ODOUR CONTROL
FOR THE HOPPERS CROSSING PUMP STATION

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INTRODUCTION

The Hoppers Crossing Pump Station, built in 1992, transports approximately 60% of Melbourne's wastewater to the Western Treatment Plant in Werribee, Victoria. The sewer main consists of 15.2 kilometres of deep tunnel from the Brooklyn Pumping Station to the Hoppers Crossing Pumping Station, and 7.3 kilometres of shallow tunnel from the pump station to the Western Treatment Plant.

Figure 1. Melbourne Sewer Network

In order to control the significant odour emissions that would be generated within the deep tunnel, an odour control facility with an extraction rate of approximately 80,000 m³/h was installed at the Hoppers Crossing Pump Station comprising a chemical scrubbing system with activated carbon polishing and a 30m high ventilation stack.

UPGRADE REQUIREMENTS

Chemical scrubbing systems, whilst providing reliable and effective treatment, have significantly high operating and maintenance costs and require the storage and use of hazardous chemicals compared to other comparable treatment methods. For the facility at Hoppers Crossing, and after more than 25 years of service, it was considered that the system was at the end of its useful life with various deficiencies noted as follows:

- No redundancy with the main treatment vessels and extraction fan (i.e. no standby capacity)
- Leakages within the air ductwork causing loss of system performance
- Use of hypochlorite and sodium hydroxide which are hazardous and require strict health and safety procedures for storage and handling
- Frequent leakages of hypochlorite and sodium hydroxide from pipework connection points
- Facility is routinely shut down for extended periods (up to several months) for major maintenance such as tower refurbishment and / or ductwork coating
- Hypochlorite scrubber required weekly maintenance which in turn required the whole treatment facility to be shutdown during these works
- Frequent deliveries of sodium hydroxide used within the process
- Excessive costs associated with the servicing and maintenance of the electrolytic cells used for the generation of hypochlorite

The Werribee Hospital is looking to expand in the near future along with development of the Werribee Employment Precinct and with other development encroachment around the plant, will lead to an increased likelihood and consequence of odour complaints. The existing facility was also unable to be upgraded to achieve increased ventilation of the sewer system (i.e. 120,000 m³/h) and to meet future boundary odour requirements.

While chemical scrubbers have provided effective and reliable treatment of gaseous pollutants for many years, Biotrickling Filters have now become the most cost effective and environmentally sustainable treatment method for municipal wastewater facilities. A detailed assessment undertaken by Melbourne Water showed that replacement of the existing chemical scrubbing facility with a BTF system would provide substantial cost savings and occupational health and safety benefits.

Figure 2. Decommissioned Chemical Scrubbing Facility

CASE STUDY DETAIL

The new odour control facility was designed to treat an initial extraction rate of 100,000 m³/h. This air was drawn from the Western Trunk Sewer deep tunnel section in order to limit corrosion and maintain the sewer under vacuum, preventing any fugitive emissions and subsequent odour nuisance along its vast length. The odour control facility comprises five BTFs operating in parallel and is configured without any recirculation pumps in a 'once through' irrigation arrangement. The treated air can then be directed to an activated carbon filter system for further 'polishing' of the air stream when inlet odour concentrations are high or bypassed straight through to the existing 30m ventilation stack for atmospheric dispersion.

Figure 3. New Odour Control Facility

The project comprised design, procurement, installation and commissioning phases which took place over an approximate two year period. Considerable cost savings were achieved through use and refurbishment of the existing activated carbon filter which was built as part of the original chemical scrubbing facility. While the BTFs can achieve the required discharge levels for most of the year, the integration of the carbon facility within the design allows for its use during times of high inlet odour loads or if loads were to increase substantially in the future.

With the need to keep the existing facility operating during the construction phase, a large connection chamber was installed during the first stage of works. This then allowed a simple cut-over at the end of the works to bring the new facility on-line.

The 4m diameter by 11m high BTF vessels and up to 2m diameter ductwork and dampers were fabricated from light weight glass reinforced plastic (GRP) to provide long life and ease of installation. Other significant equipment items comprised 185kW fans, a 144kW in-line heater, water pumping system, drainage system, access platforms, instrumentation and PLC/HMI control system.

