WATER WORKS

OFFICIAL JOURNAL OF THE WATER INDUSTRY OPERATORS ASSOCIATION

DECEMBER 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: Field O&M operators Stewie Larsen and Matt Conn prepare to replace a section of failed asbestos cement main with a PVC insert.

President's Message

Welcome to our second edition of *WaterWorks* for 2004 and the last chance for me to write something as President of WIOA - my term finishes at our AGM in April 2005. I have to say I have thoroughly enjoyed the challenges of the position and it has been great to meet so many committed water industry people both here and overseas.

In reflecting on 2004, it is true to say we have achieved a great deal but there is a huge opportunity for our Association to increase its membership numbers and relevance to the industry over the next few years. Our vision of developing a truly National association continues to gain momentum in all States and early in the New Year we hope to be able to announce an important initiative which we are sure will assist this process.

The conferences in each State have been staged and all have been hailed successful in providing information and opportunities to increase the level of knowledge and skills of operational staff. The trade companies have strongly supported these conferences as sponsors and exhibitors and many people in each State have made a huge commitment, mostly on a voluntary basis, to organise and run the events. Our congratulations and a vote of appreciation by all in the industry should be extended to everyone involved.

In reflecting on 2004, it is true to say we have achieved a great deal but there is a huge opportunity for our Association to increase its membership numbers and relevance to the industry over the next few years

At the Victorian conference in September, Life Membership of WIOA was awarded to our hard working Secretary George Wall. This distinction was awarded in recognition of George's outstanding service on the WIOA Committee and to the Water Industry since 1989. I know George was a little embarrassed by it all but it was very well received by all 420 delegates at the dinner.

During October we signed an MOU with our counterparts from New Zealand and we see this as a major step forward in building a strong cross Tasman relationship. We are now working on initiatives designed to promote the exchange of ideas, sharing of information such as newsletters and websites, sharing of operational experience by sending delegates to each others conferences and opportunities for personal development through operator exchange programs.

The further development of the water industry training package is of paramount importance to the industry and all operators. The finalisation of the new Industry Skills Council is taking longer than expected and is becoming a little bit frustrating to say the least. We have been given a guarantee that the Water Industry Training Package update will be one of the first projects undertaken once the Skills Council positions are filled. This looks like being around early April 2005.

I want to issue a challenge in two parts to everyone who has had the opportunity to read this journal. Firstly, have you enjoyed the articles and is there something that you could contribute to future editions? If there is then contact anyone from the editorial team. They would be glad to help if required. Secondly, are you a Member of WIOA? If no, why not? If you are a manager of operations staff are they Members? Again, if no, why not? The annual fee is only $15 for individuals and the value is exceptional. Belonging to an Association such as ours should be viewed as a very inexpensive way to keep operations staff at the forefront of industry developments. If you would like to join or want more info visit our website - www.wioa.org.au and you can download a membership application form from there.

Finally, the WIOA Committee wish you and your family a very Merry Christmas and a Happy, safe and prosperous New Year.

Until next time, "Happy Operating"

John Harris, WIOA President
December 2004

SOLAR SLUDGE DRYING

Ross Shannon, S. Nathan, V. Luboschik

Awarded the 2004 "Sustainable Water Award, Operator of the Year" at the WITA Water Industry Workshop held at Hervey Bay, Qld.

Introduction

The Caboolture Shire is located approximately thirty minutes north of Brisbane and is currently one of the fastest growing areas in South East Queensland. *Cabwater* is the business unit of Caboolture Shire Council and is responsible for the operation and maintenance of water and sewerage units. *Cabwater* generates approximately 14,000 tonnes of wet biosolids from four sewerage treatment plants (STPs). At present Water Authorities in South East Queensland spend approximately $40 to $50 per wet tonne for removal and disposal of biosolids and this is expected to increase significantly in the future. In general, handling of biosolids represents the highest expenditure component of the total operational budget of STPs and in *Cabwater* it is approximately 18%; around $550,000 per annum. However, major savings could be achieved by increasing the solid contents of the biosolids.

In 2000, Mixwell Pty. Ltd. submitted a proposal to install a "SolarMix" facility where the solid contents as well as the stabilisation of the biosolids would be enhanced using solar energy. Though it was the first of its kind in Australia, the technology was being used successfully in Germany and other European countries. Following detailed investigations which included field trials and visits to a few plants in Europe, it was strongly believed that the technology could deliver positive results in Queensland where the climatic conditions are far better for such a process than in Europe.

Objectives

The primary objectives of the project were to assess the solar drying mechanism with respect to:

- Rate of mass reduction of biosolids produced at the four STPs under Queensland climatic conditions.
- Rate of reduction in pathogens (stabilisation).
- Operational problems like odour.
- Economic feasibility of this process under prevailing conditions in Queensland.

Figure 1. Inside the drying hall showing the sludge-handling rake.

The Process

The solar sludge dryer consists of the following elements (see Figures 1 and 2):

- A sludge handling rake that progressively turns and moves the sludge along the floor.
- A greenhouse style drying hall that keeps the rain off the sludge and allows the free exchange of air between outside and inside the hall.
- Solar radiation that heats the sludge and therefore promotes evaporation of water.
- The air that absorbs as much water as is practical and transports it out of the drying hall.

How the system works

At Burpengary East STP (B.E.S.T.P) sludge is transported from the belt press and mechanically loaded (skid steer loader) into the drying hall. This sludge is spread evenly across the floor, which is simple asphalt road between two parallel concrete walls, 10.5 metres apart. The sludge can be loaded at any depth up to 45cm. This height is set because of the physical ability of the turning rake and is one of the limiting factors for the loading rate of sludge. The turning rake is suspended between the walls and can travel the full length of the drying hall, giving an effective working length of 90 metres. The rake is a turning barrel fitted with segmented, comb-like teeth. As the rake travels the length of the building the drum rotates, turning the sludge over and moving it a distance of about 40 cm with every pass. As the sludge progresses through the drying hall, the dry solids content increases as the water content decreases. The turning cycle is higher in summer (up to 10 times per day) than in winter when we move it only to get additional area for the newly pressed sludge. Due to this frequent turning, the sludge is transformed into granules, typically 1-20 mm in diameter. The dryer is loaded with the compacted sludge from one end and the dried granulate is emptied at the opposite end.

Operator Input

B.E.S.T.P plant staff became involved in the project in mid 2002 with the commencement of early drying tests. Two $1m^2$ wooden boxes were constructed and placed in a plastic structure open at both ends. The boxes were filled with B.E.S.T.P sludge, from the belt press, to a depth of 200mm. The sludge was then turned manually using a shovel, three times a day. Progressive dry solids tests were conducted. This trial lasted for six months, and

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revealed a potential drying rate of 5-10 kg/m^2/day.

