# DISINFECTION ALTERNATIVES FOR WATER TREATMENT IN QUEENSLAND

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**ABSTRACT**

We have prepared this presentation using illustrations from project work previously undertaken by us to provide you with an informative outcome about the alternate methods of disinfection. We are keen to convey to you examples of their use so that you may give them due consideration in future plant design.

**KEY WORDS**

Chlorine Gas, Sodium Hypochlorite, Ultra Violet, Chlorine Dioxide, Electrochlorination

## 1.0 INTRODUCTION

WestWater Enterprises Pty Ltd is a privately owned company with its head office in Perth, Western Australia. We employ 16 people with a total of 55 years experience in disinfection, water and wastewater treatment, and monitoring and control.

Our Engineering and Project Management capabilities reside in our Perth Office. Our Queensland Branch Office at Loganholme provides service and maintenance to the Queensland Water Industry through our association with Chlorination & Control Pty Ltd. (Visit our Exhibition at Stand 288)

## 2.0 DISINFECTION – WHY IS IT NECESSARY?

The Australian Drinking Water Guidelines (ADWG) devised in 1996 and revised in 2004 defined:

- "Drinking water as water intended primarily for human consumption but has other domestic uses"
- "Drinking water should be safe for use and aesthetically pleasing. Ideally it should be clear, colourless, and well aerated with no unpalatable taste or odour and it should contain no suspended matter, harmful chemical substance or pathogenic micro organisms"
- Micro biological guidelines seek to ensure that water delivered to consumers contains no pathogen (disease –causing) micro organisms.

**Hence the need for disinfection!**

## 3.0 CHLORINE GAS

Chlorine gas is widely used as the prime disinfecting ingredient in the Water Industry. It acts as a fast oxidising agent, treats organic taste and odour and produces a free chlorine residual.

Due to the hazardous nature of chlorine gas the maintenance and operational staff of a chlorine plant need to be well trained personnel. The product has a Dangerous Goods Classification for storage, handling and transport. There are some undesirable chloro-organic compounds produced when chlorine disassociates with ammonia and organic

matter in the water supply.
A typical chlorine installation will draw gas from a storage container, control and meter gas flow and dissolve the gas into an aqueous solution for use by the process.

**Figure 1:** ***Chlorine cylinder storage***

**Figure 2:** ***Typical duty/standby installation***

## 4.0 SODIUM HYPOCHLORITE

Commercially available sodium hypochlorite is produced at 12.5% available free chlorine held in a caustic based solution. It can be transported as a liquid, injected by metering pumps and in smaller installations can be decanted from bulk storage into smaller containers.

Sodium Hypochlorite has a defined shelf life and the concentration will decay in strength over time. It has a tendency when pumped at 12.5% to produce off-gassing particularly in the suction line of solution pumps. The Occupational, Health and Safety hazards are exacerbated by the caustic base.

Here in Queensland bulk deliveries of sodium hypochlorite are available from the manufacturer, alternatively smaller quantities are available in pre-packaged containers.

Sodium Hypochlorite dosing packages often include a storage tank and require a bund to retain possible leaks or spillage. A well designed system will have a dosing pump with a multi function valve to protect against off-gassing from the solution.

**Figure 3:** ***Self contained dosing package***

**Figure 4:** ***A day tank allows for dilution***

## 5.0 ULTRA VIOLET (UV) STERILISATION

Ultra Violet (UV) Disinfection is a proven technology that uses low or medium pressure mercury vapour lamps to produce UV light in the UV-C range focused around germicidal susceptibility at a wavelength of 254nm.

As opposed to the strong oxidising effect of chlorine, a UV system produces a wave length that can penetrate the cell wall of bacteria and disrupt the DNA mechanism impeding its ability to reproduce and multiply.

