

SODIUM HYPOCHLORITE PORTABLE DOSING UNIT



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ABSTRACT

Yarra Valley Water's 2013 Strategy includes a key objective on the safety and wellbeing of its staff and contractors. As part of implementing this strategy and achieving ongoing improvements in occupational health and safety, Yarra Valley Water has undertaken a review of its emergency response chlorination practices and identified a significant improvement opportunity. Historically operators have had to work from heights to spot dose tanks with sodium hypochlorite, which has potential for an unsafe combination of working from heights and chemical handling. Yarra Valley Water together with its civil contractor Bilfinger Berger Services and Jonoco Pty Ltd developed a Portable Dosing Unit which endeavours to mitigate or remove these hazards from field spot dosing activities.

The Portable Dosing Unit also offers a more accurate and effective process to spot dose reservoirs or water mains. It utilises flow measurement to volumetrically inject a specified volume of sodium hypochlorite solution into a Reservoir inlet to facilitate even mixing and reduce the potential for chemical short-circuiting. This approach to emergency disinfection enables Yarra Valley Water to respond promptly and efficiently to emergency water quality events and ensure that our contractors can work in a safe and practical manner.

KEY WORDS

Sodium Hypochlorite, Trailer, Injection, Potable, Tanks, Dosing, Safety

1.0 INTRODUCTION

Yarra Valley Water is one of three metropolitan retailers and supplies water and sewerage services to over 650,000 customers in the north and east of Melbourne. Yarra Valley Water's 9,500 kilometres of distribution and reticulation water supply is varied in its geographical features, age and condition: the water supply system distributes filtered and unfiltered supplies to 31 Water Quality Zones which includes 168 different pressure zones. The variable operation of these 168 pressure zones, which contain 52 tanks, 108 pressure reducing valve stations and 65 pump stations, can substantially affect water quality for the customer. In some instances emergency disinfection is required to rectify taste and odour issues and respond to microbiological detections.

Emergency disinfection has historically involved conducting spot dosing of water service reservoirs and elevated tanks with sodium hypochlorite. Volumes of the chemical required to spot dose any one reservoir will vary from as little as 0.2 Litres up to 150 Litres. Operators would utilise fall prevention devices to climb tanks at heights of 4 meters up to as much as 30 meters to dose the chlorine through an entry hatch. Although the right safety measures can be utilised to provide a relatively safe working environment, it does not eliminate all hazards. For anyone working in this way, it is still an awkward and inaccurate way to conduct disinfection.

Initially, Yarra Valley Water began a scoping process with its civil maintenance contractors Bilfinger Berger Services (BBS), which conducts the spot dosing, to identify key features to be included in the design of a Portable Dosing Unit (PDU).

Jonoco Pty Ltd and I&AC Services Pty Ltd were commissioned to assist with the design and fabrication of the PDU. Their contribution to the project was enhanced due to the previous experience they had in designing similar emergency dosing trailers and chlorinators for Melbourne Water, which proved to be the basis for Yarra Valley Water's design.

2.0 DISCUSSION

2.1 Design Scope

To become an effective and well utilised tool, it was decided to retrofit a trailer for ease of operation and meet some basic functional requirements (Figure 1). A trailer was chosen instead of a skid mounted unit on the back of a Ute because it removes physical lifting over a high tray, isn't as limited in its storage capacity of water and sodium hypochlorite increases operator access to valves, equipment and best addresses the key safety issues.



Figure 1: *Portable Dosing Unit*

The PDU needed to be mobile enough to access all reservoir sites and be safely parked. It also needed to be able to dose into a tank at around 40 meters head. However, as an added improvement the trailer would be required to be capable of disinfecting reticulation mains which would require a pressure greater than 120 meters head.

