SEPTICITY OCCURRENCE & MITIGATION WITHIN WASTEWATER TRANSFER SYSTEMS

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ABSTRACT

The occurrence of septicity within wastewater transfer systems often requires a significant investigative approach to determine the appropriate mitigation response.

Septicity of sewage is generally related to extended retention within wastewater transfer systems. Potential effects of septicity, simplistically, are, generation, and emission, of odour to atmosphere, and, eventual infrastructure degradation, by way of formation, *in situ*, of corrosive compounds.

Septicity produces an inherently poor working environment for operational staff within wastewater transfer systems and treatment plants. Complex operational issues arise, through generation of hydrogen sulphide (H_2S), a toxic compound prominently produced by septicity, when attempting maintenance activities within manholes, pipework, pumping stations and treatment plants.

In addition, the generation of hydrogen sulphide (H_2S), an unpleasant gaseous compound, may result in complaints from people living, working, or just passing through, the area of emission. Furthermore, issues often arouse media interest and lead to negative publicity for network managers.

Operational issues related to septicity are varied, with resolutions often a combination of system optimisation and specialist product addition, with each application scenario requiring a concerted investigation prior to solution application.

Mitigation of septicity is achievable, through the application of appropriate strategies designed to ensure both operational and managerial considerations are adequately addressed.

KEY WORDS

Hydrogen sulphide, septicity, mitigation.

1.0 INTRODUCTION

In recent times, rationalisation, and centralisation, of enhanced wastewater treatment facilities has necessitated the extension of sewerage networks, simplistically, in effect, extending the retention time of sewage prior to treatment. In conjunction with this civil infrastructure design philosophy, governments, both State and Federal, are both advocating and legislating reductions of potable water use in the commercial and domestic sectors. The effect of a legislated philosophy, simplistically, is that, as described by Barjenbruch (2003) in a European context, wastewaters entering the sewerage network are decreased in volume, but retain traditional pollutant loads. The scenario created by both effects further impacts upon sewerage infrastructure, in the occurrence of septicity and the resultant potential for creation of odourous substances within transfer systems.

Challenges for sewerage network managers in managing septicity become apparent in either, or in some cases both, of two effects – generation, and emission, of odour to atmosphere and/or eventual infrastructure degradation, by way of formation, *in situ*, of corrosive compounds. Action by network managers is generally a response to one, of two, effects of septicity – asset degradation (corrosion) within the network or complaints received from people living, working, or just passing through the area of emission of odourus substances to atmosphere. Reaching resolutions to the negative effects of septicity often results from a combination of system optimisation and specialist product addition, with each application scenario requiring a concerted investigation prior to solution application.

This report shall present the generation, and subsequent mitigation, of septicity, utilising one such specialist product, calcium nitrate, the BioRemedy Pty Ltd area of expertise, outlining the process of selection of site(s) of application with examples presented from determinations within sewer networks located in both the Central Tablelands and Mid-North Coast regions of NSW.

2.0 THE GENERATION & EFFECT OF SEPTICITY

The generation of septicity within a wastewater transfer system can generally be attributed to the hydraulic retention characteristics of the pressurised (rising) transfer mains contained within. Wastewater transfer systems are transporting wastewaters from collection sources to a treatment facility. The retention of sewage gives rise to *in situ* fermentation allowing for production of compounds described by Barjenbruch (2003) as either primary or secondary odourous substances (osmogenes), from Hubner & Seibt (1994), able to be released to atmosphere.

Primary osmogenes are fed into the sewerage network within wastewaters. In semi-industrial and industrial wastewaters, processing effluents may already contain odourus compounds, while domestic wastewaters may be a causal effect where an intermediate storage (e.g. collection pit) exists.

Secondary osmogenes develop within the sewerage network, via specific chemical and physical actions. The primary chemical action that produces the key indicator, hydrogen sulphide (H_2S) and affecting compound, of septicity is the presence of anaerobic conditions. In the course of wastewater transport, degradation of organic sulphur compounds (amino acids), carried out by biological micro-organisms can occur, to facilitate production of sulphide compounds. These volatile sulphide compounds are subsequently able to be released, in a gaseous form, as hydrogen sulphide (H_2S), in areas of turbulent flows within the wastewater transfer system.

Largely depending upon the civil design characteristics of wastewater transfer systems, secondary osmogenes are subsequently able to develop at different locations under a range of conditions, but the key points of concern remain the transferring shafts/discharge manholes of pressurised (rising) mains exhibiting long hydraulic retention, with Barjenbruch (2003, p. 358) describing these points as, ‘particularly problematical, because osmogenes can be emitted there from wastewater with an anaerobic milieu into the surrounding air.’

