

ABSTRACT

The objective of this investigation was to assess the potential of a titration bioassay i.e.: The Methanogenic Activity and Inhibition Analyser (MAIA), to determine the biodegradability of complex industrial effluents and wastewaters. Specifically, the project aimed to provide an alternative experimental method to the serum bottle method so that hazardous effluents can be pre-screened for treatment in under-utilised anaerobic digesters at sewage treatment plants in KwaZulu-Natal, South Africa. This study also aimed to provide a protocol and a simple mathematical model as experimental tools that could contribute to the development of future pre-screening studies.

MAIA was used to conduct biodegradability and toxicity studies on semi-hazardous landfill leachate and textile size effluent. Thereafter, selected studies were repeated using a conventional screening method i.e.: serum bottle method. The investigation with MAIA revealed that both effluent substrates had potential for anaerobic treatment. However, the studies highlighted certain intrinsic limitations of the MAIA apparatus to effectively pre-screen complex substrates. The existing titrimetric system is too coarse to accurately track the biochemical pathways leading from the breakdown of complex compounds to methane gas production. Further, temperature interferences and gas phase diffusion limitations associated with the existing design make the assessment of activity difficult.

The titrimetric method is comparable to the serum bottle method only if a qualitative assessment of toxicity and biodegradability is needed. However, the titrimetric method produces results in a much shorter period of time compared to the serum bottle method. Evaluated in this way the titrimetric method is the better alternative. However, the current system cannot challenge the reliability of the serum bottle method to provide good quantitative results.

A mathematical model was developed which is much less detailed than the existing one provided by Remigi (2001). It comprises only two significant anaerobic processes namely hydrolysis and acetogenesis. Simulation trials have suggested that the model is a necessary and beneficial component of the titrimetric pre-screening protocol.

This investigation has also led to the development of a more refined operating manual for MAIA. The manual provides a step-wise method for the preparation and conduction of pre-screening tests. Specifically, it highlights the need for a suitable biomass acclimation period and the importance of nutrient use for better pre-screening assessments.