ASSET PROTECTION & ODOUR CONTROL USING ODOURLOCK®

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ABSTRACT

A central NSW regional water authority has historically experienced significant problems with odour and corrosion of concrete sewerage infrastructure. The severity of the problem was such that frequent odour complaints prompted attention from the NSW EPA. The sewerage network consists of around 1,385 km of rising and gravity mains and 182 pumping stations transferring approximately 40ML/day of sewage to two treatment plants. As a result of the undulating local topography, the network is characterised by frequent changes between rising main and gravity main. The continual rising and falling nature of the sewer lines resulted in the inability to maintain sufficient dissolved oxygen concentrations in gravity sections. As a result, vast sections of the network were effectively untreated. This prompted the water board to seek a solution for the control of effect of sewerage septicity.

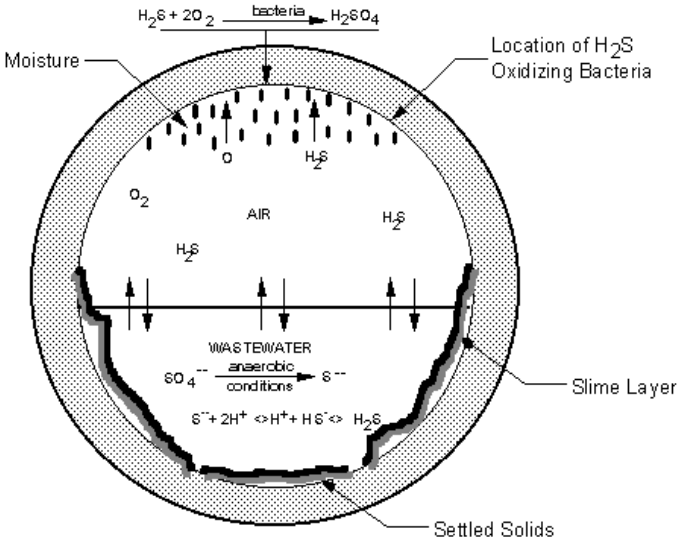
Orica Watercare developed an odour mapping process of the sewerage network to establish a thorough understanding of the problem and the council's requirements and ultimately a comprehensive control strategy. The implementation of Odourlock® dosing at 38 sites commenced in August 2002. Analysis at the main pumping station indicated a 95% reduction in hydrogen sulphide concentration. The reduction in H_2S concentration coincided with a reduction in the number of odour complaints by 50%. Further, reduced $H_2S_{(g)}$ levels within the network minimised corrosion of valuable sewerage infrastructure thereby decreasing the requirements for infrastructure maintenance and repair and hence costs.

1.0 INTRODUCTION

Despite the use of oxygen injection for the control of sewage septicity, the water authority has experienced major problems with odour and corrosion arising from their sewerage network. Frequent odour complaints had resulted in attention from the NSW EPA, and a subsequent implementation of pollution studies and reduction programs for odour issues, turning it septic (anaerobic). The undulating nature of the coastal region north of Sydney, combined with variable detention times resulted in an inability to maintain sufficient dissolved oxygen concentrations in the low pressure, gravity sections of the network, leaving vast stretches effectively untreated. Depleted oxygen levels enabled the sewerage to become septic (anaerobic) leading to the formation of hydrogen sulphide.

The generation of hydrogen sulphide in rising mains is primarily due to the reduction of sulphates to sulphides (during anaerobic conditions) by thiobacillius bacteria residing in the slime layer present on sewer walls. Solubility limitations and turbulence result in the release of hydrogen sulphide gas. Released gas can contribute to both odour complaints and concrete asset corrosion via the oxidation of H_2S by bacteria on surrounding structures to form corrosive sulphuric acid (see Figure 1). This process is influenced by the wastewater temperature, age, pH and BOD. Without treatment, acid corrosion of sewer lines, pump stations and manholes will ultimately destroy the assets.

Figure 1: ***Sulphide Generation Mechanism in Sewer Networks***



2.0 ODOUR MAPPING PROCESS

In order to develop a suitable odour and corrosion control strategy, Orica Watercare applied an Odour Mapping Process (OMP). This process applies a structured method of establishing the network odour and corrosion problem in a given system. The process was followed to discover and develop a thorough understanding of the extent of the problem with the system in question and consequently identifying the stakeholders needs and expectations. Orica Watercare then applied its knowledge and resources to the System Odour and Corrosion Map to develop a comprehensive control strategy to meet the needs of the Council.

