

Goulburn Mulwaree Council – Effluent Irrigation Scheme Medium Pressure UV Disinfection

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Abstract

Ultraviolet (UV) light has become widely accepted as an alternative option for wastewater disinfection. There are now many wastewater treatment plants worldwide using UV technology with an increasing emphasis for reuse application.

Contra Shear Technology (CST) has recently been awarded the UV Disinfection equipment supply contract for the Goulburn Irrigation scheme. The contract was awarded to Ted Wilson and Sons Ltd (TWS) who submitted an innovative design that will operate as a pressurised on demand irrigation scheme simplifying infrastructure and provided the council with a more economic contract as well as significant savings in long term operating cost.

The UV Disinfection equipment selected was the Berson InLine Medium Pressure Lamp technology that is to be fully integrated into the overall PLC/SCADA process control system.

Keywords

Irrigation, Berson, Medium-pressure, UV lamp, disinfection, wastewater, re-use,

Introduction

Berson UV-techniek is a Dutch UV Disinfection Company and is the world leader in Medium Pressure UV technology. They have been established for over 30 years and were the first to develop the cross flow In Line system.

Contra Shear Technology has been involved in the industrial and municipal Water and Wastewater market for over 20 years and recently became the Berson distributor for Australia. We are probably more know for our screening equipment but we now also offer a wide range of other equipment.

We have recently been awarded the UV Disinfection supply contract for the Goulburn Mulwaree Effluent Irrigation Scheme. Ted Wilson & Sons Pty Ltd (TWS) were awarded the main contract.

UV Technology

It was established that there was a link between the germicidal properties of UV radiation as early as 1877 but it was not clearly understood. Today, the mechanism of microbial inactivation by UV is rather well understood and resistance or immunity does not occur.

In most organisms, the DNA is a double stranded, inter-linked helix structure. These bases are sensitive to the absorption of UV light, and the maximum absorption of UV by DNA takes place at around 200 nm, while there is also a high absorption achieved at 260-265 nm. The absorption of UV energy by the nucleotide bases at these particular wavelengths result in the rupture of the dimers and microbial death occurs.

Although microbial death occurs primarily in the germicidal ranges due to photochemical damage of the DNA, it is generally accepted and considered that molecular damages of other bio-molecules, such as proteins and enzymes, at wavelengths throughout the UV range of the spectrum have a major contribution in the disinfection performance. Particular for large micro-organisms, such as fungi, protozoa and algae, UV light might not be able to penetrate far beneath the cell wall of the organisms, scarcely affecting the DNA strand(s).

UV generation

UVC is the Ultra Violet wavelength between 200-300 nm. There are two main types of generating lamps using mercury for UV Disinfection. Low Pressure monochromatic with a single spike of 254 nm and polychromatic medium pressure UV Lamps with a variety of spikes

Each lamp technology has their own unique characteristics, properties and applications, but in general the medium pressure technology is considered to be superior. Both disinfect or deactivate the DNA but the MP polychromatic waves also damage a wider range of bio-molecules such as the enzymes that allow enzymatic repair mechanisms or photo-reactivation.

Medium pressure lamps are

1. Most popular range between 2.0-3.5 kW (Larger lamps are also available)
2. Under pressure
3. Shorter 200-350mm
4. In-Pipe design
5. Cross flow configuration

Low Pressure lamps are

1. Usually only 100-330 W
2. Operate at atmospheric pressure.
3. Generally 1.5m long
4. Mostly in-channel design or constructed closed chambers
5. In-line flow configuration

Effluent Irrigation Scheme

The existing sewage treatment plant for Goulburn is located at Ross St. the treated effluent is pumped to the 600 ML Storage Pond at Gorman Rd about 4 km away. The works under this contract are for the construction of the irrigation infrastructure.