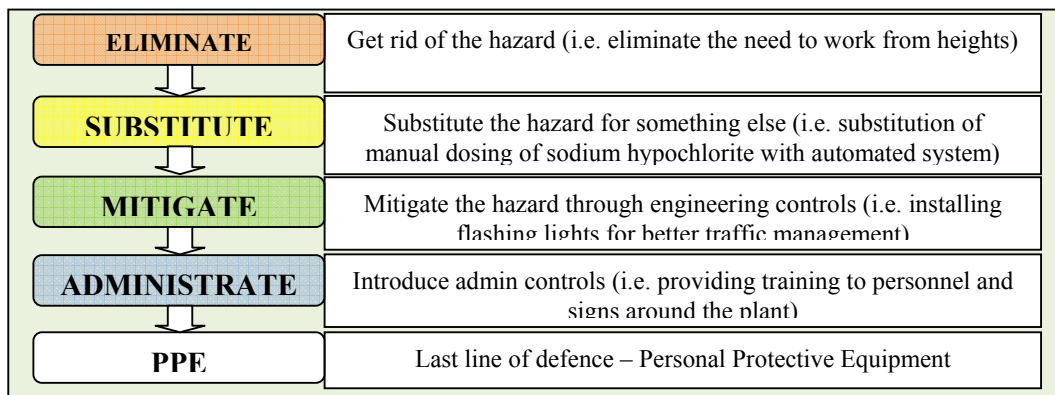


Figure 2: *Hierarchy of controls for safety (Workplace Health and Safety Training Resource Kit, 2002)*

The chlorine trailer was designed utilising principles outlined in the hierarchy of controls (Figure 2) to reduce the overall hazards associated with spot dosing where possible.

2.2 Design Features

To enable ease of access to all Yarra Valley Water reservoir sites a dual axle 2400mm x 1200mm trailer was purpose built to house the PDU. Lockable horizontal doors were installed to provide access to the sides and rear of the trailer. A Perspex partition was fabricated and placed down the centre of the trailer to isolate what are the two operating halves of the PDU: one being the sodium hypochlorite dosing (Figure 3) and storage side while the other contains a 240 Litre water storage tank, a pump and other associated equipment (Figure 4).