The first step that Orica Watercare took in developing its Odour Mapping process was to determine points of strategic issue within the system. This was a layered process that included not only the investigation of the physical attributes of the system, such as the length of rising mains, diameters of pipes, drop structures and other interesting structural features of the systems, but also utilised the knowledge that was provided by Operators and Council personnel.

The next step was to gather details of the system's dynamic operation. This included a process of verification to obtain reliable information on the flows through the system and the operational configuration of pumping stations.

In parallel to the establishment of knowledge on the sewerage system details of the chemical and biological profile of the sewage were required. The composition and configuration of domestic and trade waste in the area was ascertained by both physical testing and examination of the types and location of industries within each catchment area. This was carried out to give an indication to the type of waste that would be expected, and where these sources interconnected along the system. Sources that would impart highly soluble waste with an elevated Biological Oxygen Demand (BOD) were singled out as points of interest, as it was likely that these would exacerbate odour and corrosion issues.

Visual inspections of manholes, sewers and chambers were undertaken. This was particularly important in identifying areas susceptible to corrosion. Some areas had obviously been subject to years to attack and required immediate attention.

Figure 2: ***Manhole Showing Concrete Degradation Indicative of the Sewerage System***

Others showed early warning signs of corrosion and these locations were also given priority, as it was the aim of Orica Watercare not just to offer a reactive solution but a proactive solution as well.

Consideration was also given to the social aspects of the project. This focussed on looking at areas of past odour complaints and sensitive locations, such as manholes next to shopping centres. Orica Watercare also took out time to talk with the water board operators as they had the most intimate knowledge of the system and had essential experience as to were problem areas were in the network.

One of the key findings from this process was the identification of areas where information was not known. These gaps in information were filled by undertaking a regime of testing, collecting and collating data. Problem points were determined and prioritised in terms of how critical each location was in contributing to odour and corrosion issues.

One of the outcome of this process was the development of a regime of periodic testing and re-testing to build up a longer term profile on the area, and to check assumptions made along the way.

While this process was in progress and before it had been completed Orica and the Customer collated all existing data and information to start the development of a process map of the system and hence the solutions required to solve the issues.

In developing these solutions a costing of the treatment had also to be developed. The Orica method of providing solutions involved utilising a standard range of dosing systems with an open pricing structure. As each point of application was identified the optimal size of each combination of dosing systems could be chosen without needing to design from first principles each time.

This enabled Orica and the Customer to determine how much could be spent on meeting the initial objectives of the project and how much could be spent on moving forward. In fact the Odour Mapping Process allowed the costs of the project to be tracked at each small sub stage

3.0 OPTIMISING DOSING

Optimisation of the dose rates was achieved by firstly coming to theoretical dose rates based on the characteristics of the sewage stream to be tested and the objective of the dosing regime. These dose rates were then tested by undertaking liquid and gas testing in the line of interest over a period of time.

Throughout the process new information was and is always coming to light, which may change previous assumptions and directions. However, this is the continual path of process discovery.

Figure 3: ***Gas Testing at Manhole***

4.0 SOLUTION TO ODOUR & CORROSION PROBLEMS

The proposal to use Odourlock® outlined a sensible and relatively low cost network odour control solution for treating known problems. Odourlock® reacts instantaneously with sulphides in solution to form insoluble iron sulphide thereby preventing its release as the odorous and corrosive gas. Orica is always trying to achieve the most cost effective solution. The cost is dependent on many things; most importantly it depends upon the geographic location, and the volume of sewage to be treated. It is important to note that odour is a manifestation of the corrosion process, and as such corrosion must remain the major issue of focus. Corrosion issues need to be assigned its proper value, as the cost of not acting on such issues can be painful.

The solution also went hand in hand with a testing and analysis regime to monitor performance and identify additional problem areas. This ensured that best value was derived from the chosen solution. In short, a complete odour control and monitoring package was proposed.

The rigour applied in establishing the problem and the development of a solution facilitated the internal approval process as decisions to move forward were based on sound technical evidence. This allowed Orica and Council to quickly implement a workable solution with provision to move towards the perfect solution, by:

- Applying a flexible approach which recognised that as local conditions change, adjustments in the treatment are required.
- Implementing an ongoing performance monitoring process,
- Effective odour control minimising complaints,
- Reducing risk EPA fines due to odour breaches.