Design Data

Flows for Stage 2	100 - 400 L/s
Temperature Range	5 – 30 Deg C
Transmission	≥ 45 %
Water quality:	Secondary sewage effluent
TSS:	< 20 mg/l (90%ile)
Influent	1 x 10 ⁶ cfu / 100 mL
Effluent	< 150 cfu/100 ml
Inactivation	Log 3.8 (3.5 - 90%ile)

Originally this was a construction contract based on a conventional design from the Department of Commerce which is the old Public Works Department of NSW. It was based on pumping from the storage pond through an in-channel Low Pressure UV disinfection

system to a secondary 200 m³ storage tank, with an overflow or precautionary discharge to the Wollondilly River. The actual pumping system for the irrigation scheme followed.

The alternative TWS design took an innovative approach and basically eliminated the secondary storage tank and pumped directly to the irrigation scheme from the storage pond and incorporated the Berson UV system into the irrigation pressure main.

A point worth noting is that the Wollondilly River runs into the Sydney Water catchment area so this project was of interest to them.

The advantages were significant

1. Lower capital cost - Single pump station resulting in simpler infrastructure lower capital cost
2. Much simpler construction cost – The Storage Pond embankment required significant reconstruction to fit the new pump wet well and the concrete channel for the UV disinfection. The new design used a floating pontoon for the submersed pumps and the MP UV system is an in pipe system and has a very compact foot print
3. Lower operating cost – Single pump station results in considerably less operating power cost. Plus simpler maintenance. The Berson UV uses fewer lamps and the system is simpler to maintain with everything being accessible above ground and without the need to lifting gear.

UV Equipment selection

Because of the low transmissivity and the high log reduction required we offered a four (4) UV Chamber system based on two (2) parallel trains of two (2) in series.

Model selected were the Berson Inline 7500+WW series chambers with 12 lamps in each, so a total of 48 lamps. Each lamp is 3.5 kW MP MultiWave with a 4 stepped power control system that allows them to operate between 2.2 kW and 3.75 kW per lamp.

L0 – 2.20 kW

L1 – 2.65 kW

L2 – 3.10 kW

L3 – 3.75 kW

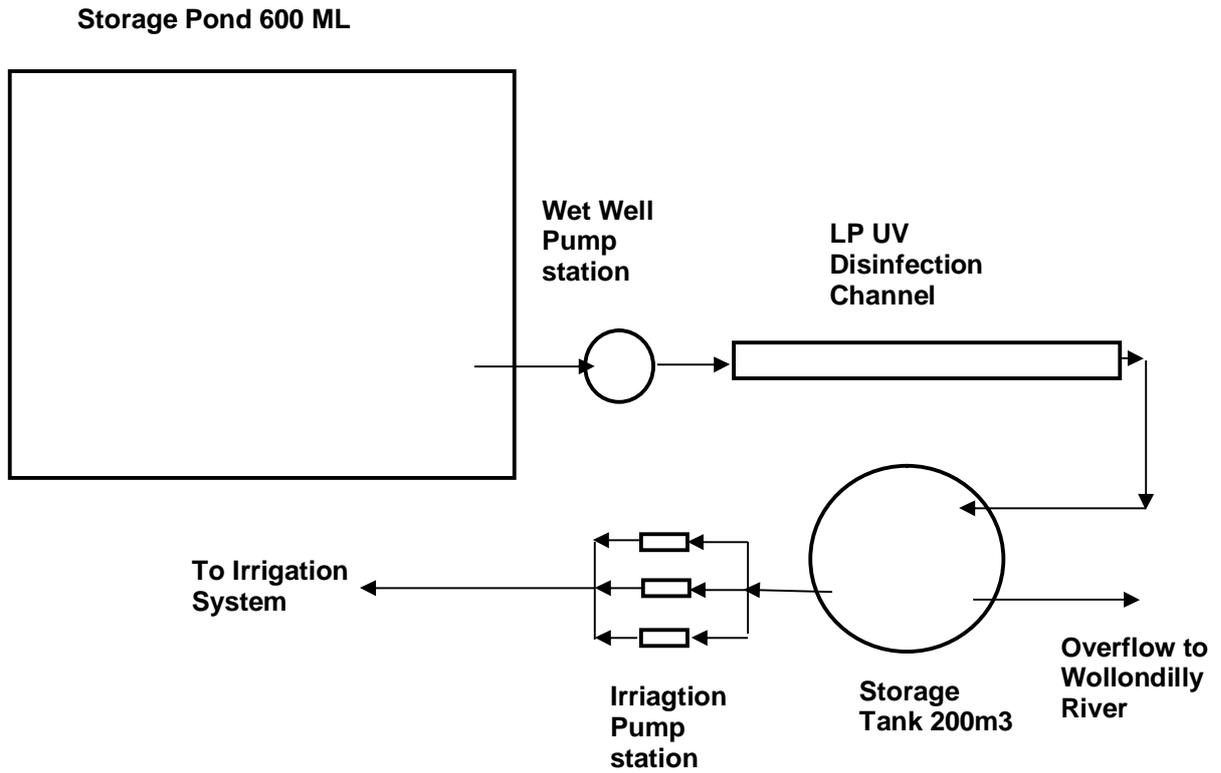
The system is designed to operate with either one twin train or both together to disinfect flows between 100 and 400 lt/sec