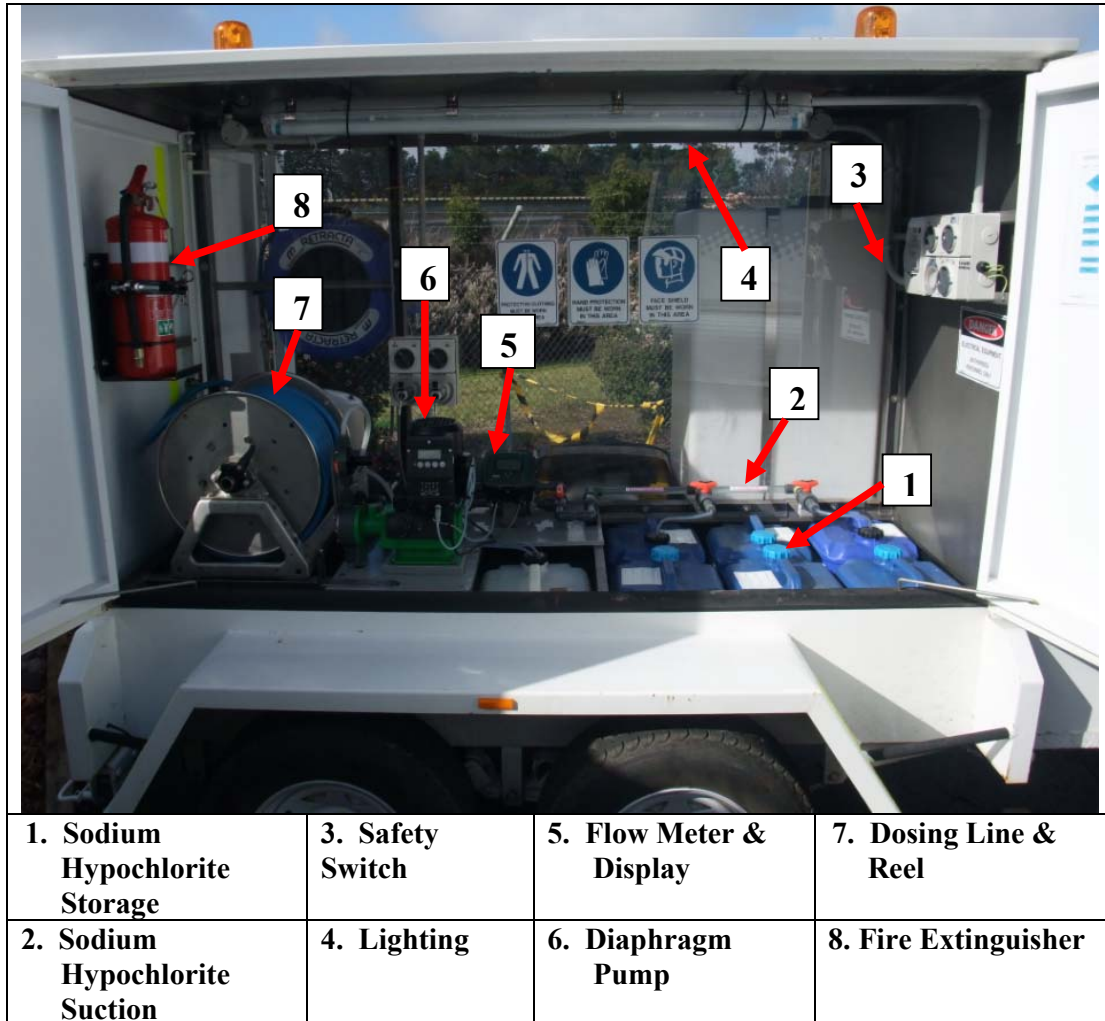


Figure 3: Chemical storage and dosing side of PDU

The trailer can be powered by either the Yamaha petrol generator or via an extension lead that can be connected onsite. All electrical connections and housing are rated IP66 to ensure that operators and equipment are safeguarded from faults arising from rain or any incidental splashing. Permanent light fittings are installed within the trailer and temporary mountable flood lights can be attached onto the roof if required. Flashing safety lights have also been installed on the trailer roof to assist in situations where traffic management is required.

The PDU has been designed to hold six 15L carboys to provide a total storage capacity of 90L of hypochlorite solution. The chemical is drawn out of two selected carboys by small hoses through fabricated lids and up to the main pipe work. This configuration was deemed most advantageous as it limits the amount of manual and chemical handling required by the operator, who needs only lift the carboy received from the chemical supplier straight into the PDU to be simply installed for use.

The carboys are stored within three equally sized and interconnected compartments within the storage bund on the floor of the trailer to ensure that there is no movement during transit. The bund itself is fully removable and is located underneath the whole of the chemical dosing system. It is fabricated from high density polyethylene sheeting and has the capacity to capture 328 Litres. A drain valve is located at the rear of the trailer to facilitate the emptying of the bund if required.

