clothing or disposable overalls (any light coloured clothing will get wrecked). As with the sand layer, only rough levelling is required as the anthracite will self level during backwashing. Once the anthracite has been added, refill the filter using the backwash system to the level where the water usually drains down to when backwashing. Let the anthracite soak for a few hours.

23. Backwash the Filter Again

Backwash the filter again for as long as possible to remove any anthracite fines. Once again, this may require you to drain down your wastewater storage prior to the commencement of the backwash. Surface scraping of fines may also be required.

Recommissioning the Filter

24. Putting the Filter Back Into Service

Despite the extended backwashing that the filter has already undergone, it is unlikely to produce top quality water right away as it needs to be “seeded” with floc to “ripen”. Where possible, filter to waste until the filter outlet turbidity returns to acceptable operational levels.

25. Continue to Actively Monitor the Filter’s Health

To ensure that the filter does not need any major maintenance for many years, make sure that the backwash is regularly observed and make notes of any changes to the backwash or air scour pattern. Make adjustments to the air scour rate and / or time, and the backwash rate and / or time as necessary to ensure that the filter is kept clean. Keep accurate records of the chemical dosing regime, clean bed headloss (headloss at the start of a run after backwashing) and headloss accumulation rate and regularly inspect the filter to check for mudball formation and any other signs of poor health. Adjust the filter run time if necessary. Do everything in your power to protect the integrity of the filter bed and prevent any harm coming to the filter bed. Even though the filter can now be classified as “new” make sure it is included in a regular and rigorous filter inspection and monitoring program. This will ensure that it provides reliable service for many years to come.

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BRAIN TEASER - WATER

1. A streaming current detector is used to measure:

a. How fast water flows

b. The size and number of particles in water

c. The neutralisation of charge in water after the addition of coagulant

d. The ionic strength of the water to determine the TDS

2. Which of the following tests is used to determine the total bacterial population in water?

a. Total coliforms

b. Heterotrophic plate count

c. Presence absence test

d. Zeta potential

3. True colour in water is due to:

a. Suspended matter such as iron and manganese precipitates

b. Natural organic matter

c. DOC

4. The nephelometric method is used to measure:

a. Suspended solids

b. Lead and copper

c. Alkalinity

d. Turbidity.

5. The target for filter performance is a turbidity of:

a. <0.3 NTU

b. <0.1 NTU

c. < 1.0 NTU

d. <0.5 NTU

6. Particle counters in the water industry commonly measure particles in water in the size range:

a. 0 to 5 micron

b. 10 to 15 micron

c. 2 to 15 micron

d. 15 to 20 micron

7. UV absorbance at 254nm is commonly used as a simple measure for:

a. NOM

b. DOC

c. SUVA

d. NTU

8. Which of the following is not a factor in determining the Langelier Saturation Index?

a. pH

b. $CaCo_3$

c. Temperature

d. Salinity.

9. A common disinfectant is

a. Hydrochloric acid

b. Fluoride

c. Sodium Hydroxide

d. Sodium Hypochlorite.

10. A chemical storage tank holds 25000L when full. Its level at 9am on Monday is 63%. By 9am Friday, its level has fallen to 47%. Assuming that the rate of chemical consumption remains the same, what is the earliest day of the following week that you could request a delivery of 15000L?

a. Monday

b. Tuesday

c. Wednesday

d. Friday

Cynthia's WIOA Wrap

The Water Industry Operators Association (WIOA) held the Annual General Meeting and Victorian weekend seminar at Ballarat in March. Around 40 operators and tradies attended to share ideas, network and visit Central Highland Water's Ballarat South Wastewater Treatment Plant.

One of WIOA's newest corporate supporters, CDS Technologies has just completed further trials under the Victorian State Government's Smart Water grants program, demonstrating their ability to mine sewage and produce Class A re-use effluent in a timely and cost-competitive manner - 0.5ML/D maximum in under 8 minutes @ under $60/KL.

A group of keen Tasmanian operators arranged a meeting recently with WIOA to discuss the options available for them to provide services to operators in their State. Later this month, WIOA will also be meeting with a number of interested people in Brisbane to discuss ways to best service operators in Queensland as well. We'll keep you updated on the outcomes of these important initiatives in future editions of *WaterWorks*.

The prolonged drought in the Wimmera Mallee has seen Grampians Water select ITT Flygt to supply in a short time frame, two RO plants to augment water supplies in Hopetoun and Rainbow. Commissioning will commence in June. Any enquiries call Eddy Ostarcevic at Grampians Water.

