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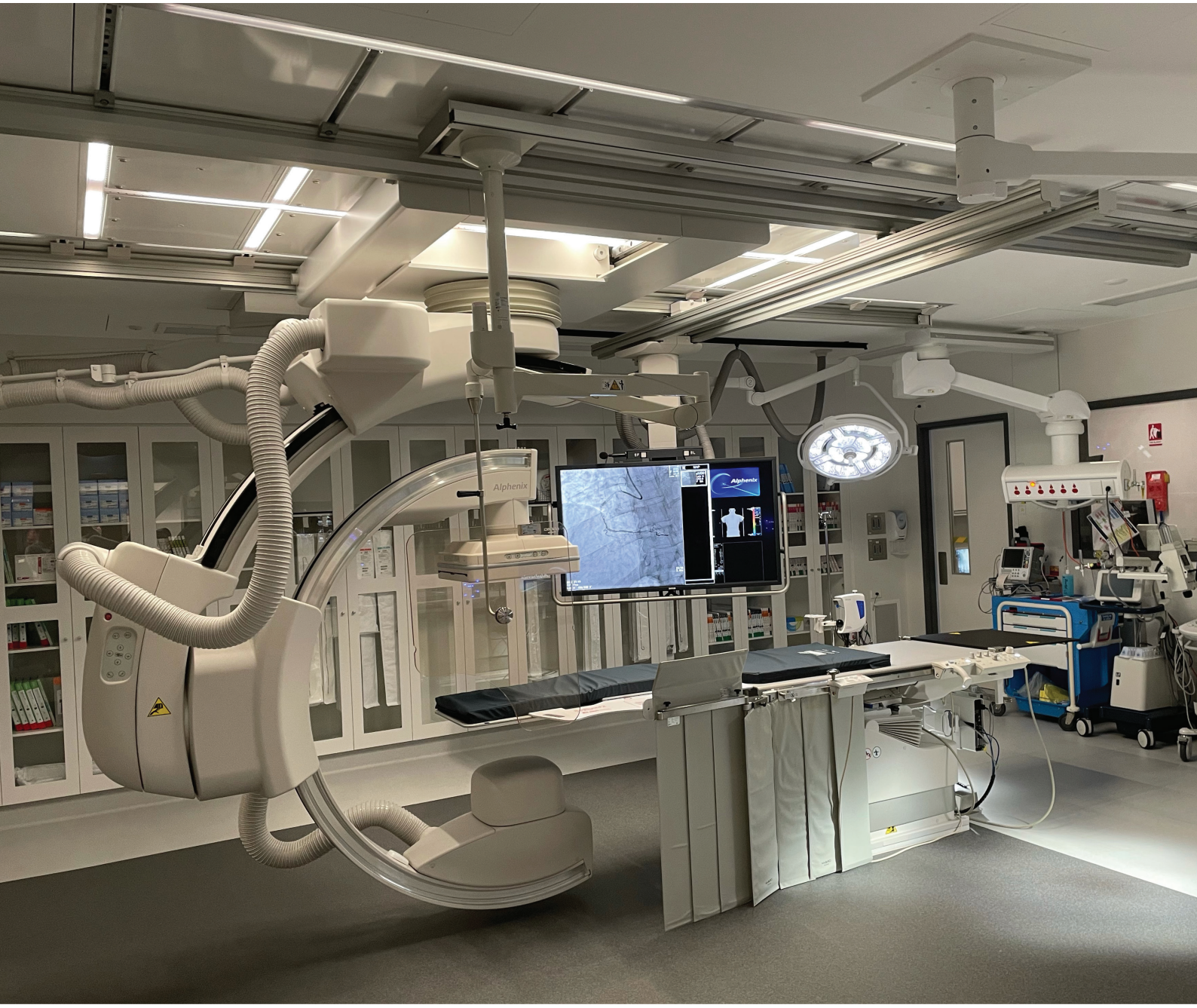

FEATURED INSIDE:

ECHUCA HOSPITAL – SOLAR THERMAL PROJECT

'SMART' AND 'ALL ELECTRIC' HOSPITALS – A NEW REALITY.

AI – MAKING THE IMPOSSIBLE POSSIBLE

CASE STUDY

NEW INNOVATIVE APPROACH TO INLINE DRINKING WATER TREATMENT AT TOOWOOMBA HOSPITAL (QLD)

Traditional water disinfection treatments require continuous maintenance and carry the risks associated with on-site handling of hazardous chemicals. Ecas4 Australia's revolutionary electrochemical disinfection technology challenges this age-old approach with an inline electrochemical disinfection process that allows for a dual effect: microorganisms are either electrocuted inside the cell or killed thanks to the action exerted by the residual chlorine synthesized by the system.

Drinking water service providers include all councils or businesses involved in the treatment, storage, distribution and reticulation of water for drinking purposes. They are responsible for managing and operating their water supply, monitoring water quality, handling customer complaints, and working with Queensland government regulators in the event of an accident. As a Queensland service provider, the Toowoomba Regional Council is responsible for providing quality water supply and sewerage services to customers in the Toowoomba Region.

The site. Toowoomba Hospital is located on an 11.3-hectare site bordered by residences and facilities to the north, Pechey Street to the east, West Street to the west, and the rear of residences along Joyce Street to the south. The site is located 2 kilometres from the central business district of Toowoomba and is elevated, making it visible from a distance. The site contains around 25 buildings, most of which date from the 1950s onwards. Most of the early buildings are located in the south-west corner of the site, and it is in this area that the boundary of the heritage register is located.