Plant operators had two major concerns at the commencement of the project.

1. 'Will this process affect our health?'

We soon discovered that excessive agitation of the sludge; at less than 20% Dry Solids turns it pasty and soon putrefies. We learned to limit turning cycles to no more than eight per day and even less during wet weather to avoid the problem. Not long after commissioning we checked the entire drying hall with a standard "Eagle" Gas-Tech and found oxygen at 20.9, hydrogen sulphide at zero and L.E.L for methane at zero. When the sludge is allowed to compost, for any length of time, the smell of ammonia is present but since the hall promotes ventilation this soon dissipates and is not noticeable outside the hall.

2. 'How will we handle the extra workload?'

In the early days of operation, life was hectic with learning operating techniques, making mistakes, correcting mistakes, testing and familiarising ourselves with the various turning cycles. At this time, a year later, we have settled into a regular loading and turning routine. The auto turning cycles can be programmed for up to a week ahead, and the only other work is transporting the sludge from the belt press

Figure 2. The drying hall.

to the drying hall. Routine dry solids tests are conducted once per week and take one man approximately two hours.

Construction

Building work began in January 2003 and was completed by June 2003. At a preliminary meeting the plant operator requested that the construction area be fenced off and signed as a separate work zone from the rest of the plant. We also asked for specific lunch and toilet facilities, for workers within their zone. This undertaking saved us from the tedious tasks of health and safety inductions for workers, delivery drivers and sub-contractors. We found that this system worked extremely well.

Commissioning

Two technicians arrived from Germany at the end of June 2003 to complete the set up and programming of the drying rake. Our introduction consisted of half a day of intensive instructions and demonstrations, and then we were on our own. Fortunately, the operational procedures are relatively simple and we soon mastered them. The control panel is set up with a modem that has direct access to Germany and any problems that we could not solve only required an overseas phone call to have them righted. We found this support to be invaluable.

Table 1. Relationship between dry solids and water content.

% of Solids	Dry Solids	Water	Total Weight Lost in Kg	Amount of Water in Total Weight	% of Reduction
15	150	850	1000	0	100
16	150	788	938	63	6
18	150	683	833	167	17
20	150	600	750	250	25
22	150	532	682	318	32
24	150	475	625	375	38
26	150	427	577	423	42
28	150	386	536	464	46
30	150	350	500	500	50

Operation

In Germany they load the wet sludge in and the dry product out with mechanised loaders. This requires the operators to enter the drying hall on a regular basis. At B.E.S.T.P, Cabwater has incorporated an automatic conveyor system to remove the end product and load it into a waiting truck or hopper. This system has had some problems with its ability to handle sludge that is dried to less than 35% dry solids. At percentages above 35%, the material becomes more granular and friable in texture and flows more readily. Cabwater engineers are investigating the possibility of upsizing the present equipment. The advantage of this loading technique is, of course, reduced labour input into the process.

Our first mistake was to try and load the drying hall to full capacity. This required many turnings and the sludge became pasty and then phew! - What a stink! That was abandoned and trucked out. We then learned to load slowly in small doses and gradually increase load rates until best performance was achieved.

We now know that sludge below 15% dry solids content is difficult to treat and even at 15% can only be turned 8 times a day to avoid pastiness. In Germany they recommend treating sludge with a dry solid content of a minimum 20%. This would make our jobs easy. There are future plans to install a centrifuge at B.E.S.T.P in order to obtain a drier sludge cake. In the meanwhile we must pay close attention to our belt press operations, in order to maintain 15% dry solids or better. This is an area where all plant operators can make significant savings in transport costs.

Measurement

Drying rates are calculated and measured in kg/m^2/day. Note that 1 kg/m^2 represents an area of 1 m^2 covered in water to a depth of 1 mm. Drying rates vary with the weather and interestingly rates have measured between zero and a whopping great 30 kg/m^2/day. Our year round average rests around 8 kg/m^2/day.

In Germany and mid Europe they achieve drying rates of 2-3 kg/m^2/day. Obviously Australia is a drier continent and our evaporation rates are approximately threefold that of Europe.

Analysis of Sludge Weight

On average the sludge produced at *Cabwater* has 15% solids. This means there will be 850 kg of water and 150 kg of dry solids in one metric ton of wet sludge. If through drying, the percent solids can be increased to 26% there will be 150 kg of dry solids and only 427 kg of water.

Table 1 shows that:

- The amount of water will be halved when solid content is increased from 15% to 26%.
- The total weight of the sludge will be halved when the solid content is increased from 15% to 30%. This means expenditure on disposal will be approximately halved.

Results

After performing many tests on various sludges from *Cabwater* it appears that our facility has a, more or less, fixed drying capacity no matter how fast or slowly sludge is fed through it. This figure of 7.5 kg/m^2/day means that, over the floor area of approximately 1,000 sq m, we evaporate 7.5 tonnes of water every day. This represent a transport saving of $130,000 per annum. Bureau of Meteorology records show that South-East Queensland has a natural evaporation rate of 1600mm of water per annum. This is equivalent to 4.4 kg/m^2/day. I would therefore award our facility an efficiency rating of 7.5/4.4, which is 1.7, compared with a natural rating of 1. Surely the challenge for the future is to increase that factor. How can we do this?

The first step involves Meteorology and building design. By installing mechanical ventilation it would be possible to move more water out more efficiently. *Cabwater* is soon to investigate the installation of additional fans at B.E.S.T.P solar sludge drying facility.

The second step for enhanced evaporation is in the area of Microbiology and heat exchange. As the sludge progresses through the hall a composting effect takes place. Temperatures up to 65 degrees C

have been measured in the compost zones. Surely the sludge could be dried in a fashion to deliberately encourage composting and then a heat-exchange system used to increase evaporation of water.

Frequently Asked Questions

What size plant does the Solar-Dryer suit?

The solar dryer is designed for middle sized STP's. Existing dryers are installed in plants between 500 and 75000 ep. The annual mass of solids treated varies in these plants between 500 and 3600 t/year.

What kind of sludges can be treated?

The system requires a compact sludge with a dry residue of no more than 20%. This can be achieved with simple band-filter presses. The sludge should not be mixed with burnt lime; otherwise there will be problems with ammonia fumes (NH_3 at a pH value of 12).

What about bad smells?

The initial smell of the plant sludge has to be accepted. As the biosolids are turned and aerated, the smell disappears rapidly and the active aerobic bacteria change the smell into one similar to compost. As long as the sludge has a dry residue of better than 20% and does not form a paste, no additional bad smells are formed during the drying process. This is true also for the storage over several months e.g. during wintertime.

How long does the drying take?