100 lt/sec – Single train – Power level L0

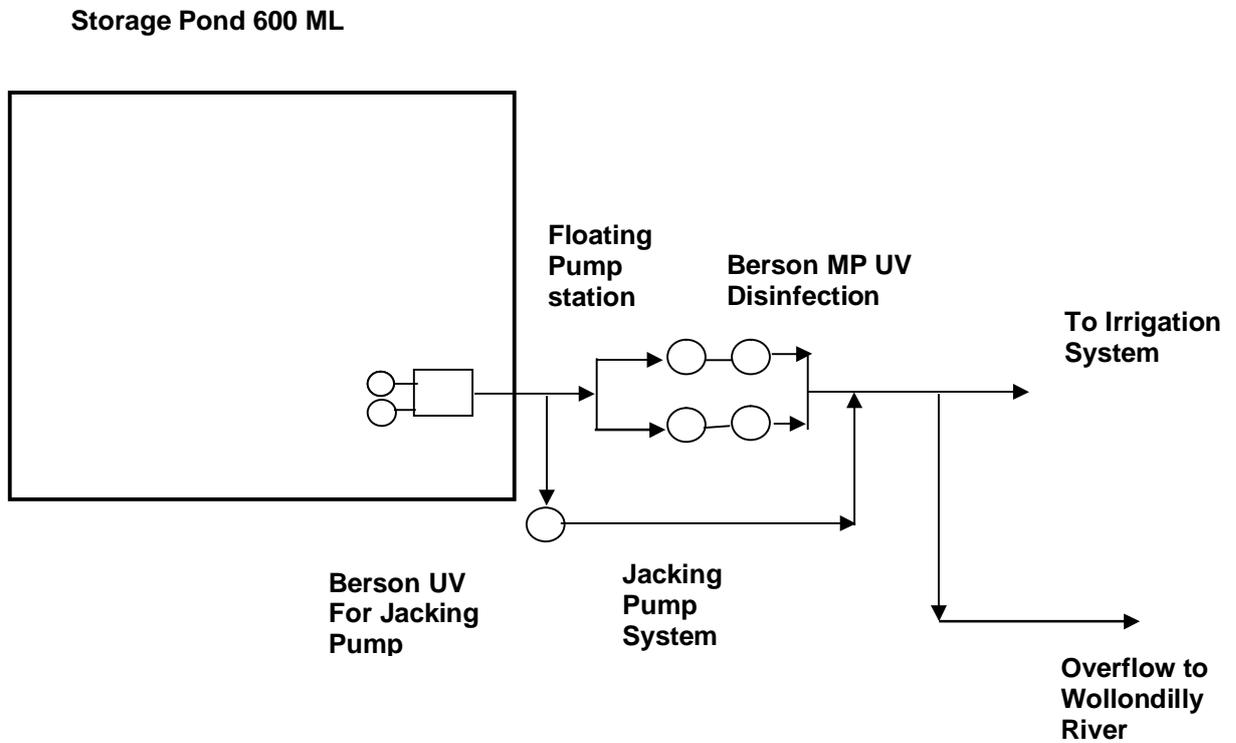
400 lt/sec – Twin train – Power level L2

It has been assumed that there will be leakage in the system and this will be taken up by the jacking pump system, which is a low flow system to maintain the irrigation system pressure when there is no demand.

