Co-digestion of industrial waste and domestic wastewater

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INTRODUCTION

EThekwini Water and Sanitation (EWS) runs 27 wastewater treatment plants which process approximately 460 Ml/day of sewage. This corresponds to 100 tonnes of dry sludge per day produced, which has to be disposed of properly (eThekwini Municipality 2011). After treatment the waste water final effluent is discharged to a nearby water source. In several South African coastal cities, the water resource is usually a deep sea outfall. Treated effluent disposal into any water body is controlled and regulated through a discharge permit from the department of Water and Forestry (DWAF). Organisations that disposes effluent to a marine or surface water source have to pay a fee. The municipality has to pay 4 cents/m^3, which translates to approximately R6.7 million per annum, which is 2% of the R350 million spent on waste water treatment activities (Bailey 2004).
Sludge disposal into the sea may become illegal in the future, at that point alternative disposal methods will be necessary. Disposal on land may also be limited by restrictions due to regulation of metals in the soil (Paul and Liu 2012). Due to the restrictions on sea disposal that may exist in the future EWS plans to cease disposal of sludge into the sea from its Southern Water Treatment Works as more evidence of its impact on the environmental impact of wastewater becomes available (eThekwini Municipality 2011)

METHODS

This study's research methodology was developed with the primary aim of testing the validity of the hypotheses that*: Data obtained at higher temperature on the laboratory batch reactor can be used to calibrate the big digester model after adjusting it using temperature coefficients.*
as a prerequisite to establishing a full-scale co-digestion model (CDM) that would permit the co-digestion of high strength industrial effluents with municipal sewage sludge at the Amanzimtoti co-digestion facility (ACDF). The following was required in order to test the validity of the hypotheses:

1. An Anaerobic digestion (AD) model able to adequately represent the steady state operational performance of the ACDF (ADM Model). This was required in order to initialise the laboratory based parameter identification platform model (LBRM). Moreover, through its calibration to describe the steady state operational performance of the ACDF, the influent primary sludge (PS) and effluent digested sludge (DS) could be characterised in terms of model components.

2. A laboratory based parameter acquisition method that met the requirements and limitations of EWS needed to be proposed. The ability of this method to acquire kinetic parameters that capture the influence of a carbohydrate dense co-substrate on microbial kinetics subsequently needed to be established.