It is important to note that stepwise addition of the solution allows minimum cost to be achieved compared with classical tendering, where the proposed solution can either overcompensate or underestimate what is really required. Classical tendering asks the question and requires an answer. A better method is to ask the question and propose a process to answer the question.

Another important aspect of the solution offered by Orica was that by obtaining a sound knowledge of the customer's process and network Orica was able to offer solutions with a rigorous technical basis, while the use of established packaged solutions provides certainty in terms of costing. A good example of these established package solutions is the utilisation of Orica's Containerised Dosing Units (CDU) which provide a secure, robust and totally self-contained dosing system.

The implementation of Odourlock® dosing throughout the Gosford sewerage network was achieved by the initial installation of 38 storage dosing facilities, sized 450 L to 30,000 L capacity according to sewage flows to be treated.

5.0 ODOURLOCK® DOSING

The Odourlock® series are iron salts used to control odour and corrosion in sewage networks. Most sewer odour issues are related to the presence of hydrogen sulphide (H_2S), as discussed above. The concentration of H_2S gas is a product of the sewer conditions and level of dissolved sulphides in the sewage.

Odourlock® works by reacting, and binding, with the dissolved sulphides to form insoluble iron precipitates. By effectively "removing" the dissolved sulphides from the sewage flow, the formation of the gaseous sulphur based compounds is dramatically reduced, and along with it the odour. The iron salts that from are stable under anoxic or anaerobic conditions, so unlike oxidation processes the reaction is irreversible.

Corrosion issues are also dramatically reduced using Odourlock®. Corrosion in cement structures is caused by acidic compounds, primarily sulphuric acid, attacking the concrete substrate. By removing the sulphides that would normally combine with hydrogen molecules to from sulphuric acid the rate of corrosion is minimised.

6.0 ODOURLOCK® DOSING FACILITIES

The site constraints and required storage volumes varied considerably between the 38 strategically nominated dosing points. Odourlock® is classified as a Class 8 corrosive.

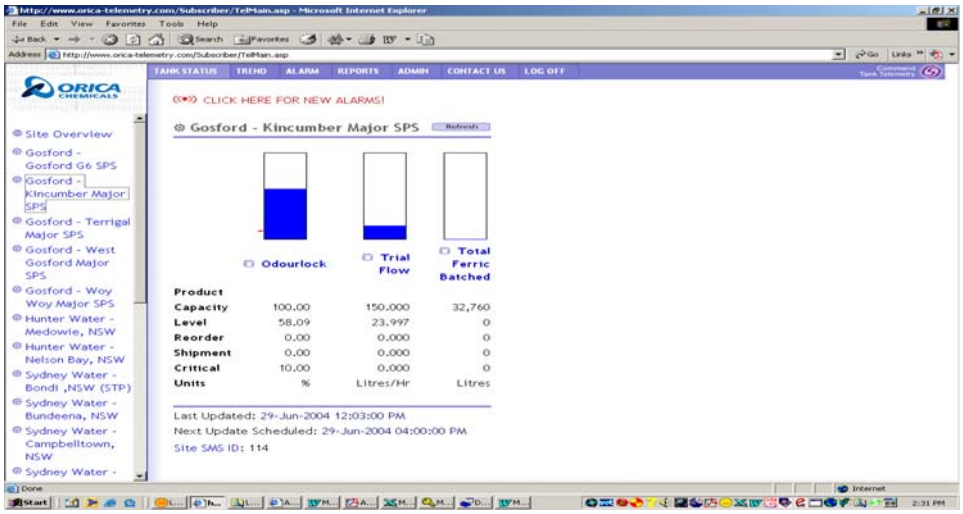
The close proximity of several dosing points to residential areas necessitated bunding, security and safety equipment such as safety showers and eye wash stations at each dosing facility. Two dosing systems were implemented for the project. The OCS self contained dosing package was employed for the small installations whilst the Orica CDU™ serviced the larger sites.

