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Effect of intermittent flows and ventilation in hydrogen sulfide dynamics in wastewater collection systems

PhD student
Ana Rita Ventura de Matos

PhD program
Environmental Engineering (IST, University of Lisbon)

Supervisor
Filipa Ferreira (CERIS, IST, University of Lisbon)

Co-supervisor
José Saldanha Matos (CERIS, IST, University of Lisbon)

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Summary

Hydrogen sulfide related issues in wastewater collection and treatment systems have been a concern for several decades, due to its negative environmental impacts and potential risks for human health. These include the generation of toxic or lethal atmospheres and release of unpleasant odours. Hydrogen sulfide is also the cause for major material degradation phenomena, like enhanced metal corrosion and concrete disintegration, causing annual economic impacts of several billion dollars. In this dissertation, aspects not fully understood regarding sulfide generation and release in systems under intermittent conditions were studied, in several full scale wastewater and sludge conveyance systems. Experiments were conducted in two gravity sewers of different characteristics, downstream of pumping stations, to evaluate the influence of intermittence in headspace parameters and ventilation, and of those in gas pollutant concentrations (hydrogen sulfide and methane. This indicates that odour and gas release may occur in different locations of the sewer than what could be expected, and also that H2S contact time with sewer and manhole walls may increase, thus leading to greater corrosion potential. The impact of different ventilation setups in terms of exposure risk potential was also assessed. Sulfide generation rates in sludge rising mains, as well as hydrogen sulfide fluxes in confined sludge retention infrastructure, were found to differ from those obtained with wastewater, and were not adequately represented by forecasting models developed for those effluents. As such, a second order polynomial equation was adjusted to simulate the generation of sulfide in a sludge force main. Several considerations regarding variations in biofilm activity along its length were made.

This study also allowed for observations regarding optimization of system operation, in terms of reduced reagent usage, with economic and environmental benefits. Lastly, the developed hydrogen sulfide concentration model adequately fit the observed data for both locations and effluent types it was applied to. Moreover, it was able to override some shortcomings of existing models, namely by taking short term variations into account (as those induced by the intermittence of pumping events), as well as long term effects, with the inclusion of seasonality effects in emission rates. This study has contributed with improved knowledge that can be used for both sewer process modelling, as well as for practical applications in decision making processes, in terms of headspace dynamics and sulfide control strategies.

Keywords

H_2S, hydrogen sulphide, intermittent conditions, odours, sulfide build-up.

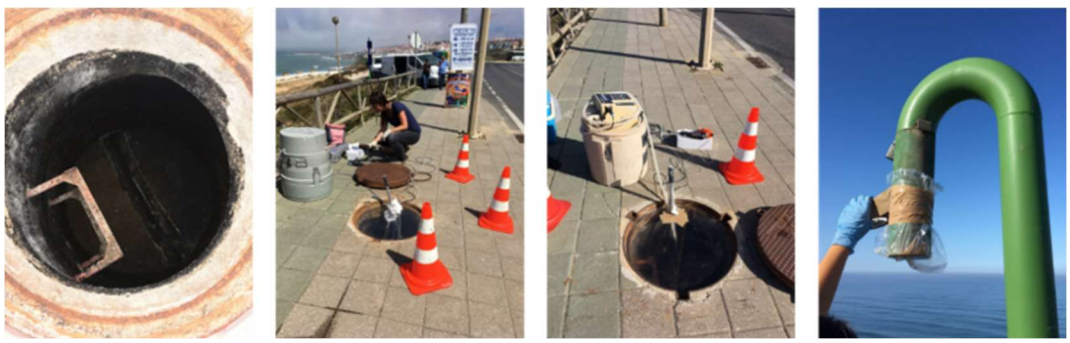

Photo views of the Foz do Lizandro trunk sewer monitoring / Imagens do trabalho de monitorização de H2S no Sistema de drenagem da Foz do Lizandro.