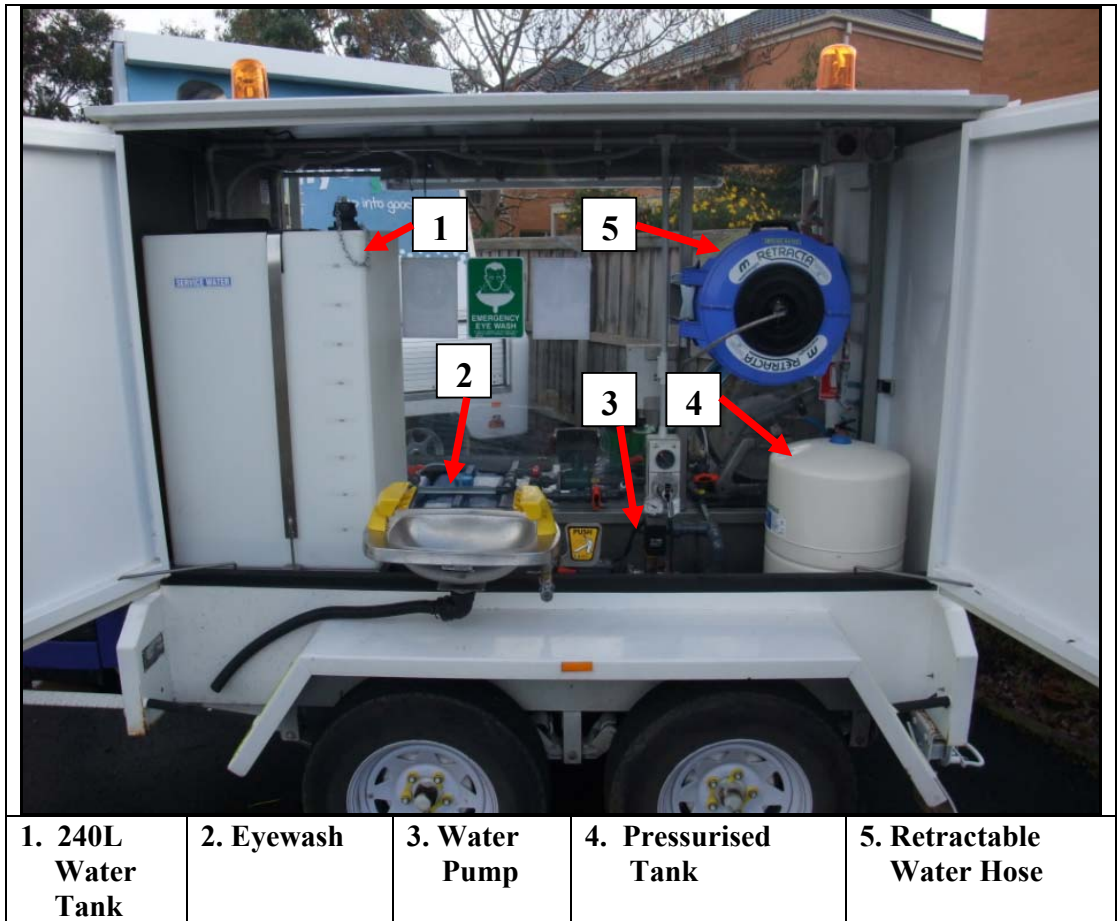


Figure 4: *Potable water supply and eyewash*

The 12.5% sodium hypochlorite solution is pumped from the storage section by a Grundfos hydraulic diaphragm metering pump which has a capacity of 54 Litres/hour at 160 meters head. The pump draws the sodium hypochlorite from the carboys via a flow meter and delivers it to the dosing line. The pump and all pipe work and other fittings are constructed of materials that are corrosion resistant which is vital when processing sodium hypochlorite. A 15 Litre waste tank is also available to collect all waste produced during the dosing process.

The flow meter located on the suction side of the chemical dosing pump is the operator's interface to control the pumps and the dosing volume. The MJK Magflux 7300 flow meter and digital transmitter display are set up in such a way that the desired volume of chemical need only be input for the diaphragm pump to start up. The flow meter will then monitor the total volume and the flow rate on the display and will stop the pump once the intended volume has been dosed.

The sodium hypochlorite, upon being pumped through the diaphragm pump, will enter the 12 millimetre diameter, 50 meter dosing line that is housed on a stainless steel reel to facilitate an easy deployment to the chemical injection point. The end of the dosing line is fitted with a quick connect coupling and non-return valve to ensure that back flow from the dosing point is prevented.

The potable side of the PDU supplies water for the dosing system flush, spill clean ups and an eyewash facility. The 240 Litre storage tank feeds a Davey centrifugal pump which regulates supply to a 60L pressure vessel which is kept at around 30 meters head. This is to ensure that even when power is off the eyewash is still able to be used.

The eyewash is installed so that it can be folded out pre-dosing to provide an effective wash station if a spill occurs. The water storage capacity when full provides enough supply for 30 minutes continuous usage.

A 15 meter hose with trigger nozzle attachment has also been installed to facilitate washing down of the PDU after use as well as flushing of the chemical dosing system into the 15 Litre waste tank. The quick connect coupling can be attached into the pipe work on the dosing side to flush the system if it is not intended to be used for an extended period.

2.3 Operation

Once parked onsite, the deployment of the PDU is relatively simple although due to the presence of chemicals and other working hazards it requires the attention of two operators. Personal Protective Equipment (PPE) is required to be used at all times while operating the PDU; this includes safety footwear, gloves, face shield and apron.

