Impacts of Trade Waste: Dairy Wastewater

1 Methodology

The same reactor system as in the case of brewery wastewater was used. The control reactor was intermittently fed with sewage while the experimental reactor was dosed with a mixture of dairy (10% v/v) and domestic wastewater (90% v/v). In order to characterize dairy wastewater, samples were collected from Parmalat Industry in South Brisbane on three occasion and samples were analysed for various parameters. The wastewater composition varied significantly from batch to batch. To minimize the impacts of the variation of wastewater composition on biofilm activity, synthetic dairy wastewater having a composition that represented average characteristics values was prepared by using skimmed milk powder and other necessary chemicals. The reactors were operated for about 3 months to establish pseudo steady-state conditions and to develop mature anaerobic biofilm on the walls of the reactor and the carriers.

The study was divided into two parts: long and short-term dosing studies. The long-term exposition tests were carried out to the experimental reactor that has been adapted to the dairy wastewater with a mixing ratio of 10 % v/v. However, in the long-term study, the pH of the system was not controlled. A number of batch tests were performed in each stage to observe any changes in the sulfate reduction and methane production capabilities of the biofilm resulting from dairy wastewater addition. As the part of the short-term studies, several batch tests with different concentration of dairy wastewaters were performed on a sewer reactor that has been adapted to 10% v/v dairy wastewater. In this study, dairy wastewater concentration of 0 to 50% v/v was used while pH was maintained at a constant (normal) level.

2 Results

The changes in sulfate concentration in 90 minutes (length of a batch test) in the reference and experimental reactors, which also gives amounts of sulfide produced in the two reactors, are compared in Figure 1. The amount of sulfate reduced in experimental reactor was always lower than that in the reference reactor. The variation in the amount of sulfate reduced is related to the variation in feed sulfate concentration.

The rates of dissolved sulfide production with different feed concentrations (domestic WW only in reference reactor and 90% v/v domestic WW + 10% v/v dairy WW in experimental reactor) are compared in Figure 2. Similar performances were observed in both the reactors during the baseline study. However, comparison during the second phase of test shows lower production of sulfide in the experimental reactor as compared to the reference reactor. On average sulfide production rate in experimental reactor was 30% lower than that in the reference reactor. Methane production in two reactors (experimental and reference) with different feed compositions is compared in Figure 3. The addition of dairy WW shows decrease in methane production by about 10%.