The specific evaporation per m^2 of ground area is constant and varies only with the weather conditions. Therefore the drying time required is a function of the thickness of the layer and the climatic conditions. In summer, the time to dry a 10cm thick layer of sludge to reach a dry residue of 90% may take less than one week, but during winter only partial drying is achieved.

How dry does the end product become?

The final percentage of dried residue achieved is only a matter of time. Even in winter a highly dried product can be achieved, however the specific water output per ground area is much smaller in winter than in summer. The speed of evaporation slows down when the dried residue reaches 70%.

How much area is required?

In Germany the area necessary for drying, loading and unloading is about 1.5 m^2 per ton of sludge. This can be modified according to the initial humidity of the cake, the desired final dry solids and the stacking volume between the possible emptying periods.

Can one speed up the drying process?

If the sludge is treated in digesting towers, the gas is normally used to drive a stationary motor to produce electricity. The motor's thermal energy can be used to heat up the dryer's floor, thus reducing both drying time and cost. Such a plant was installed in Switzerland in August 1999.

What about running cost?

The energy demand of solar drying represents only 2% to 3% of industrial drying. As such the running cost is very low. In Germany the typical cost is around 50 Euro (approximately Aus$90) per ton of water extracted.

There are other hidden savings to be obtained from using this drying process. For example, the dried sludge is now accepted at Caboolture Rubbish tip as a clean fill and can be trucked there on a round trip of 20km. A round trip from B.E.S.T.P to the current wet sludge disposal site is 140km. Thus there is a transport saving. Ongoing benefits also include less truck time in the road, reduced fuel consumption, less tyre wear, reduced exhaust emissions, less maintenance of truck and road and reduced landfill of an obnoxious material.

Conclusions

The results to date indicate that the solar sludge drying process is extremely effective at both stabilising the biosolids and dramatically reducing the volume and mass of the material to be transported and reused. Since the installation of the solar sludge dryer, *CabWater* has estimated that it will have a cost saving of in excess of 50%. In real terms, it is expected that the solar sludge process will remove a minimum of 3,300kg of water from the fresh biosolids and will save *CabWater* approximately $80,000 to $100,000 in biosolids disposal costs based on current prices. In addition to these savings, the biosolids product collected at the end of the process will have a number of options for beneficial use and who knows, in the future the dried product may even become a saleable commodity. B.E.S.T.P. treatment plant staff have already noticed that the stuff makes excellent lawn fertiliser!!

The Author

Ross Shannon (07 5498 5954) is assistant plant operator at the Burpengary East Sewerage Treatment Plant.

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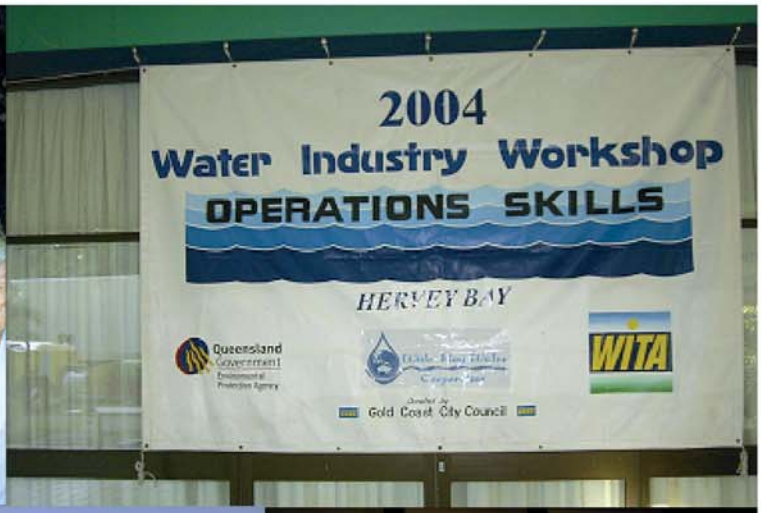

QUEENSLAND

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STATE OF THE ART OPERATIONAL MANUALS

Jason Whittaker

Judged Best Paper at the Annual Victorian Water Industry Engineers and Operators Conference 2004

Background

Goulburn Valley Water (GVW) provides water and wastewater services to over 105,000 people in 56 towns and cities covering a geographical area of some 20,000 sq. km in north central Victoria. The systems include 1450 km of water mains, 42 water treatment facilities, 27 wastewater management facilities, 253 sewer pump stations and 900 km of sewers.

In April 2000, GVW undertook an operations review with the aim of identifying key issues facing its Operations Group. The review followed a period of significant investment in new infrastructure and technology, requiring the Authority to increase its focus on the operation and maintenance of these assets.

The review identified several factors that could impact on the ability of GVW to continually deliver high quality water services to customers. One of the main factors identified was the lack of concise operations and maintenance (O&M) documentation.

The existing documentation varied from poor to reasonably good, however few systems were comprehensively documented. Some of the systems managed by GVW have been in operation for almost 100 years and had virtually no manuals at all. This made operating the systems very difficult and often led to inconsistencies in operational practices. Traditionally information on plant operation was passed from operator to operator, not all of which was correct. As a result, the information on plant operation and process control provided by the current operators can sometimes be "this is the way it has always been done", or "this is the way I was shown".

Reviewing the existing manuals and their varying quality and content reinforced the need for new manuals to be developed. The lack of O&M documentation placed a heavy reliance on the collective knowledge of the key operational personnel. This translated into more problems as experienced people retired and were replaced with inexperienced personnel. Newer operators were unfamiliar with individual facilities and were forced to *reinvent the wheel* when it came to particular plant idiosyncrasies and fault finding. This lack of experience and available reference material increased the risk of sub-optimal system operation. With the Authority increasing its focus on the effective operation and maintenance of its assets, the importance of documenting the collective experience of all personnel in detailed O&M Manuals was highlighted.

Operations Section / Process Element	General	Raw Water Supply	Alum Dosing	Clarification	Filters	pH Correction	Chlorination	Clear Water Storage	Generic or Attached Items	Other Business Areas
Purpose & Targets	KPI's, objective settings of elements, general description of process elements								EPA License& WQ requirements	EMS & Customer Contract
Safety	OH&S issues, 'Hazard Rating', training and protective equipment requirements								MSDS and Dangerous Goods OH&S SOP	Safety Plans
Management	Levels of authority and notification, required training to operate								GVW authority hierarchy	
Design Criteria & Components	Size, capacity and design assumptions, component description								Equipment list & supplier data including scanned supplier information and electronic information such as CDs of pump manufacturers' specifications	Asset Management, Supplier Register
Maintenance	Table of frequency (less frequently then monthly), type and location.								Suppliers Register and contacts, standard work order forms, spare parts list	Asset Management
Monitoring	Table of frequency (monthly or more frequently), type and location								Testing SOP, EMS requirements	EMS, Techbase
Normal Operation	Start up, operation and shut down procedures, chemical purchasing procedures, PLC / Citec / SCADA controls								Quality Management System Operation SOPs and log sheets, chemical suppliers	
Manual Operation	Manual start up, operation and shut down procedures								Operation SOP	
Process Control	Available process adjustments and likely impact, adjustment steps									
Trouble Shooting	Potential problems such as failure of PLC, possible cause and remedial action									
Emergency	Potential system failure and emergency responses								Emergency Response Procedures, Notification of Key Customers	Emergency Response Plans, Priority Customer List, AquaRate(database of all customers)
Other	Supply quality requirements, irrigator conditions, major customers								Service Suppliers list	
Drawings	Plant Drawings								Electronic Plan room	

Figure 1. Facility information matrix.