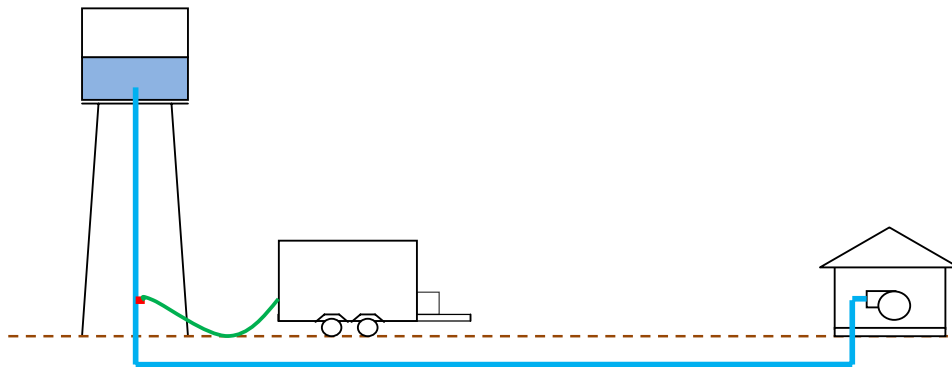


Figure 5: *PDU deployed for on-site operation*

The required dosing volume is provided to the operator in a lookup table which requires knowledge of the tank level and the existing chlorine residual in the storage to achieve a target concentration of 0.6mg/L. The free chlorine residual is identified by testing a

reservoir sample using a Hach chlorine test kit before and after dosing.

The eyewash facility is the first piece of equipment to be setup on the trailer. This is followed by the generator being switched on or power being plugged in from the site to provide lighting if required. All valving in the chemical and potable pipe work within the trailer are configured for dosing and the 12 millimetre diameter dosing line is then fitted to the tank using the easy fit coupling.

The sodium hypochlorite injection point will either be located on a tapping on the inlet main or on the tank wall in the vicinity of where the main enters the floor, whichever of the two is easier to access and install. The methodology of dosing a reservoir using the PDU requires the water within the tank to be moving to facilitate mixing of the solution. To do this, one of the operators will run the pump station or altitude valves which supply the reservoir in manual to provide inflow to it. This process is much more effective in providing a fast even dispersion of the hypochlorite solution than through manual dosing from an entry hatch. This procedure also eliminates the need to work from heights to dose the tank and the probability of the chemical short circuiting and exiting at the outlet before it has been mixed sufficiently.

Following the deployment of the PDU and the generation of inflow to the tank the only task left is to dose the required chemical volume. The dosing line is generally kept full with sodium hypochlorite when in daily use and is purged with water either at the end of the week or if the PDU will be disused for an extended duration.

Once the required volume has been dosed into the system, the PDU is decommissioned and readied for transit to the next job. This involves depressurising the dosing line by opening the waste tank valve and then reconfiguring the pipe work valving as per procedure to isolate the chemical and water storages.

On average the time taken to disinfect a reservoir has marginally increased, however the value of the PDU is that it provides a safe and effective means for emergency dosing.

3.0 CONCLUSION

Yarra Valley Water through extensive consultation with its maintenance contractors Bilfinger Berger Services and with the assistance of Jonoco Pty Ltd and I&AC Services Pty Ltd, has successfully designed and built a Portable Dosing Unit which significantly reduces the severity and quantity of hazards associated with emergency spot dosing. Other associated improvements with the dosing accuracy and processes provide a more robust and scientific methodology that will yield quality outcomes into the future.

4.0 ACKNOWLEDGEMENTS

Yarra Valley Water would like to acknowledge the team at Jonoco Pty Ltd and I&AC Services Pty Ltd for their support and quality service from design through to operation.

Yarra Valley Water would also like to thank Melbourne Water for sharing their learning from their trailer design and operation which ultimately lead to the successful design of the PDU.

5.0 REFERENCES

Workplace Health and Safety Training Resource Kit. (2002). Retrieved July 12, 2010, from Safework SA: <http://www.safework.sa.gov.au/contentPages/EducationAnd>