Table 1 provides for a general outline of problematic locations within wastewater transfer systems.

Table 1: ***Problematic locations for point-source odour generation***

Location	Cause(s)	Effect
Gravity Sewers	Anaerobic state (long detention; low slope, low flow velocity)	Dependant on construction and operation
Wastewater Pump Stations	Long collection period within pump well Wastewater flow receipt	Creation of an anaerobic environmental condition Osmogenes are stripped out through turbulent flow release
Transferring Shafts/Discharge Manholes	Wastewater from pressurised (rising) main has possibly begun to ferment during low-flow periods	Osmogenes are stripped out through turbulent flow release
Sewer Manholes	Dependant on incoming wastewater: - Anaerobic (high risk of odour) - Aerobic (lower risk of odour)	Osmogenes (previously formed) are stripped out, potential for odour complaints

In each of the listed scenarios, the potential for osmogenes to be 'stripped out' is apparent, achieving two (2) possible causal effects:

1. Odour generation (principally hydrogen sulphide); &
2. Corrosive conditions, leading to asset degradation (over longer-term of exposure). Concrete 'Corrosion' effect is illustrated within Figure 1.

Figure 1: ***Concrete 'Corrosion' Within Sewer Manhole***

3.0 MITIGATION OF SEPTICITY – A CONSIDERED APPROACH

Once network managers have made the decision to attempt to mitigate either the occurrences, or effects, of septicity within a wastewater transfer system, many technologies are available for deployment. As described by Jeavons *et al* (2000, p. 227), 'there is a baffling array of odour abatement technology available, with many claiming to be the universal panacea.' Available technologies include physical, chemical and/or biological methods, either applied individually, or in combination. Each method has particular effectiveness if applied to the appropriate application; therefore it is generally the responsibility of the network manager to attempt to judge the requirement(s) in a holistic manner, i.e. with a 'catchment-based' view.

The catchment-based approach allows for identification of the most appropriate application(s) of the appropriate technology within the problematic wastewater transfer system.

BioRemedy Pty Ltd is the provider of the N-Virox™ Septicity Control Program, utilising calcium nitrate (solution) to promote, and sustain, an anoxic (nil oxygen, nitrate present) environmental condition, suppressing hydrogen sulphide (H_2S) production within wastewater transfer systems. The N-Virox™ Septicity Control Program, in mode of operation, is a nutrient addition, to promote a natural biological process.

Adoption of the N-Virox™ Septicity Control Program, as facilitated by BioRemedy, uses a combination of the following information in order to realise both efficiency and efficacy within practical application:

- Anecdotal evidence, provided by network managers;
- Field-based sampling and monitoring; &
- Mathematical modelling.

4.0 MITIGATION OF SEPTICITY – MODELLING REQUIREMENTS & NEEDS

The N-Virox™ Septicity Control Program, as facilitated by BioRemedy Pty Ltd allows for a holistic assessment of requirements within a transfer system. Key to the understanding of application of the N-Virox™ Septicity Control Program is that the negative end-point effect (either, or both, odour emission or asset degradation/corrosion) is, in most cases, generated upstream within the sewerage transfer system, via sulphide generation/formation within the pressurised (rising) main sections (illustrated, simplistically, in Figure 2).

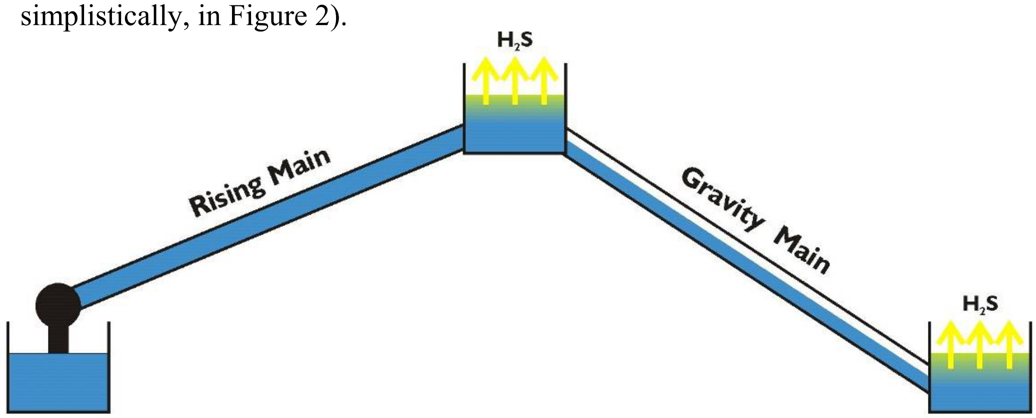

Figure 2: ***Sulphide Generation and Hydrogen Sulphide (H_2S) Emission***

Design of sewage transfer systems usually are comprised of a complex network of either pressurised (rising) and gravity mains, each of which may be either directly or indirectly production points for septicity. Given this potential complexity, it is paramount that practical application(s) within the transfer systems are appropriately selected. The N-Virox™ Septicity Control Program is instituted via application of a calcium nitrate solution to the wet well of the defined sewage pump station (illustrated as Figure 3).