Manuals were required for all water and wastewater treatment plants, pumping facilities, and collection and distribution systems. A number of alternatives to deliver a concise and comprehensive library of manuals were considered.

The preferred alternative involved a partnering approach between in-house operational and technical staff and technical consultants to produce Intranet based manuals. The tendering of the project ensured Goulburn Valley Water would receive a diverse range of submissions from consultants eager to showcase their latest wares. The use of specialist external consultants ensured that the manuals developed would be user friendly and state of the art.

Requirements

GVW recognised early in the concept stage that for the O&M Manuals to be an acceptable and usable reference guide, the information needed to be technically correct and presented in clear and simple terms. This was essential to ensure that the document could be understood by Authority personnel with a wide range of industry experience and technical ability. There also needed to be a high level of "ownership" by those involved in developing and using the manuals.

In-house workshops with the operations managers and field staff further identified the requirements for the manuals. These included:

- An Intranet based system available to the entire organisation.
- Manuals for individual facilities, rather than entire systems.
- Flow schematics depicting process elements in order of sequence.
- A structured layout to access information relating to the process elements. e.g.
  - Raw water
  - Alum dosing
  - Treated water
- A standardised layout for each process element
  - Purpose and targets
  - Safety
  - Design criteria and components

- Maintenance
- Monitoring
- Normal operation
- Process control
- Trouble shooting and emergency operation.

• Access to standard operating instructions, manufacturers' literature and complete sets of drawings (electrical, civil, P&ID etc).

Development Strategy

The preferred strategy for developing the O&M Manuals was one that involved the contribution of the operators, internal technical personnel and external consultants. It was recognised that GVW staff would have the greatest knowledge of their system operations, however it was felt that the selected consultant would have a crucial role in providing an independent view to identify issues overlooked through GVW familiarity.

Appointing a Consultant

After a tender review PPK were appointed to develop:

• A user friendly interface for navigation that allowed users to access material in several ways, including hotlinks to suppliers documentation on the web

• An O&M Manual design template that would allow ease of documenting field information from site.

• A standard directory structure and naming convention for the management / maintenance of the collected data.

• An appropriate quality control system for the manuals

The Template

Figure 1 depicts the matrix structure for the manuals. The matrix shows how a user is able to access the information vertically as a particular process element, or horizontally as an operation section across the process elements.

The Screen Layout

A standardised layered screen layout was developed to reduce user confusion. The screens are split typically into 3 areas with a title across the top, a side bar and a standardised main screen with data and menu selections. Figure 2 shows a top-level screen for the Goulburn Valley system.

Review Workshops and Operating Requirements

Upon completion of a prototype web-based manual, further workshops with the potential users were held to obtain feedback. The workshop comments were reviewed and changes to the manual prototype were undertaken. By this stage, the staff, and in particular the operators involved in the development workshops couldn't get enough of the concept. Workshops suddenly ran overtime and an abundance of additional features were requested.

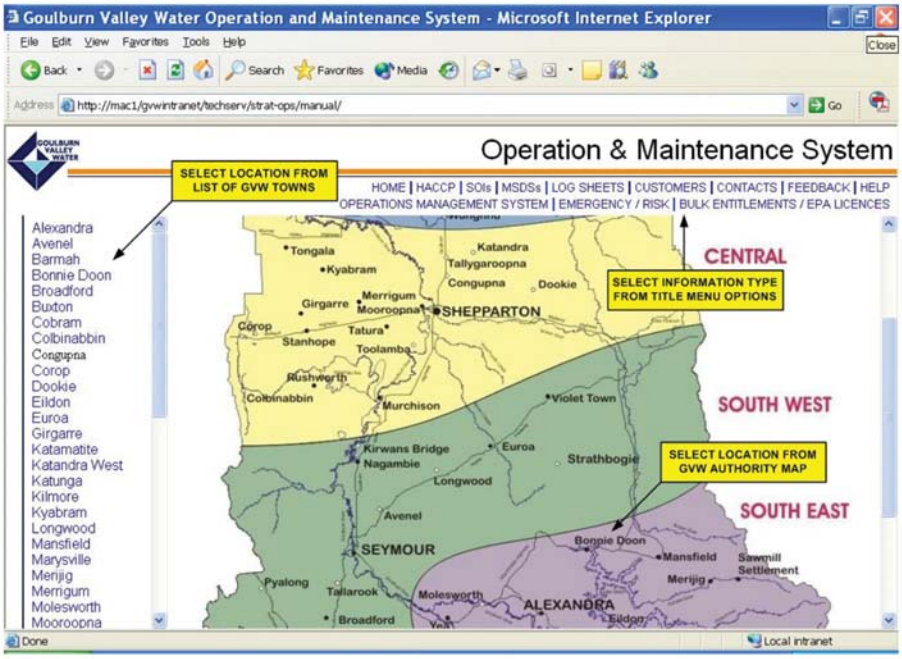

Figure 2. Screen view of O&M System Front Page showing title, side bar and main screen.

One key outcome of the workshops was the need to ensure that all information was no more than three clicks from the front page. Further than three clicks and a user found it too lengthy to access the information.

Technical Review

A technical review phase followed since it was critical to ensure the information supplied was accurate. It also provided a significant learning opportunity for technicians and operators. One of the benefits resulting from the documenting of O&M manuals across the authority and having the process descriptions reviewed is that it allowed, and will continue to allow, problems in facility operation to be identified. Site audits can be undertaken and plant optimisation can be investigated. Operators and technicians then gain a greater understanding of plant processes and are able to correct or improve operating techniques. They were also able to learn from the experience offered by other more specialist technicians and operators.

The Final Product

Access to information and sites / facilities from the main screen is by simple mouse clicks on the graphic or text. These use Hot Spots, Drop Down Menus and Hyper Links to move the user to the required data source. The front GVW System main page is essentially a menu for site and plant selection within the system and also allows access to specific water and/or wastewater corporate documentation. The second level Town System page provides a listing of system plants and process elements and additional items such as major customers. It also includes a Township System map showing layout and location of facilities with links directly to these facilities from the main screen. The third level is the Plants/Facilities page that provides a listing of the operations sections from the side bar. A plant process diagram allows selection of specific process element instructions such as Standard Operating Instructions and Equipment Manuals.