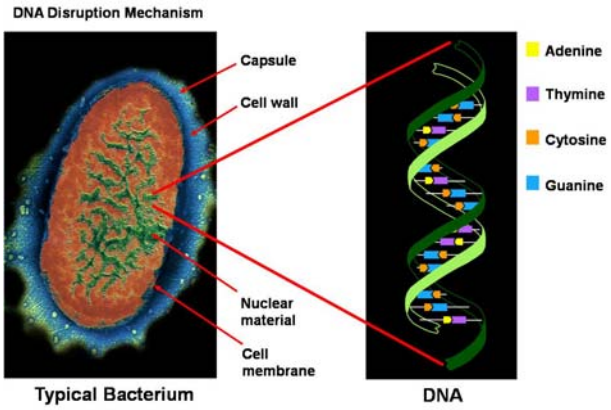


**Figure 5:** ***Bacteria cell and DNA***

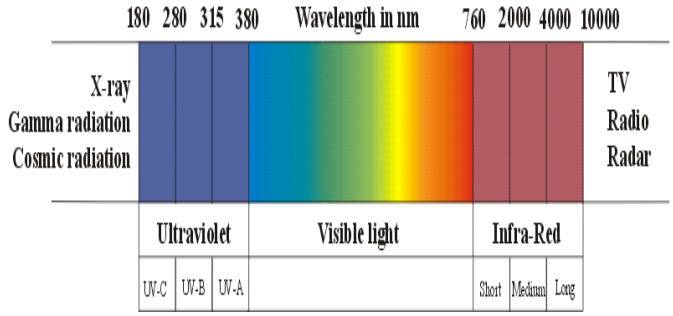


**Figure 6:** ***Ultra violet wavelengths***

The construction of a conventional UV Chamber will include inlet and outlet connections, with the UV lamp encased in a longitudinal quartz sleeve. To protect against biofilm fouling an automatic wiper mechanism is usually employed to wipe the quartz sleeve at pre-determined intervals. Modern UV chambers have an intensity monitor that can be used to vary the power applied to the lamp, thus maintaining an optimum dose at the wall under varying process conditions.

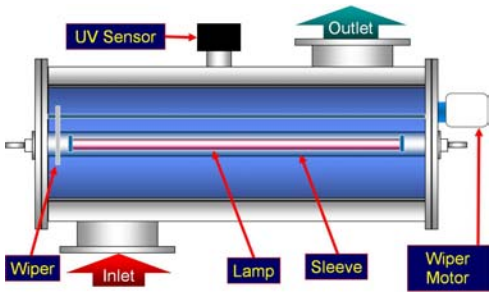

**Figure 7:** *UV chamber*

## 6.0 CHLORINE DIOXIDE

Since the early days of manufacture, chlorine dioxide has been used in potable water treatment plants successfully to eliminate taste and odours particularly those caused by phenol pollution.

Chlorine Dioxide does not produce the formation of trihalomethanes (THM). Early concerns about possible health threats from the inorganic by-products when using chlorine dioxide have been dismissed by comprehensive toxicological studies.

Several plants are commercially available to generate chlorine dioxide on site by using a sodium chlorite in solution or a solid form reacted with either sulfuric or hydrochloric acid or even chlorine solution and gas.

**Figure 8:** *Onsite sodium hypochlorite generator*

## 7.0 ELECTROCHLORINATION

Electrochlorination uses seawater or a saturated brine solution to produce hypochlorite via an electrolysis process within an electrolytic cell.

DC current is passed through the saline solution. The anode oxidizes the chloride irons to produce CL2 while the cathode reduces the water to produce an NaOH solution plus hydrogen H2. The chlorine reacts with the NaOH solution to produce NaOCL.

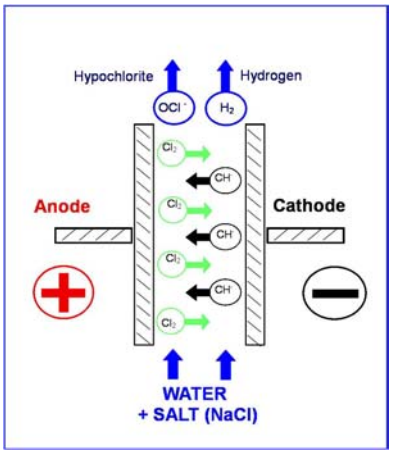

**Figure 9:** ***Electrochlorination***

The electrochlorination process uses the basic ingredients of salt and electricity to produce a low strength sodium hypochlorite solution which is stable with no off-gassing and managed with a low operator interface.

The hydrogen byproduct can be extracted and diluted within a well designed plant and discharged safely to the environment without the risk of explosion.

The electrolytic cell does require periodic acid cleaning to maintain a healthy operating state.

**Figure 10:** ***5kg/hr Brine electrochlorinator***

**Figure 11:** ***2.5kg/hr unit***

## 8.0 CASE STUDIES

### 8.1 Example A

Practical applications for disinfection systems could be to include the addition of sodium hypochlorite to a small pressure pump and filtration system for a remote community.

**Figure 12:** ***Pressure pump set & sand filter***


**Figure 13:** ***Commercially available hypo dosing system***

## 8.2 Example B

A mining camp water supply system may include a variable speed pressure pump system, diesel driven fire pump, UV sterilization supplemented by a small hypochlorite dosing package.

**Figure 14:** ***Potable water supply for a 350 man camp***

## 9.0 CONCLUSION

We have attempted to draw your attention to some of the alternatives that are available for the disinfection of water supplies. Hopefully we have stimulated your appetite to pursue these alternate technologies further.

## 10.0 ACKNOWLEDGMENTS


1. Handbook of Chlorination and Alternative Disinfectants, Fourth Edition,
   George Clifford White

2. Australian Drinking Water Guidelines, 2004
   National Health and Medical Research Council (NHMRC)
   Natural Resource Management Ministerial Council (NRMMC)