ORIGINAL DESIGN CONCEPT



TWS DESIGN



Conclusion

The Australian industry has been dominated by Low Pressure in-channel UV designs. However with this project and others, end users and designers are starting to appreciate the benefits of closed reactor Medium Pressure systems,

In this case the advantages of the Berson InLine UV system that allowed the innovative design approach by TWS were clearly demonstrated resulting in significant benefits to the council.

MAIN PARTS OF AN INLINE BERSON UV SYSTEM

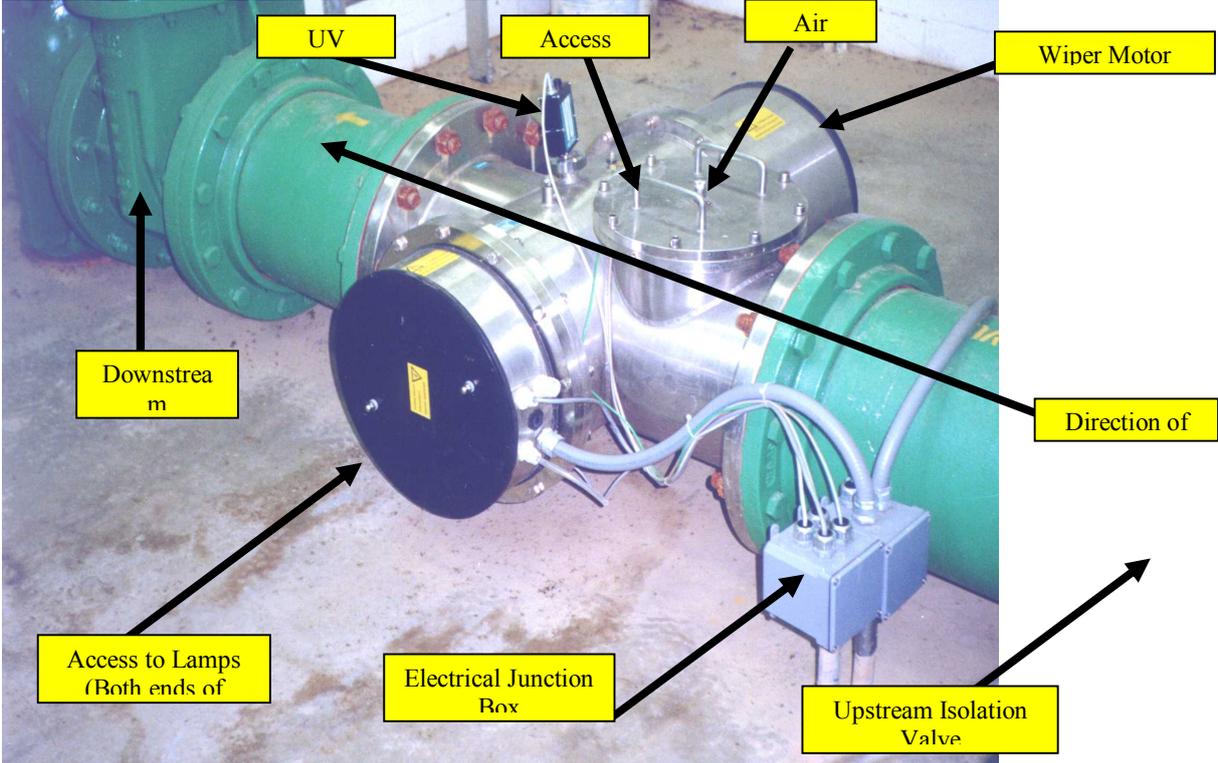


PHOTO SHOWS TYPICAL PARALLEL SYSTEM



PHOTO OF SITE – FROM POND WALL SHOWING 600ML STORAGE POND