Outcomes

Gone are the days of a bundle of hard copy manuals stuck on a shelf or hidden in a cupboard to collect dust, go out of date and never to be referenced. The web-based O&M Manuals has allowed the consolidating of all available system knowledge and placed it at the fingertips of ALL personnel in the Authority.

We were worried whether the operators would use the system, after all it was designed around and for their needs, but we found because they have been involved from the beginning through the concept, development and conclusions that they actually have a fair bit of ownership in the product and what has been produced. Acceptance is continuing to grow as further developments are made and more operators break the ice and use the system and actually see that it works. We hold operator forums several times throughout the year for different departments and we will use the O&M Manuals as a topic for discussion just to see where we are at and obtain feedback and to introduce new personnel to the product. We have found that it is now being used by field operators, technical and engineering personnel in various departments such as development, major projects and environmental. It has actually provided in some instances a method for training new employees as it is being used as part of their induction training to sites.

It is no longer just an O&M Manual system but a centre and access point (in conjunction with the Sharepoint Portal Server) to store and look for information relating to the operations of all our water and wastewater systems including links the Drinking Water Quality Operations System, HACCP, EMS and OH&S systems. Our IT department as always are looking to the future and searching the market place for software upgrades. For this project that includes a searchability function and document versioning for auditing purposes. There is investigation into making the system more portable with the use of laptops and CD's and tablet PC's and providing better access from remote sites with Microwave links or access via mobile phone technology.

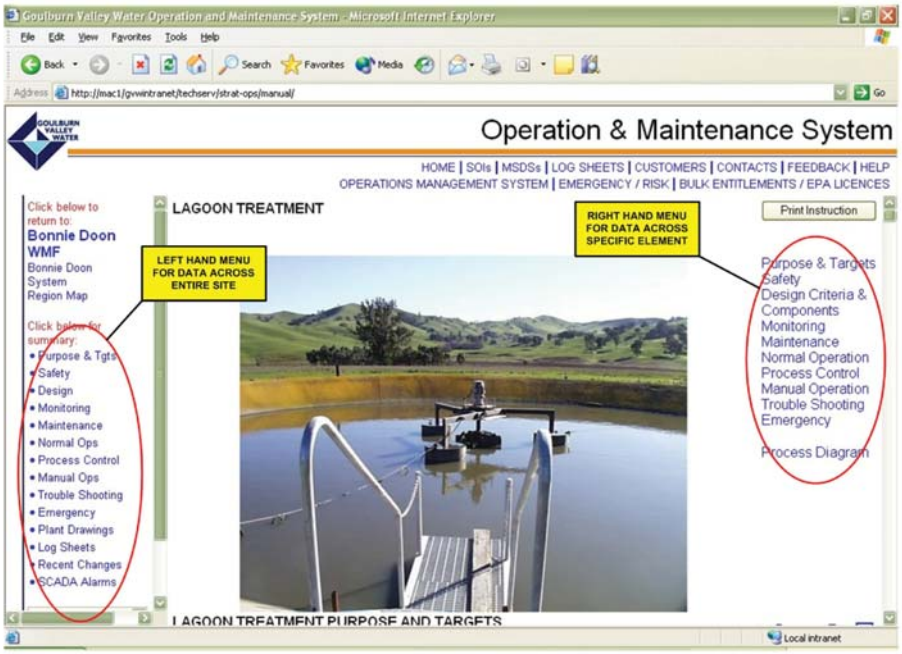

Figure 3. Screen view of WMF process element instruction.

To provide an easy method of maintaining and updating new information collected through plant optimisation and upgrade, and ensuring sufficient information is supplied, a contract specification clause has been developed and is now included in all tender documentation that requires O&M Manuals be produced to a specific standard and containing ALL information required by GVW.

It has taken 3 $^{1}/_{2}$ years to document the current systems (excluding new works and upgrades) and to put into context would comprise about 7000+ marked up digital photos, 500+ flow schematics and drawings, 7000+ pages of text and a cost of $850,000 (this cost would be substantially higher if totally outsourced).

Acknowledgements

The author wishes to thank all Goulburn Valley Water field and technical staff involved for their assistance in providing the information, expertise and knowledge to allow the development of the manuals. Andrew Chapman from PPK greatly assisted the successful development and delivery of this project.

The Author

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NITROGEN REMOVAL USING TERTIARY FILTRATION

Suzie Hatch & Colum Kearney

Awarded first prize at the 2004 AWA NSW Operators Conference held at Penrith Panthers in September.

Background

In 2002 the West Hornsby and Hornsby Heights Sewerage Treatment Plants (STP) completed a Biological Nutrient Reduction (BNR) upgrade. Prior to the upgrade the plants were achieving Total Nitrogen (TN) of approximately 25mg/l. The aim of the upgrade was for both plants to achieve a TN of 5mg/l as a 90 percentile in the effluent. Included in the BNR upgrade was the installation of a methanol dosing facility to provide an external carbon source to allow more removal of TN.

Due to the nature of BNR, process designers were unsure how to combine and quantify the internal organic carbon food source from the fermenter with the methanol in order to achieve desired TN levels. It was up to the production team to test various quantities and dosing points of the methanol to optimise the best results for nitrogen removal from the wastewater. Both plants were commissioned in June 2002 and after 18 months of process changes the plants were still only achieving approximately 7mg/l of TN in the plant effluent. We were a long way from reaching the goal of the upgrade.

At a similar time a pilot project of dosing methanol to the filters was being carried out at Quakers Hill STP. Although the trial showed some promising results for TN reduction, it had to be abandoned due to the nature of their shallow bed sand filters, which were unable to cope with the added solids production. It was then recommended that further testing be carried out at the Hornsby Plants to see what affects this dosing would have on dual media filters.

In November 2003, both Hornsby plants conducted trials of dosing methanol to the tertiary filters to determine the ability of the filters to further reduce nitrogen prior to disinfection.

The Hornsby Treatment plants both operate under a five stage modified Bardenpho process, which is illustrated in Figure 1.

Primary effluent, fermented sludge and Return Activated Sludge (RAS) mix in the **Anaerobic Zone**, which provides an environment free of dissolved oxygen where much of the biological phosphorus release occurs. The flow then enters a three-way splitter where Mixed Liquor Recycle (MLR) is returned to the process and flows into the **Anoxic Zone**. This zone provides an environment free of dissolved oxygen where denitrification occurs. Flow then enters the **Aerobic Zone** where the presence of dissolved free oxygen, ammonia and carbonaceous components are biologically oxidised and phosphorous uptake occurs. Within the **Secondary Anoxic Zone** methanol or ethanol is added to provide an external carbon source for denitrification. Flow then enters the **Re-aeration Zone**, which provides a small amount of additional nitrification and phosphorus uptake before the secondary clarifiers.