WIOA has recently introduced an award which recognises the outstanding services of individuals to the Association. The first members to be inducted as Delegates of the Inextricably Obstructed Tap Society (I.D.I.O.T.S) are Ron Bergmeier, Richard Greenhough, Tony Hourigan, Barry Waddell and George Wall. Congratulations to you all.

Operators on the Move

- Mt Hotham Resort Management Boards Dick Shaw has left to pursue a new lifestyle in Paynesville. He will still be active in WIOA activities and is looking for a job - if anyone can help please contact WIOA.
- Noel Stewart has left Danfoss and joined Honeywell.
- Glenn McKinnis of Grampians Water and David Blanch of Melbourne Water retired earlier this year. We wish Glenn and David all the best in their new endeavours.
- Glenelg Water staff have moved back into their newly renovated offices in the main road of Hamilton.
- Nick Bray has left WSL Consultants after 10 years and has joined Goulburn Valley Water as Works Co-ordinator, Water Treatment based in Seymour.
- Sean McKinney joins CDS Technologies from Ondeo Nalco Australia as part of the Southern Region sales team. After 16 years in the air-conditioning industry, Sean's move is a gutsy one, but consistent with his interest in environmental issues relating to water.
- Mary-Jane Crosbie previously of Selby Biolab and Amcor has started her own company, Leatherback Environment, specialising in ISO14001 Environmental Management Systems - contact her at maryjane@leatherback.com.au.

Coming Operator Focused Events

July 26 - 30, Queensland Operators conference at Hervey Bay

September 1 & 2, WIOA 67th Annual conference in Wodonga

September 21 & 22, NSW Operators conference at Penrith Panthers

Contributions to this column can be emailed to Cynthia Lim at Cynthia.Lim@fluids.ittind.com or call her on 0409 403 237.

Water Quality and Distribution Systems Seminar

Anthony Evans, Seminar Chairperson

The WIOA recently staged a seminar aimed specifically at distribution system operators dealing with issues relating to the operation or maintenance of the water reticulation network. The seminar was convened in response to demand from WIOA Members, as well as by a need identified through discussions with various water system managers. The event was held in Rockbank, not far from Melbourne, and was attended by 140 operators. We extend our thanks to Western Water for helping with the organisation of the day.

After extensive consultation, a program that was relevant and targeted specifically at the distribution system operators was arranged. The presenters were chosen carefully to ensure that we had skilled and knowledgeable people sharing their experiences with us. The presentations were pitched at a hands-on level and importantly, the intent of this seminar was to provide some ideas about what can be done and the when, where and how of doing it. The speakers included:

- **Peter Mosse** - (Gippsland Water) talked about the new environment for drinking water quality management, ADWG, HACCP and how to monitor systems to improve water quality and therefore service delivery to the customers. He also spoke about solving problems using dirty water and odour complaint case studies as examples.
- **Jill Busch** - (Gippsland Water) spoke about the importance of disinfection for the effective control of pathogens along with some specific practical examples.
- **Neil Healey** - (Goulburn Valley Water) talked about managing work teams where there is a cross over of duties between water and wastewater functions.
- **John Hearn** - (South West Water) spoke about the role of the operator in keeping the distribution system running well and showed us a very important tool - a white bucket to check water colour.
- **Anthony Ohlsen** - (Central Highlands Water) spoke about an odour case study and emphasised how subjective this issue can be. He also gave us an opportunity to experience some 'watery smells' first hand.
- **Malcolm Hill** & **Andrew Forster-Knight** - (South East Water) spoke about flushing mains and showed us a predictive model they are working on to allow flushing to be better targeted for optimum results.
- **Greg Creek** - (EPA Victoria) gave us some info on what we should or shouldn't do with the water flushed out after cleaning and distribution system repairs.
- Last but not least **Melinda Bawden** - (WSL Consultants) spoke about sampling and gave us important information on the do's and don'ts of sampling.

Overall the day was a resounding success and the interactive workshop session at the end of the day provided us with a few ideas to investigate and possibly include in future seminars. The overall view was that we should run this event again to cater for those operators not able to attend this time. There is also a possibility of staging a similar event in other States so if you are interested, contact the WIOA Secretary Mr George Wall at seminar@wioa.org.au and he'll get in touch with you.

Anthony Evans (aeva@swwa.com.au) is an operator employed by South West Water in Warrnambool.

Watery Tales

Kristine Hunter

Ken Turner's brilliant article about Bleaching Customers in December 2002 *WaterWorks* (been there done that - could really relate!) has prompted me to pass on some "tales" of my own that may be of interest to operators.

Anyway, I've been at East Gippsland Water for 3 years now as their Water Quality Officer. When I started the monitoring program was fairly basic but met regulatory requirements. Since then I have expanded the monitoring program much to the dismay of the operators here who claim I have tripled their workload!