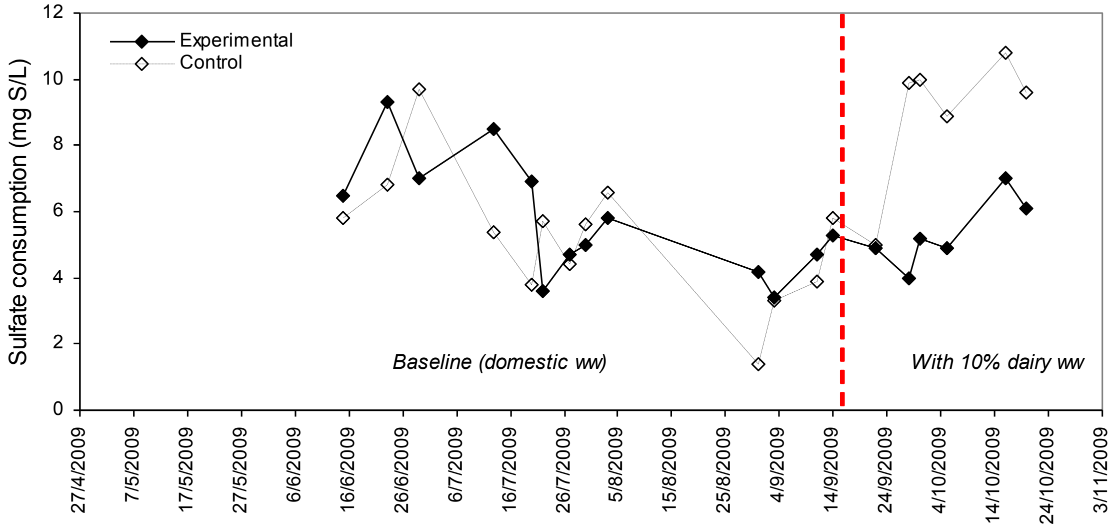

Figure 1: Change of sulfate concentration during the batch tests

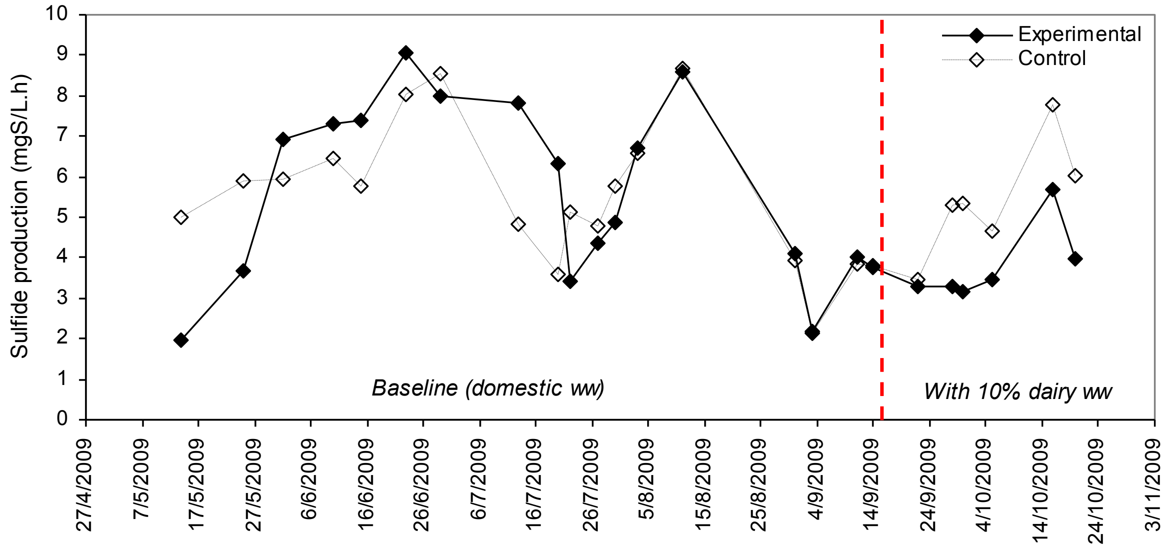

Figure 2: Comparison of sulfide production rate with different feed compositions

The results discussed above clearly show that the addition of dairy WW has negative impacts on both sulfide and methane production. The impacts on sulfide production were more severe on sulfide production than on methane production. In addition to the impacts on methane and sulfide production, introduction of dairy WW has also caused decrease in pH. Initial average pH in the reactor with 100% domestic WW was 6.8, while that with 10% dairy WW decreased initially to 6.2) and further decreased to about 6.0 after 2 weeks of exposition to dairy wastewater.

The results of the short-term study, where different proportions (0, 5, 10, and 25%) of dairy wastewater were added into the experimental reactor, are presented in Figure 4. The results show that the activity in terms of both sulfide and methane production was highest at 10% addition of dairy WW (corresponding to soluble COD of 630 mg/L). This is mainly because the biofilm was adapted to the similar conditions with respect to sewage composition. Lower activities were observed when the proportion of dairy wastewater was either increased or decreased. At lower soluble COD (sCOD) concentrations, the activity of SRBs and methanogens decreased most likely due to insufficient substrate availability. At higher sCOD concentration, it is likely that the level of unidentified inhibitory compounds increased leading to a decrease of both sulfide and methane rates.