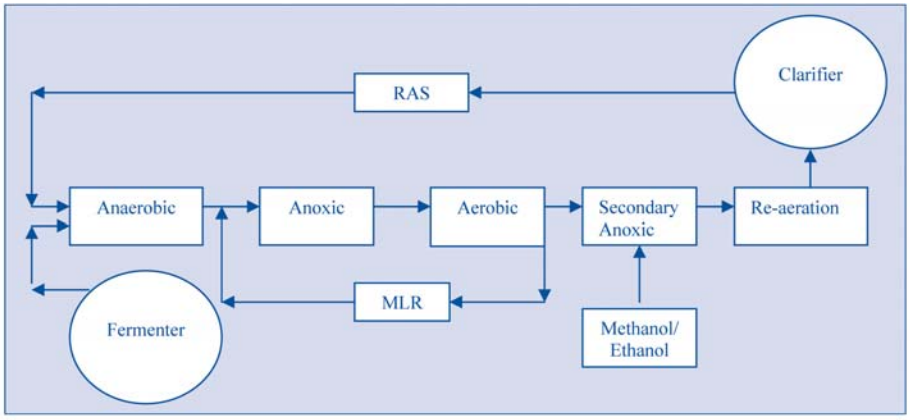

Figure 1. 5 Stage Bardenpho Biological Nutrient Removal Process.

In both the Hornsby Heights & West Hornsby plants (Figures 2 and 3) the secondary treated effluent passes to dual media filters containing a top layer of anthracite and lower layers of sand and fine gravels. Effluent from the filters is disinfected with UV prior to discharge. Filter backwash water is pumped back to the head of the plant.

What is Nitrogen Removal?

Nitrogen removal within wastewater treatment can best be described as a combination of two biological reactions,

Figure 2. The Hornsby Heights plant.

notably nitrification and denitrification. This two-step process is achieved by a variety of bacteria that function under different environmental conditions in separate zones within the wastewater treatment facility.

Nitrification occurs within the aerobic zone (environment where free oxygen is present). Micro-organisms in activated sludge known as autotrophs (nitrifying bacteria) require this oxygen and alkalinity within the aerobic zone to convert the ammonia into nitrites and then nitrates.

Denitrification occurs in the anoxic zone were no free oxygen is available. Heterotrophic bacteria convert the nitrite/nitrate produced during nitrification to nitrogen gas. These bacteria require a carbon source (food) for this reaction to occur. This carbon source can be derived from the raw sewage or fermented sludge or added from some external source. At the Hornsby treatment plants this external source of carbon is methanol or ethanol.

Hornsby Heights STP

During the trial, the Dissolved Oxygen (DO), sludge age and mixed liquor recycle were all kept constant. Baseline filter effluent nitrate (NOX) and ammonia were measured over a period of 7 days. Dosing to the filter influent commenced with a dose rate of 5 mg/L flow paced to the primary effluent flow. This dose was increased to 10 mg/L at a later stage.

The time between backwashes of the filters for most of the trial was 18 hours. As the filters were starting to fail the time between backwashes was decreased to 16 hours and then again to 12 hours before ceasing the methanol dose. The results of the trial are shown in Figure 4.

At a methanol dose rate of 5mg/L the nitrate results varied showing some decrease but nothing substantial. When the dose rate was increased to 10mg/L an average decrease across the filters was 1.3mg/L

Due to the solids increase in the filters, the trial had to be abandoned. We were alerted to the problem as the filters were continually backwashing on head loss. We realised that two out of the four filters had not been upgraded for ten years and required sand and media replacement.

West Hornsby STP

Prior to the trial at West Hornsby all methanol dosing to other points in the process were stopped. Figure 5 shows the results and also illustrates dosing quantities and any changes made during the trial.

Figure 3. The West Hornsby plant.

During the dosing of methanol to the Tertiary Filters at West Hornsby STP the backwash time remained at 24 hours. This was to allow as much biomass growth on the filter bed increasing biological activity thus gaining as much nitrogen removal as possible from the filters within the backwash run time.

It must be noted that as well as testing of nitrates, ammonia and COD analyses were also carried out. There was no significant variation in these results over the period in which the trial was carried out.

In early March 2004, dosing to the filters was stopped as the filters became blocked and continually backwashing on head loss.

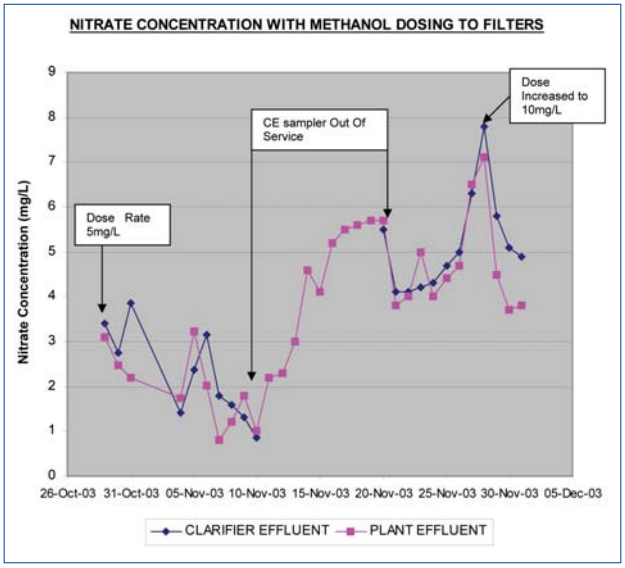

Figure 4. Nitrate results for the CE & FE during the Methanol trial at Hornsby Heights STP. (Note: period from 10/11/03 to 19/11/03 problems with CE sample.)

As can be seen from Figure 5 it was not until the dose rate was increased to 15mg/L that the trial began to show a clear difference between the amount of nitrate recorded in the Clarifier Effluent (CE) compared to the Final Effluent (FE). Approximately one week after dosing was restarted to the secondary anoxic zone at 15mg/L there was a significant reduction in the overall nitrate levels in the plant effluent. The average difference between the nitrate present in CE and that in FE for the period from the 08/12/03 to the 19/01/04 was 2.5mg/L.

Conclusion

As can be seen from the results at the Hornsby treatment plants the ability to dose methanol or ethanol to the tertiary filters can reduce the nitrogen levels in plant effluent. However, the degree of nitrogen removal is vulnerable to many factors specific to each individual treatment plant or process condition.