Part of my job was to ensure that staff had adequate training and understanding of the how, why and when of taking water samples. Some of the classics I have encountered have been part of the training sessions. Writing a Standard Operating Procedure/Works Instruction for taking a water sample, I included the instruction on flaming taps only to have to rewrite it after an irate phone call to include "flame taps after removing plastic tap fittings"(!)

Sampling during total fire ban days also presented a problem from the tap flaming point of view! I went to the local CFA and explained what we did but they still insisted that we would need a permit and a tanker of water on standby! Fuming at bureaucratic stubbornness and the lack of common sense exhibited by Government Authorities, I went out sampling with staff not long afterwards and watched while someone actually set fire to a tap! Needless to say we don't sample on total fire ban days anymore! I was also forced to rethink the flaming issue at Dinner Plain where it was kindly pointed out to me (in words of two syllables or less) that there were no garden taps in the Village and flaming a fire hydrant (our sample sites) would not be easy! Sample sites also had to be relocated as flaming the tap next to the petrol bowser at the local servo was out! When it came to trying to explain how to take a 'clean' sample (ie. you and any appendage do not become part of the sample) I was impressed by the lateral thinking of placing a handkerchief (clean of course!) over the tap to filter out any impurities and thus get a 'clean' sample.

In 2001 I conducted an audit of all of our sampling sites by sending out a spreadsheet to the operators and asking them to check the site against some criteria: easily accessible by staff, no fence, no dog, on the same side of the road as the mains, occupied site (ie. water usage) etc etc. I received the checklist back from Omeo with ticks and crosses next to sites. When I went up there to do some sampling I was surprised at one of the sites that met all criteria, especially, as the operator pointed out, the 'occupied site' criteria - we were sampling at the local cemetery! The Works Supervisor pointed out that we had never had any complaints from the occupants regarding access or water quality!

In terms of customer queries regarding water quality I have had some doozies!! One gentlemen kept me on the phone for nearly an hour whilst he expounded on politician's superannuation perks, the lack of support for normal pensioners, how hard it was to get mail order brides these days (!?!), the usual gripes and grumbles about politicians and snouts in troughs etc etc only to finally get around to his water quality query - why were we spending $30 million on increasing the flow down the Snowy River when it only runs out to sea!! Another was how do lead levels affect ornamental carp - apparently the dam at the bottom of the garden held prized carp but also ducks and husband and son were fond of duck shooting but the missus was worried about the lead shot in the water!

Various complaints about substances we add to consumer's water that has caused problems - fluoride stains school trousers as one irate customer was informed by the local chemist, only to find out that we do not fluoridate any of our water supplies in which case the problem was still ours because her kids were costing her a fortune at the dentist! Requests for water to be tested for 'stuff'. I'm sure everyone would have similar tales! One of the best I've had was when I was with the State Water Laboratory (going back a while now!!) and I had a query as to what water quality was suitable for consumption by emus (budding emu farmer!). This was beyond my area of expertise so I directed him to the Healesville Sanctuary (Australian Native Wildlife Park). When I got home that night my husband, a zookeeper at Healesville Sanctuary, couldn't wait to tell me about some nutter that called in wanting to know about water quality for emu consumption! I just nodded and smiled - about all you can do under most circumstances!

The Author

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ANSWERS TO WATER TREATMENT BRAIN TEASER (from December 2002 *WaterWorks*)

Q1. Optimum Alum dose rate (ppm/v) = 3.5mLs of 1% jar test solution X 10 = 35 ppm/v

Q2. Current Alum dose rate (ppm/v) $= \frac{\text{mLs/min}}{\text{L/sec}} \times 16.67 = \frac{20}{11} \times 16.67 = 30.3$ ppm/v

Q3. Alum feed rate (mLs/min) $= \frac{\text{ppm/v}}{16.67} \times \text{Plant flow rate (L/s)} = \frac{35 \times 11}{16.67} = 23$ mLs/min

Q4. The optimum Alum dose rate would remain the same as in question one regardless of the flow.

Q5. Alum feed rate (mLs/min) $= \frac{\text{ppm/v}}{16.67} \times \text{Plant flow rate (L/s)} = \frac{35 \times 22}{16.67} = 46$ mLs/min

Q6. Possible options could be the use of polymers or alternative coagulants. If sufficient treated water capacity shut down the plant until raw water quality improves. Use alternative raw water supply if available.

As you can see above there are many alternative solutions, and they will vary from plant to plant. It also highlights the importance of having strategies in place to respond to changing conditions.

This will include maintaining records of how these events were handled in the past eg. Dose rates, changes in plant set up, raw water supply quality etc.