4.3. IMPACT OF OXYGEN INJECTION ON H_2S CONTROL

The lab-scale sewer systems with the configuration shown in Figure 15 were used to investigate the effectiveness of pure oxygen injection on sulfide control.

The results of the study showed that:

- The oxygen injection is effective in controlling sulfide production during periods when oxygen is present. In addition to preventing sulfide from formation, any sulfide present would be oxidized (Figure 16).
- However, oxygen injection has no long-lasting inhibitory or effect on the SRB activities. Figure 16 shows that sulfide production by the biofilms that have received oxygen injection for 86 days resumed as soon as oxygen depleted. This has been further confirmed by the results presented in Figure 17, which shows that the sulfide production capability of the oxygen receiving biofilms, measured as the maximum sulfide production in the absence of oxygen and substrate limitation, was no lower than that of the reference biofilms.
- Figure 17 further shows that oxygen injection enhances SRB activities in the downstream sections of sewers. This is due to the re-generation of sulfate (from sulfide) at sites where oxygen is injected so that more downstream sewer biofilms are exposed to sulfate, which enhances the growth of SRB.

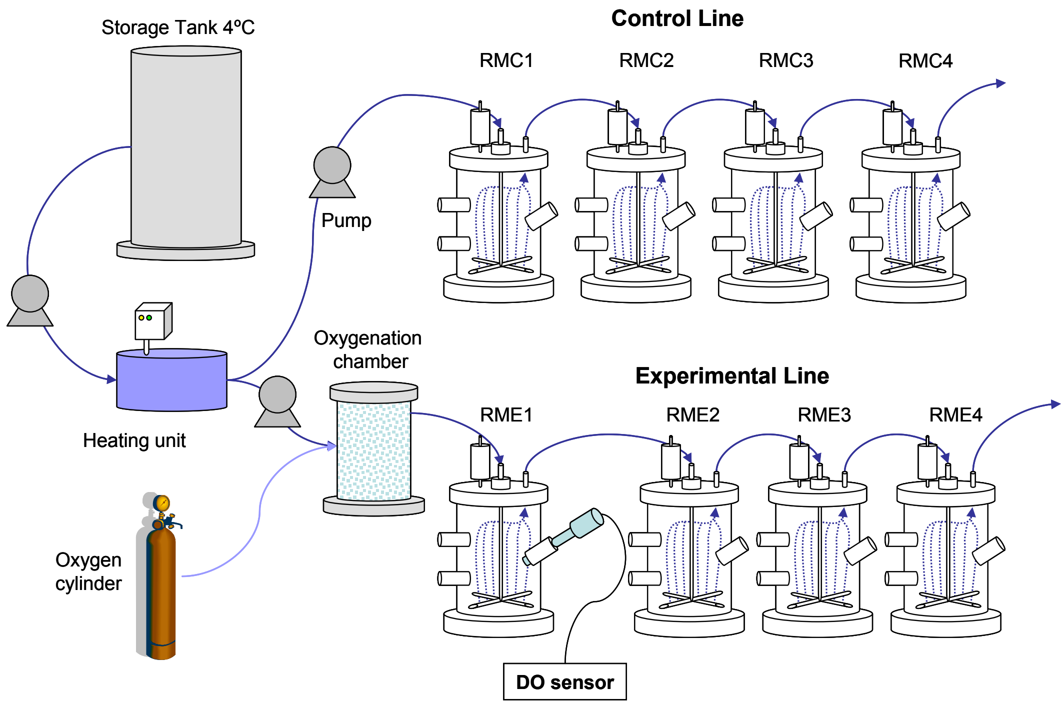

Figure 15: Reactor setup showing the series of rising main control reactors (RMC1-4) and the parallel experimental reactors (RME 1-4) with the oxygenation chamber prior to the first reactor.

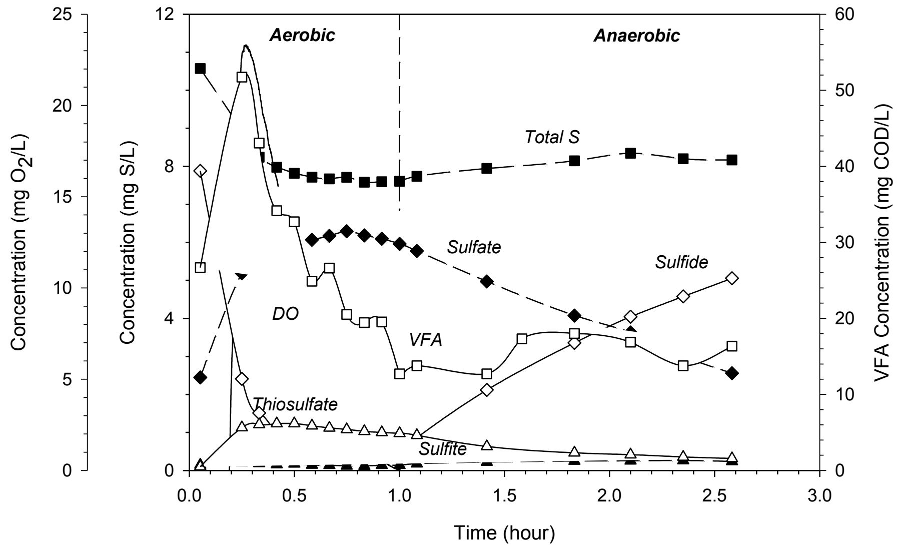

Figure 16: Profiles for oxygen, VFA and various sulfur species during both aerobic and anaerobic conditions following oxygen injection (Batch tests conducted on Day 86 of continuous oxygen injection).