Probably the most significant factor that impacts on the nitrogen removal process in the tertiary filters is the capacity and backwash period of the filters.

A problem highlighted at Hornsby Heights STP was that two of its four filters operated poorly and blocked up very quickly with the addition of methanol. Further analysis of these two filters showed that they had approximately 40% less media than the other two filters; consequently these two filters are to be refurbished.

West Hornsby STP with eight slightly larger filters running on a

24-hour backwash time proved that it could remove further nitrogen from the process. However, after a period of time the filters here started to block up and could not function properly. It is widely accepted that perhaps the best way to alleviate the issue of filters blocking up due to biomass growth and increased levels of nitrogen gas accumulation is what is termed a 'bumping procedure' at the filters. This involves aerating the filter media occasionally between backwashes so as to relieve nitrogen gas accumulation and extend the filter run time, thus maximising the filters ability to remove more nitrogen from the process.

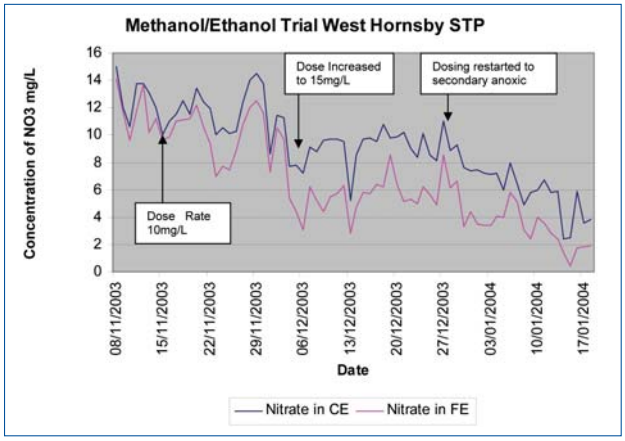

Figure 5. Nitrate results for the Clarifier Effluent & Final Effluent during the Methanol trial at West Hornsby STP.

This bumping procedure was not carried out at either of the Hornsby treatment Plants as it was uncertain what, if any long-term detrimental effects this may have on a dual media filter. Researching the Internet, it was found that several treatment plants in Europe and the US have installed filters (BIOSTYR & BIOFOR) that are specifically configured for nitrogen removal. Methanol addition to the unaerated sections of these filters is suitable for denitrification.

This trial has proven that it is possible to remove nitrogen using tertiary filters. However, it is recommended further studies be carried out to assess if the additional costs involved in dosing methanol/ethanol to the filters and higher energy consumption with increased backwashing or bumping of the filters is economically viable in terms of process results and plant operations in the long-term.

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The Authors

Suzie Hatch (suzie.hatch@sydneywater.com.au) and **Colum Kearney** (colum.kearney@sydneywater.com.au) are both Production Officers with Sydney Water and work at the Hornsby Treatment Plants.

CYNTHIA'S WIOA WRAP

Industry news

The **WIOA annual Victorian conference** was held on 1 & 2 September in Wodonga with a record number of 110 trade sites occupied.

As an outcome of the Victorian Government's White Paper; Grampians Water has merged with Wimmera Mallee Water to form **Grampians Wimmerra Mallee Water**. Additionally, Lower Murray Water has merged with Sunraysia Rural Water to form **Lower Murray Urban and Rural Water Authority**.

Ecowise Environmental acquired WSL Consultants in April 2004. We congratulate Stuart Longmuir and Antony Gibson on their new appointments as Principal Consultant and Manager of Consulting Engineering, respectively, at Richmond. Ecowise has also recently acquired Water Ecoscience to form Australia's largest analytical and consulting environmental services company. To contact Ecowise in Richmond call 03 9429 4666.

We welcome Australian owned **ATMR - Total maintenance,** based in Carrum Downs, as a new Corporate Supporter. With full workshop and site service facilities including crane truck, catering for the maintenance, repair and overhaul of pumping equipment to the water/ waste water and industrial sectors, all brands and types of pumps are deemed repairable by ATMR. ATMR - TOTAL MAINTENANCE.14 Damosh Ave Carrum Downs Vic, PH (03) 9770 8099 or Tony Taylor mobile 0405 539 743.

The annual **WIOA charity golf day** was held in Trafalgar and attended by over 30 golfers. Over the past 6 years the event has now raised over $10,000 which has been donated to charity. Congratulations to this years winners, Jill Busch, Stuart Cluning and Peter Cluning. A big thank you goes out to all our sponsors - including major sponsors, Gippsland Water, Environmental & Process Technologies (a division of Biolab) and ITT Flygt.

South West Water are about half way through the implementation of SCADA at all pump stations and plants.

Congratulations to **Anthony Evans,** WIOA committee member, who won 2 Gold Medals and 3 Silver medals at the Alice Springs Masters Games in Clay Target Shooting.

The **Nestlé** (Warnambool) reuse scheme is nearing completion. This will provide condensate water for the Golf Course and when not required it will bypass the WWTP and go directly to the outfall.

Integration of Danfoss flowmeters into **Siemens Process Instrumentation & Analytics.** On 1 September 2003 the Flow Division of Danfoss A/S was transferred to Siemens, to augment the Process Instrumentation & Analytics division of Siemens Automation & Drives. Fourteen months later we have a new look, new code numbering system and new literature. However the well-known products with their performance and reliability have not altered. Local stock holding has advanced to allow ex-stock delivery of most sensors from DN6 through DN600.

The skilled sales force resides in every state, and is able to provide application evaluation and assistance with both new and existing product. Contact the Customer Care Centre on 131 773 for pricing and availability.

People

Congratulations to **George Wall**, who was awarded Life Membership of WIOA - our most prestigious award at the September conference.

Ron Bergmeier, Director of Australian Pollution Engineering, was officially inducted to the Inextricably Obstructed Tap Society (I.D.I.O.T.S) in recognition of his commitment and support of the WIOA.

Congratulations to **Peter Tolsher** from Anglian Water, the recipient of the AWA Victorian Operator of the Year, awarded at the WIOA conference.

Heath Seuren has returned to ITT Flygt as Victorian Service Manager.

Jim Ridding of South West Water has retired and moved to Bridgwater Bay near Portland.

Ken Turner has left Gippsland Water to join Goulburn Valley Water as District Manager, South East. He is replacing **Carl Brookman** who has joined the Sydney Catchment Authority.

Margarita Grozdanoski, previously of WSL Consultants and Biolab, has now joined Sitest, the Australian distributor of Eutech portable and process instrumentation for water and wastewater analysis. To contact Margarita call 0404 482 060.

Tony Hourigan has left Acromet and joined Alldos Oceania as Regional Manager for the southern states.