Toowoomba Hospital was recently expanded to include a large new entrance and wards building, housing for maternity and surgical services, a medical village for private practises and large administrative and research buildings. Most of this development is located at the eastern end of the site and is not included within the heritage register boundary.

The problem. The Medical Block of the hospital has a drinking water system that includes 2 storage tanks of 15kL each. Although these storage tanks represent a

reserve of water in the event of a lack or limited supply by the Toowoomba Regional Council, the presence of large volumes of water open to the atmosphere and in conditions of relative stagnation, especially if supported by levels of optimal temperature, allows the volatilization of the residual chlorine initially present in the water, with the consequent possibility of proliferation of bacteria, including pathogenic species for humans (Legionella, Pseudomonas aeruginosa, Staphylococcus aureus, etc.). As anticipated, the Toowoomba Regional Council is responsible for providing safe and reliable water to its customers (to the hospital, in this case); however, the responsibility ceases at the water meter, so any subsequent treatments become the responsibility of the end customer (i.e., the hospital).

Due to the risks associated with the low levels of free chlorine in the water present in the storage tanks, the maintenance personnel were forced to manually dose the tanks with liquid chlorine to shock chlorinate the water and try to keep the microbial quality under control. Evidently, also for the reasons set out above, periodic shock chlorination interventions do not represent optimal management: on the one hand they require the use and consequent handling of relatively dangerous chemical products; on the other hand,

it is precisely the fact of introducing the disinfectant in a discontinuous way that requires shock interventions, which aim to resolve belatedly what should be managed regularly. It should also be noted that the addition of large quantities of disinfectant (shock intervention) leads to a rapid decline in water quality, due to the presence of possible by-products and salts, which can contribute to the onset of other problems (for example, corrosion of the tank and connected pipes).

The solution. In August 2021, Aquastream Water Solutions installed and commissioned a new drinking water treatment system, with the aim of eliminating the occupational health & safety risks related to dealing with chemicals (liquid chlorine, in this case) and provide full control of microbial water quality in the Medical Block. Although the goal has been reached by treating the water in such a way to consistently supply a free chlorine level between 1.5 and 2.0 mg/L, no chemicals are added to the treated water.

The drinking water treatment system represents one of the first field applications of a WaterMark certified device made in Australia by Ecas4 Australia, a company focussed on engineering for health and hygiene. The system includes two electrochemical cells (eBoosterTM, patent pending), a dedicated control panel, and a Prominent chlorine meter. The eBoosterTM cells are installed in parallel, within a dedicated hydraulic line (bypass) that therefore allows any maintenance operations without interrupting the water supply to the building.

Each eBoosterTM cell (model B2k) contains multiple electrodes covered with a special coating that supports polarity reversal, thus eliminating the need for periodic shutdowns and cleaning to remove calcium and/or magnesium carbonates that otherwise precipitate on the electrodes, hindering the correct functioning of the system. The electrodes are used to force a low voltage electric current through the water being treated and thus allow a series of electrochemical and chemical reactions. Sergio Ferro, Technical Manager of Ecas4 Australia, explains it as follows: “The electric current leads to the electrochemical production of disinfectants from the water itself (reactive oxygen species) or from species dissolved in the water (for example, chloride is oxidised to free chlorine). Once the desired disinfection process has occurred, everything returns substantially to the way it was before: the free chlorine returns to the original form of chloride, and the reactive oxygen species are reduced back to water. Therefore, there is no overall change in the chemical composition of the water, apart from a significant reduction in microbial content and/or organic substances initially present in the water”.

The benefits. Compared to chemical disinfection methods, electrochemical disinfection of water has the advantage of not requiring transport, storage and dosage of chemicals. In addition, the disinfection effect can be adjusted according to the on-site demand by adjusting the setting, either remotely

or onsite. Electrochemical disinfection of water containing chlorides exhibits a residual effect due to active chlorine not being immediately consumed and is often more cost-effective and requires less maintenance than other disinfection methods.

The drinking water treatment system recently installed at the Toowoomba Medical Block has been designed in such a way as to allow the possible future treatment of larger volumes of water than the current ones, considering two eBoosterTM cells. Although the latter are installed on a line that continuously recirculates the water inside the storage tanks, for safety reasons a flow switch has been inserted that allows the supply of current to the cells to be interrupted in the event of a lack of flow. The chlorine meter provides a continuous and online reading of the level of disinfectant present in the treated water; the signal produced is processed by the control panel PLC and used to adjust the current sent to the eBoosterTM cells, in order to obtain the desired quantity of residual active chlorine.

The system allows for remote monitoring and management by Aquastream (connection is via the secure Queensland Health BMS), as well as monitoring by Queensland Health itself.

Based on current working conditions, the useful life of the electrodes inside the eBoosterTM cells can be estimated at over 40,000 hours (4.5 years, assuming a 24/7 workload), with a power consumption of less than 60W per hour or 1.4kWh per day (i.e., as a small old-fashioned light bulb). The cost of electricity is therefore around 30 cents/day.

Gavin Kingon, Aquastream Water Solutions Sales Consultant, commented: “We were surprised with the quality of this product: Ecas4 Australia provided a great support and everything we needed; the system, which is WaterMark certified and therefore suitable for drinking water, arrived ready to install, and already configured for remote monitoring”.

Sergio Ferro (Technical Manager of Ecas4 Australia) holds a PhD in Chemical Sciences; he worked as a researcher at the University of Ferrara (Italy) for about twenty years, before immigrating to Australia by invitation. His expertise includes electrochemical reactivity, material chemistry, surface science and environmental chemistry, with particular attention to application aspects, such as the development of new electrodes for industrial electrochemistry, the use of electrochemical methods for water disinfection, and the remediation of water and soils.