Toxicity / substrate inhibition analysis

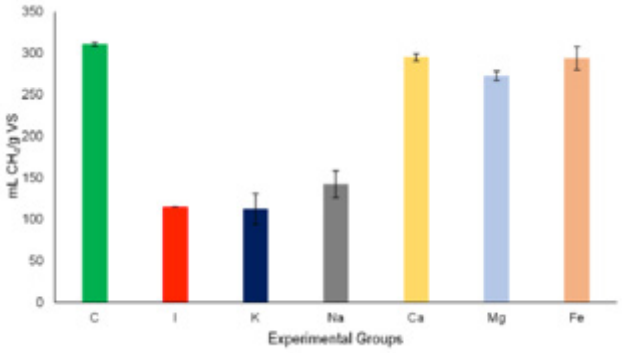
Many of the waste types that can be treated with anaerobic digestion contain toxic compounds that may inhibit or introduce irreversible damaging effects to the process. In order to better understand the toxicity of these substances and determine the tolerance level of the microorganisms, toxicity/inhibition tests are essential to perform. These are standardised batch tests that should be performed under very controlled conditions where the investigated compound is added in increasing concentrations. The use of the highly automated batch fermentation system AMPTS II to perform the analysis ensures data with both high quality and quantity and minimal effort from the user.

Example 1

Investigation of the toxicity of a substrate

Many potential substrates, in particular industrial effluent, with toxic compounds might inhibit anaerobic processes. It is therefore very important to properly investigate the extent of the toxicity effects by performing toxicity and inhibition tests.

The AMPTS II allows to the user to easily perform this kind of analysis with minimal effort and generating high quality data (Buntner et al., 2014).

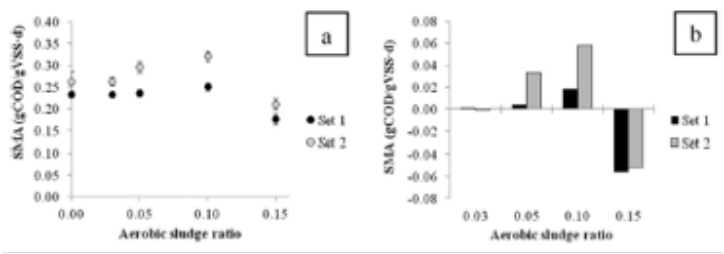


Methane potential of cellulose (Avicel) at high concentrations of humic acid with positive control (C), inhibition control (I) and various salt additions (Yang et al., 2014).

Example 2

Evaluate how additives might decrease effects from inhibiting compounds

In order to decrease the toxic effect of certain substrates it might be necessary to supplement compounds that can counteract some of the negative effects. By performing toxicity tests, based on fermentation in batch procedure, with different types and amounts of additives, it is possible to determine the most effective approach to limit the toxic effect. These types of studies are ideally performed with AMPTS II as the simple operation of the system allows the user to screen many types and different amounts of the additives simultaneously (Yang et al., 2014; Zhang et al., 2014).



The absolute value (a) and increase/decrease (b) in specific methanogenic activity at different fractions of aerobic sludge added to the anaerobic sludge (Buntner et al., 2014).

Substrate toxicity and inhibition

General description of toxicity and inhibition tests

A toxicity or inhibition test is usually performed by studying the difference in specific biomass activity. Often a standard substrate (e.g. NaAc) is used at a fixed concentration and at a fixed inoculum to substrate ratio. The inhibitor or toxic agent is then added at different concentrations after which the methane production is recorded over time. After sufficient time has passed (1-5 days) the biomass activity is determined from the slope of the period with a constant gas production rate.

By performing the test at different concentrations of the toxic compound, the inhibitor constant (KI50) or median lethal dose (LD50) can be determined as the concentration when only 50% of the original activity is maintained.

References

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