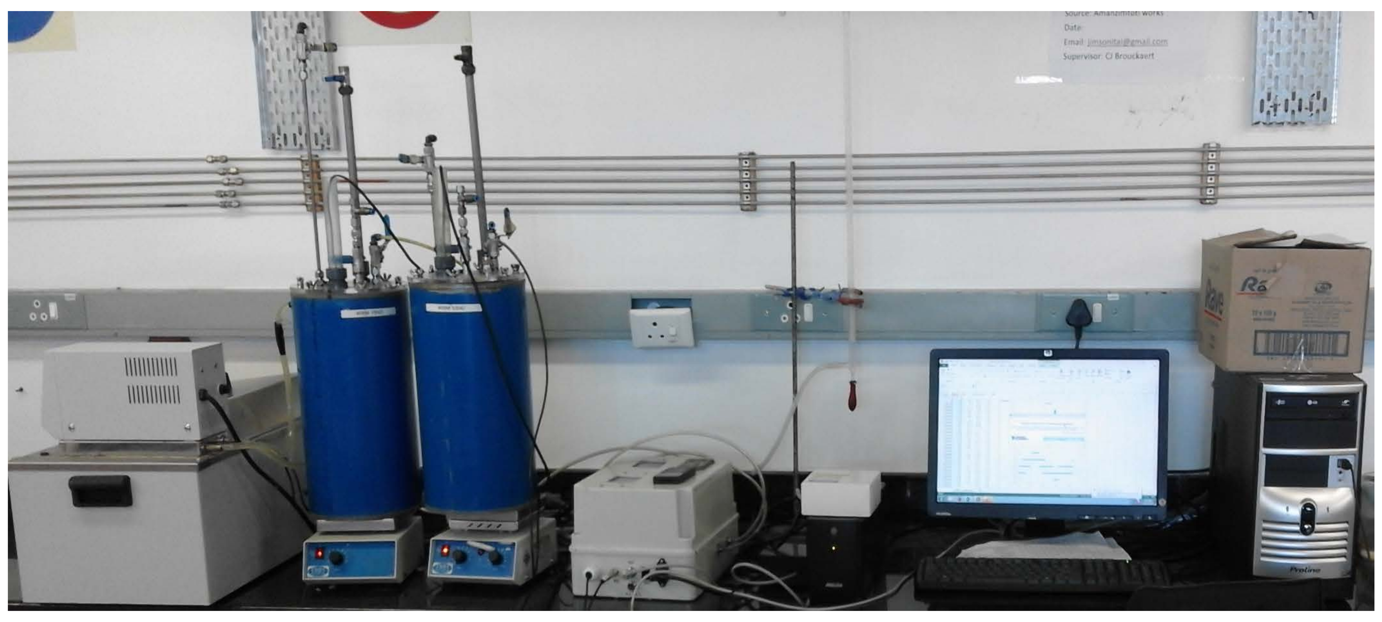

Figure 1: the laboratory based parameter identification reactor platform .

RESULTS

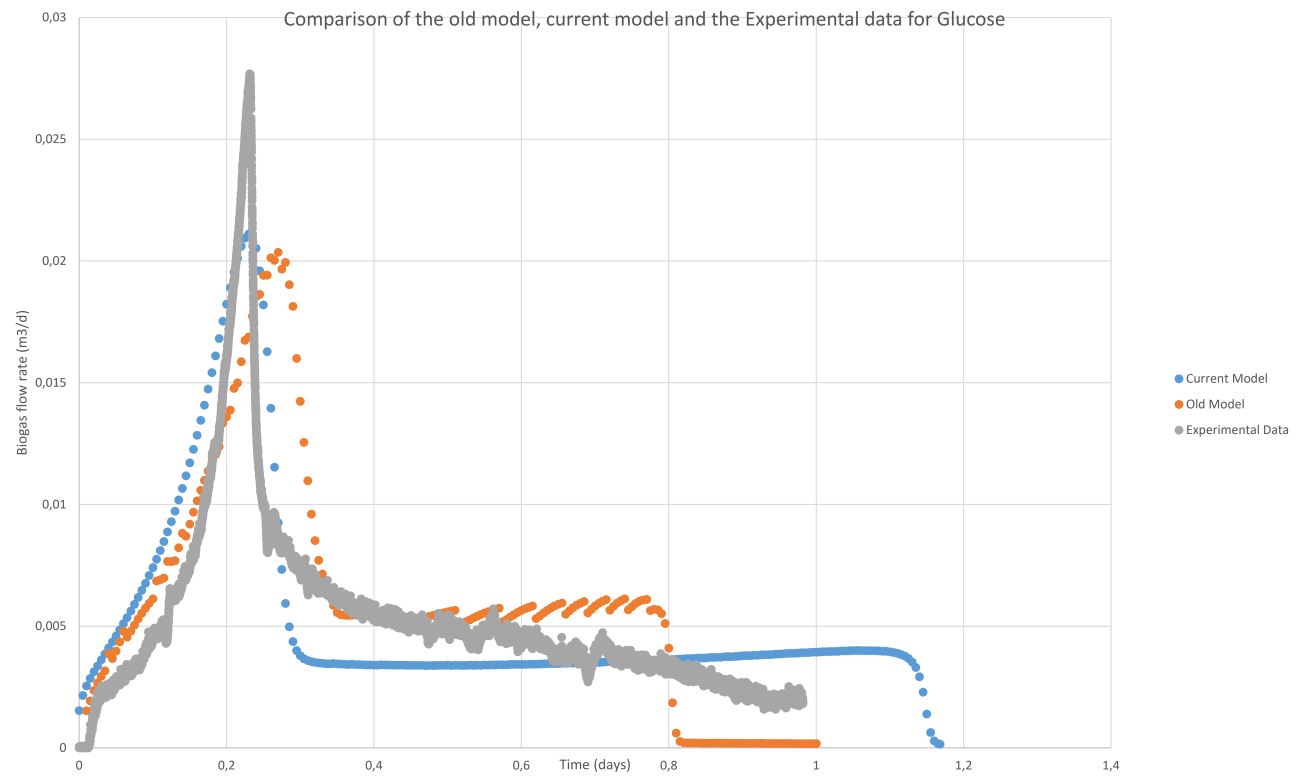

Figure 2: Comparison of experimental data, initial model and current model.