Irrigation water is required in the BTFs to maintain a moist environment and dissolve compounds in the foul air to support the growth of odour removing bacteria. The facility has been configured to use Class C and Class A recycled water sources with potable water to be used as an emergency back-up if required. Since recycled water is used, and apart from the necessary power required to run the fans and other minor electrical sources, operating costs for the facility are much lower than that of the previous chemical scrubbing facility by comparison. Without the need for any hazardous chemicals, nor any significant on-going support and maintenance (can be operated as an unmanned plant, unlike the chemical scrubbing system), the facility has demonstrated its substantial value to the community and overall cost effectiveness.

The use of GRP vessels and ductwork provides major advantages to large facilities such as this, however the sheer size and importance of these items requires strict quality assurance to ensure the inherent long design life is achieved. While Manufacturers implement their own various quality assurance activities, 3rd party independent inspections are considered essential to ensure the agreed design and manufacturing standards are being adhered to.

The sewage flowing through the Hoppers Crossing Pump Station has a high industrial component with odorous compounds such as hydrogen sulphide, mercaptans, carbonyl sulphide, ammonia and a vast array of volatile organic compounds present within the extracted air. Inlet hydrogen sulphide concentrations vary between 5 to 12 ppm with concentrations reaching in excess of 20 ppm on occasions during summer months. Inlet odour varies widely with concentrations exceeding 110,000 OU on occasions indicating the significant contribution of odorous compounds other than hydrogen sulphide.

An extensive performance testing program confirmed that the facility met the strict discharge limits for odour and hydrogen sulphide amongst other pollutants. Figures 4 and 5 show the hydrogen sulphide and odour treatment performance for the facility. With the addition of atmospheric dispersion from the vent stack, the resulting ground level concentrations within the surrounding area are significantly below odour detection thresholds.

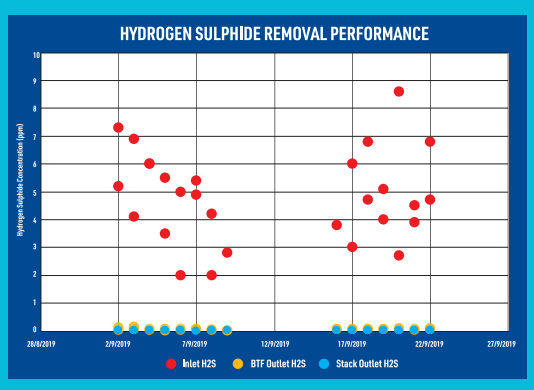

Figure 4. Hydrogen Sulphide Removal Performance

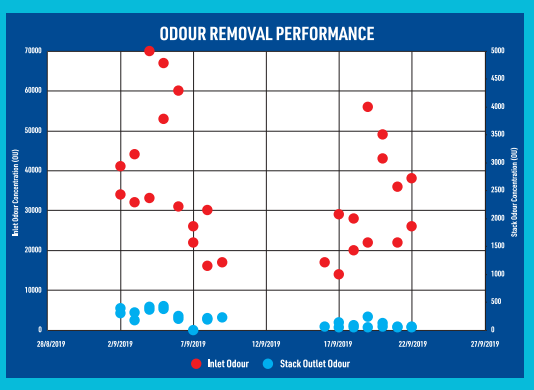

Figure 5. Odour Removal Performance

CONCLUSIONS

Over the last two years since it began operation, the facility has continued to perform to its design intent of achieving effective odour mitigation of this major sewerage system using recycled water and with minimal operator supervision or intervention.

The success of the project has been due to the excellent cooperation between Melbourne Water, John Holland, KBR, CleanTeQ Aromatrix and their other service providers which resulted in substantial capital cost savings and minimised shutdown periods of critical sewerage services.

The replacement of the chemical scrubbing facility at the Hoppers Crossing Pump Station by a Biotrickling Filter (BTF) facility also represents a significant milestone in the evolution of large environmentally sustainable low-cost air treatment schemes within Australia.

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