Orica has developed the CDU™ to meet the requirements of dosing in remote locations required for odour control. These units have been designed to incorporate, and comply with, all legislation. The CDU™ units are compatible with a variety of products and dosing is designed to be fully automated. All tank and associated piping is prefabricated so that the units can simply be connected to dosing lines, water supply and electrical inputs. Another attractive feature of these units are that they are fully relocatable.

Figure 4: ***Chemical Dosing Unit (CDU) Installed at Dosing Site***

Orica has an Internet telemetry system to monitor and automatically plan for refilling. The CDU™ ingrates into this system and allows the customer to concentrate on performance monitoring while Orica ensures that there is always sufficient chemicals to provide effective odour control. E-mail and SMS messages are to provided so that critical and important messages are sent to both Orica and the Customer.

Figure 5: ***Orica's Internet Telemetry***



7.0 PERFORMANCE OF THE ODOUR STRATEGY

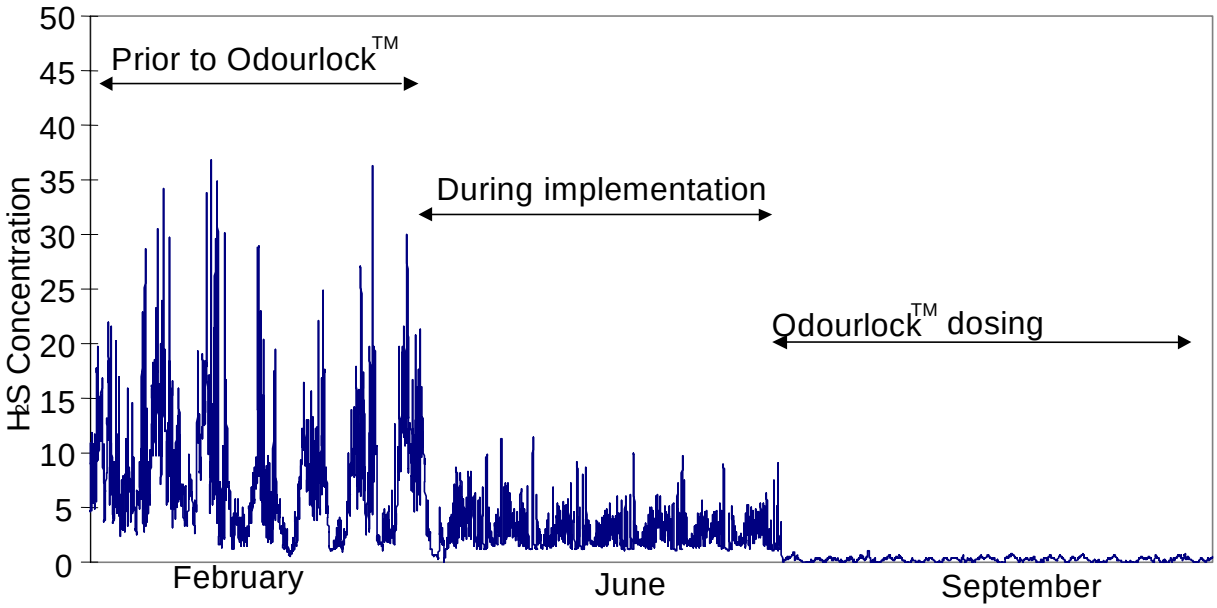
Implementation of Odourlock® dosing across the 38 sites commenced in August 2002.

The main objective to the project were to;

- Reduce odour complaints
- Reduced corrosion of the system
- Demonstrate to other stakeholders that the water board is addressing the issue

A comparison of hydrogen sulphide levels prior to and during dosing is represented in Figure 6. The 95% reduction in H_2S concentration was achieved at the main pump station. The customer target for a 95 percentile less than 2ppm was achieved.

Figure 6: ***Hydrogen Sulphide Gas Levels***



The reduction in sulphide levels corresponded with a decrease in the number of odour complaints received by the water board by 50% thus demonstrating to their ratepayers and the NSW EPA that they have tackled the sewage odour problem successfully. Further, reduced $H_2S_{(g)}$ levels within the network minimises corrosion of valuable sewerage infrastructure.

Without the customer achieving its goals the solution cannot be ratified as a success. This requires an intimate and detailed sharing of knowledge, and will engage more resources than would be necessary with just the straight supply solution. In this way it has been found that both Orica and the customer can benefit from greater knowledge, which ultimately provides a demonstrably better solution.