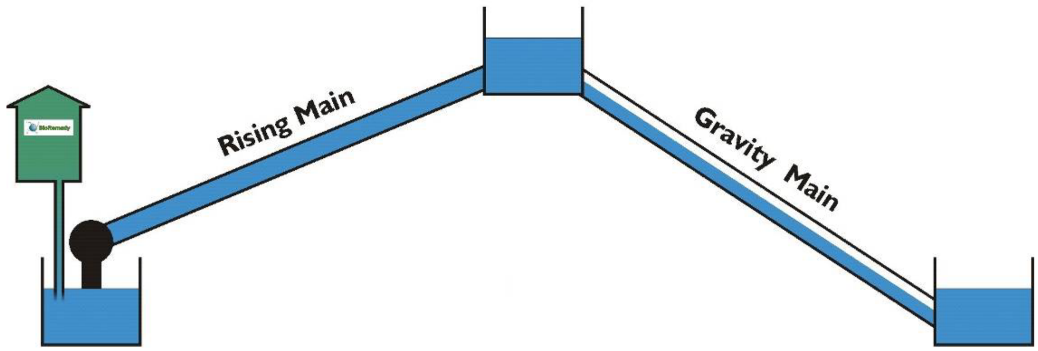

Figure 3: ***The N-Virox™ Septicity Control Program – Practical Application***

4.1 Control Program Application – Modelling Examples

Mid-North Coast (NSW)

- Catchment detail provided by local network manager identified a major area of concern within the southern termination of a sewer transfer network of nine (9) sewer pump stations. A small, infrequent, occurrence of odour complaints had been raised by local residents and recorded by the network managers. Severe asset degradation was being experienced within sewer manholes, with some manhole structures being rehabilitated via institution of epoxy-based resin refurbishment, at considerable cost.

- Pressurised (rising) main data was subsequently provided, detailing main lengths, diameters and sewage flows.

The criteria for program application related to modelled potential sulphide load generated within each of the pressurised (rising) mains comprising the sewer transfer system (catchment).

Outcome: Based upon model conclusions, one (1) primary (required) application site was determined, with one (1) secondary application site for future consideration.

Central Tablelands (NSW)

- A village, back-log sewered approximately ten (10) years previous, appeared to be generating septic sewage discharging to a greater regional city catchment. Severe asset degradation had been noted within, and, at the termination of, the village sewerage transfer network, where it joined the larger downstream catchment. The village sewerage transfer network is comprised of four (4) sewer pump stations, largely configured in series.

- Pressurised (rising) main data was subsequently provided, detailing main lengths, diameters and sewage flows.

The criteria for program application related to modelled potential sulphide load generated within each of the pressurised (rising) mains comprising the sewer transfer system (catchment).

Outcome: Based upon model conclusions, one (1) primary (required) application site was determined, for annual review, in terms of need, as residential growth, and hence increased sewer flow within the village, is expected, over the medium to long-term.

5.0 CONCLUSIONS

Septicity, simplistically, a net-result of long hydraulic retention of sewage within sewer transfer networks, has the ability to generate management issues relating to odour (hydrogen sulphide) and asset degradation (corrosion).

Available technologies for the management of septicity, and its effects, include physical, chemical and/or biological methods, either applied individually, or in combination.

BioRemedy Pty Ltd a provider of septicity control technology, utilises a calcium nitrate solution, added direct to the wet well of sewer pump stations to promote, and sustain, an anoxic (nil oxygen, nitrate present) environmental condition, suppressing hydrogen sulphide (H_2S) production within wastewater transfer systems.

Application of the BioRemedy N-Virox™ Septicity Control technology is based on a holistic 'catchment-based' perspective, in order to realise positive outcomes in regard to mitigation of odour and asset degradation over the long-term. Successful deployment and management of the program seeks to allow network managers to both positively influence community sentiment (through the reduction of odour emission), and minimise unexpected and inconvenient infrastructure refurbishment.

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