- Figure 18 shows that oxygen uptake rate and VFA consumption rate of the oxygen-receiving biofilms increased dramatically after oxygen injection. This means available oxygen would be quickly consumed and during long quiescent periods, the anaerobic conditions favourable for sulfide production would be quickly established in the system, thereby negating any positive effect achieved by oxygen injection. High VFA consumption is another main concern as this would create a limitation of carbon source for downstream nutrient removal plant.

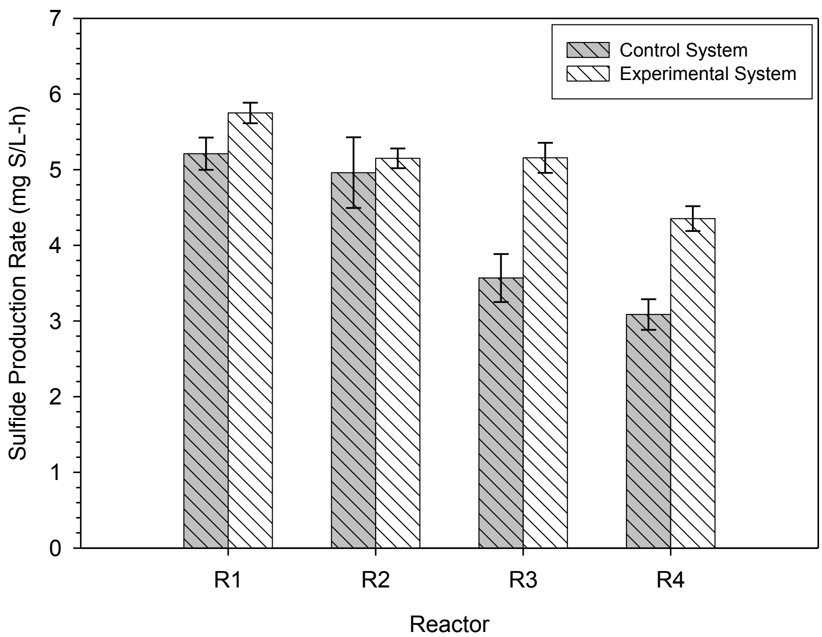

Figure 17: A comparison of the sulfide generation rate in the experimental and the control system

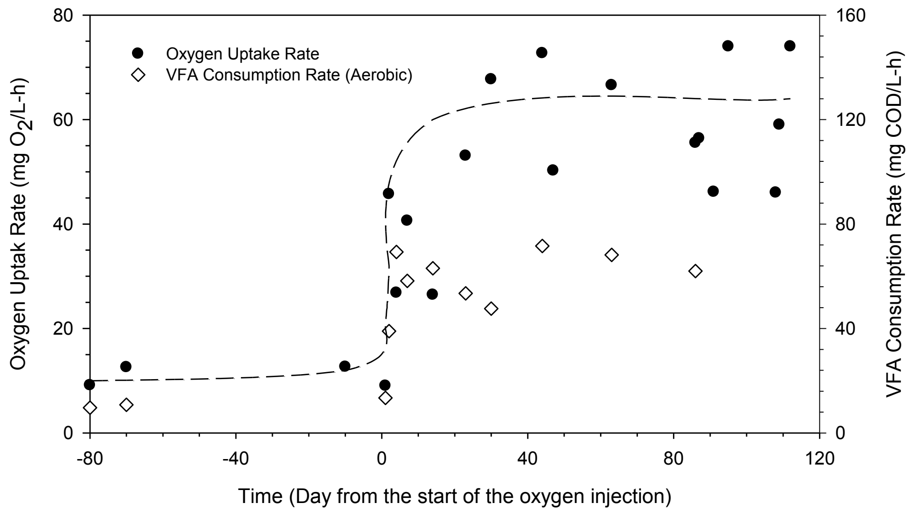

Figure 18: Change in oxygen uptake and VFA consumption rates before and after continuous oxygen injection in laboratory-scale rising main reactors.

The above results lead to the conclusions that, while oxygen is effective in controlling sulfide production; however, its effectiveness and efficiency are highly sensitive to the injection locations. In general, the point of injection (POI) should be "reasonably" close to the points where sulfide control is required (Point of Control - POC). An injection site should be selected such that (1) there would be an adequate hydraulic retention time (HRT) between POI and the POC to enable the full oxidation of any sulfide present at the POI before it reaches the POC, and that (2) aerobic conditions are maintained between the two points with minimum requirement of oxygen.

The selection of the injection sites and the determination of the dosage profiles could be a difficult task, particularly for large, complex networks. As will be shown later in the report, the sewer model developed in this project provides a powerful tool for these tasks (Section 4.9).

A further lesson directly learnt from field studies was that there should be no high points between POI and POC, as otherwise air pockets rich in oxygen and hydrogen sulfide would form at such locations causing corrosion of pipes. This has been observed in several GCW's rising mains.