The current model is a much better fit compared to the initial model. The area under the current model curve and the area under the model curve are shown below

DISCUSSION

Table 1: Area below the experimental data curve and the area under the current model curve.

Experimental data Area under the curve (m^3)	0.004294547
Current model Area under the curve (m^3)	0.006089569

The area was calculated using the Trapezium Rule. The difference between the two approximates the difference between the mass balance of the data and the model. The volume of gas produced in the experimental data compared to that of the model is approximately two thirds that of the model. At this stage of the project, this is enough to say the model is sufficient to represent the experimental data.

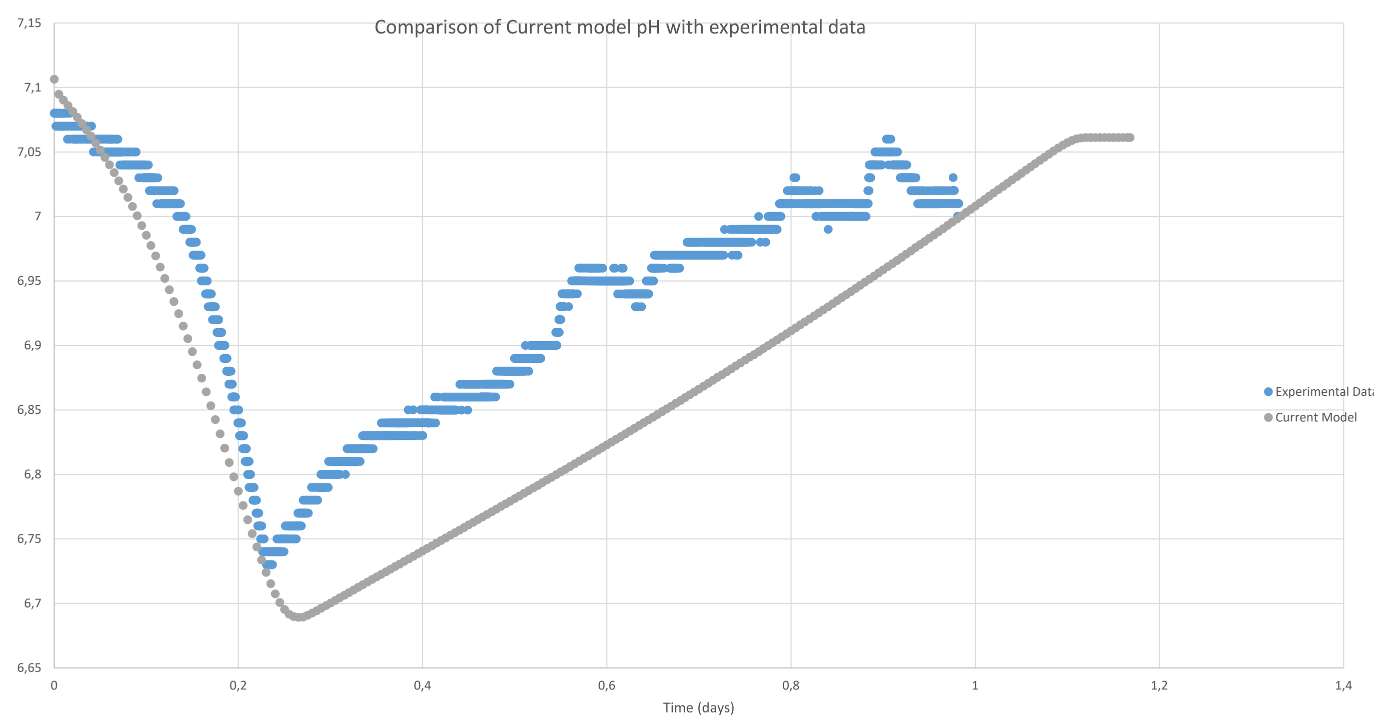

Figure 3: pH of model and experimental data.

The model pH is lower minima compared to the experimental data pH showing that the model shows a less buffering capacity compared to the actual process. Further investigations into possible causes may be necessary to improve the model buffering capacity to improve process control.

CONCLUSIONS

The project will take the following steps in testing the hypothesis:

- The two reactors in the LBRM will be run concurrently using the same batch of sludge. The first reactor will be run at 35 degrees Celsius while the control will be run at room temperature.
- A further study into the temperature coefficient used in the model will investigated, to determine how the coefficient compares to the one obtained for experimental data.

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