Upcoming events

- Applications for the Kwatye Prize of $6000 value to recognise innovation in water and sponsored by Environmental & Process Technologies (a division of Biolab) will open in February 2005. For further details contact Cynthia Lim on 0409 403 237 or info@wioa.org.au
- WIOA will be holding their 2005 weekend seminar in Trawool on 2-3 April.

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

"Is this what I wanted?" A tall story or is it?

Ken Turner

I have this problem. I need to obtain a pump that will pump up to a header tank to supply a safety shower and eyewash at a disinfection plant. For safety reasons the pump needs to supply enough water to keep up with the shower output. A fairly simple task I thought.

Running across the new graduate engineer in the hall I thought that this could be a great little job to ease him into his new position. Explaining what I wanted he happily accepts the task and heads off full of enthusiasm.

Two days go by and no reply, a week, two weeks. Four weeks later a document hits my desk, and I now realize this lad has potential and his schooling has not been in vain. The document is bound into a folder with a full-page summary sheet up front and looks great.

A wave of worry comes over me after pawing through the full design details, a full page of pump curves, OHS issues, a Gant chart and PID electronic layout. My original concern mounts when I find it is 64 pages long.

Concern turns to horror "WHAT" $232,000.

The Author

Ken Turner was a Disinfection Technologist with Gippsland Water. He recently accepted a position as District Manager South East with Goulburn Valley Water, tel 0409 179 774.

BRAIN TEASER - Workplace Safety

1. What is the safe minimum level of oxygen required for working in confined spaces?

a. 20.9%

b. 19.5 %

c. 23.5 %

d. 100 %

2. Who is responsible for an employee's health and safety while at work?

a. The employee

b. Managers

c. Supervisors

d. All of the above

3. Which of the following form part of an employer's duty of care?

a. Training and supervision

b. Adequate welfare facilities

c. Safe systems of work

d. Regular rest breaks for smokers

e. All of the above

4. Which TWO of the following tasks require Health and Safety certification?

a. Working in a confined space

b. Operating a forklift

c. Conducting a Health and Safety Risk assessment

d. Conducting a Health and Safety Contractor induction

5. What is the correct order for the Hierarchy of Controls?

a. Engineering, Elimination, PPE, Substitution, Administrative.

b. PPE, Administrative, Engineering, Substitution, Elimination.

c. Elimination, Substitution, Engineering, Administrative, PPE.

d. Elimination, Engineering, Substitution, Administrative, PPE.

6. You must wear a fall arrest system when

a. Undoing bolts 30 cm above your head while standing on the ground

b. Standing on the first rung of a step ladder when tightening a bolt

c. When working on a scaffold 2.5 m off the ground

d. While walking on uneven pavement

7. Who might be involved in safety inspections?

a. Health and Safety representatives

b. Training and Safety officers

c. Workers from the area being inspected

d. Supervisors

e. All of the above

8. Eye protection should be worn when

a. reading *WaterWorks*

b. performing a draw down test on an alum solution

c. investigating a leak on a chemical dosing pump

d. using a high speed drill

9. When should you obtain a copy of a Material Safety Data Sheet (MSDS)?

a. Prior to purchasing a chemical

b. Before working with a chemical

c. To find out what type of PPE is required when working with the substance

d. To find what type of first aid treatment will be required, if needed

e. All of the above

10. What is the only type of self contained breathing apparatus that is recommended for use at gas chlorine dosing facilities?

a. negative pressure

b. positive pressure

c. zero pressure

11. Suitable footwear that should be worn at a water or wastewater treatment plant could include:

a. open toed sandals or safety boots,

b. thongs or sneakers

c. steel capped gumboots, or safety boots

d. safety shoes or bare feet.

How Well Does Cold Water Clean???

A young man went to visit his 90-year-old grandfather in a very secluded, rural area of the state. After spending the night, his grandfather prepared breakfast for him consisting of eggs and bacon. He noticed a film-like substance on his plate and he questioned Grandpa, "Are these plates clean?"

Grandpa replied, "Those plates are as clean as cold water can get them, so go on and finish your meal."

That afternoon, while eating the hamburgers his grandfather made for lunch, he noticed tiny specks around the edge of his plate, and a substance that looked like dried egg yokes. So he asked again, "Are you sure these plates are clean?"

Without looking up from his hamburger, the grandfather huffed, "I told you before, those dishes are as clean as cold water can get them, now stop being so picky!"

Later that afternoon, he was on his way out to get dinner in a nearby restaurant. As he was leaving, Grandpa's dog started to growl and wouldn't let him pass. He yelled back, "Grandpa, your dog won't let me out!"

Grandpa shouted, "COLD WATER, GET OUT OF THE WAY!"

Answers to Water Brain Teaser (from June 2004 *WaterWorks)*

1. A streaming current detector is used to measure: c The neutralization of charge in water after the addition of coagulant

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

3. True colour in water is due to: b Natural organic matter

4. The nephelometric method is used to measure: d Turbidity.

5. The target for filter performance is a turbidity: b <0.1 NTU

6. Particle counters in the water industry commonly measure particles in water in the size range: c 2 to 15 micron

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

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

9. A common disinfectant is 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

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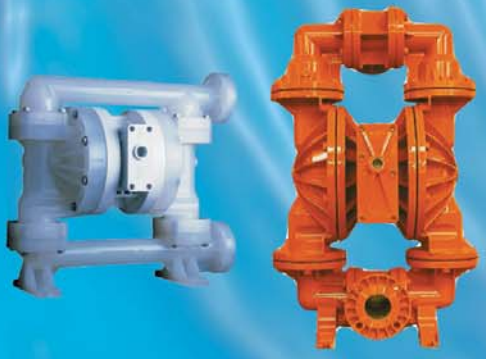

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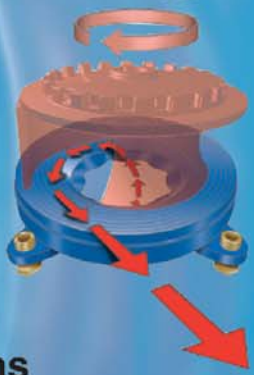

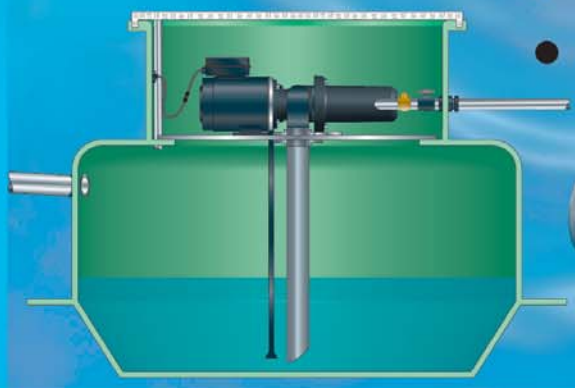

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