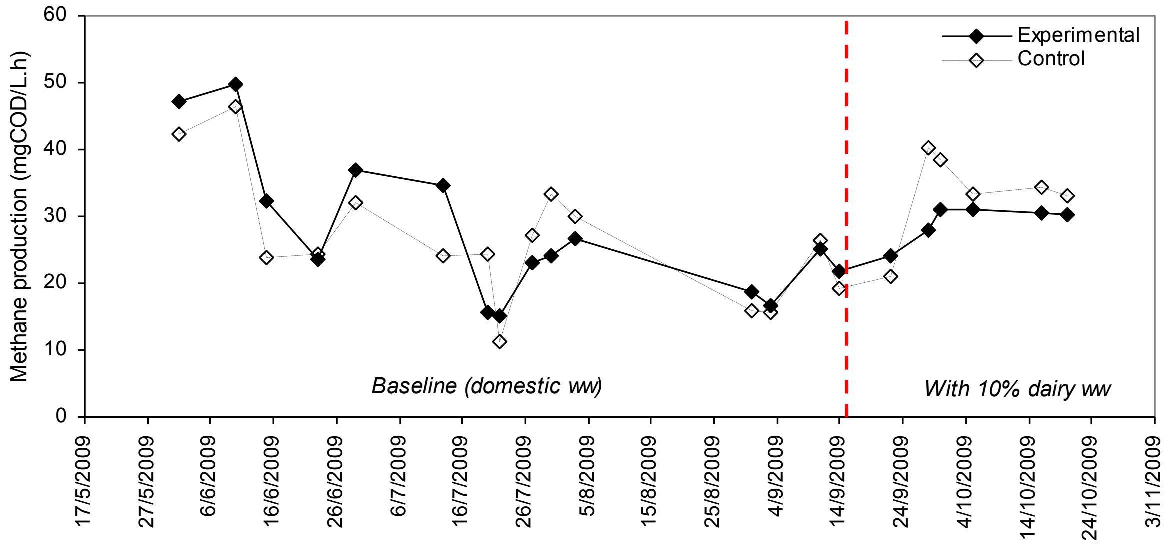

Figure 3: Comparison of methane production

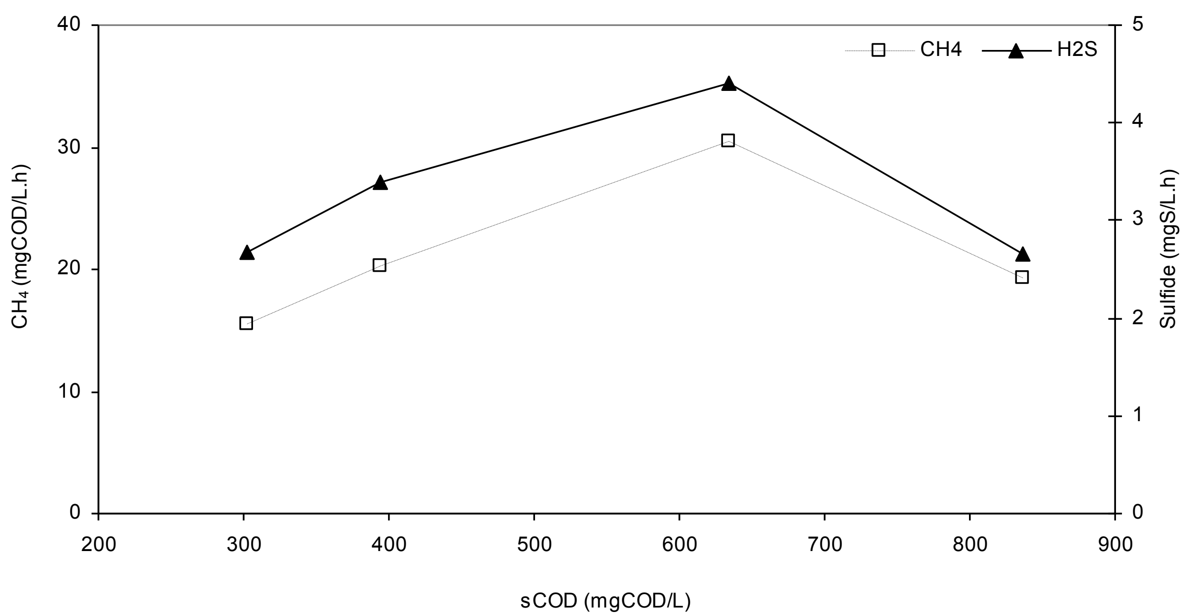

Figure 4: Sulfide and methane production rates during short-term exposition tests

3 Conclusions

The study revealed that the addition of dairy wastewater affected sulfide and methane generation in a laboratory sewer system. The addition of 10% v/v dairy wastewater resulted in the decrease of sulfide and methane production rates by up to 30% and 10%, respectively. These results are different from those observed with brewery wastewater. No significant change in activity was observed in the latter case despite low pH. A number of postulations are made for the decreased activity and possible causes include: slow biodegradation of dairy waste due to slow hydrolytic step of fat degradation, production of some inhibitory compounds during fat degradation, and absorption of fat to the biofilm surface thereby affecting substrate transfer to the biofilm. Significant increase in COD concentration and decrease in pH were observed in reactors dosed with dairy WW. The decrease in pH will have significant impacts in a situation where a rising main receiving dairy wastewater discharges into gravity main as liquid-air transfer of H_2S will be higher at a lower pH.