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The Impact of Mycotoxins on the Anaerobic Digestion Process

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Abstract : Next to the well-known inhibitors in anaerobic digestion like ammonia, antibiotics or disinfectants, the number of process failures connected with mould growth in the feedstock increased significantly in the last years. It was assumed that mycotoxins are the cause of the negative effects. The financial damage to plants associated with these process failures is considerable. The aim of this study was to find a way of predicting the failures and furthermore strategies for a fast process recovery. In a first step, mould-contaminated feedstocks causing process failures in full-scale digesters were sampled and analysed on mycotoxin content. A selection of these samples was applied to biological inhibition tests. In this test, crystalline cellulose is applied in addition to the feedstock sample as standard substrate. Affected digesters were also sampled and analytical process data as well as operational data of the plants were recorded. Additionally, different mycotoxin substances, Deoxynivalenol, Zearalenon, Aflatoxin B1, Mycophenolic acid and Citrinin, were applied as pure substances to lab-scale digesters, individually and in various combinations, and effects were monitored. As expected, various mycotoxins were detected in all of the mould-contaminated samples. Nevertheless, inhibition effects were observed with only one of the collected samples, after applying it to an inhibition test. With this sample, the biogas yield of the standard substrate was reduced by approx. 20%. This result corresponds with observations made on full-scale plants. However, none of the tested mycotoxins applied as pure substance caused a negative effect on biogas production in lab scale digesters, neither after application as individual substance nor in combination. The recording of the process data in full-scale plants affected by process failures in most cases showed a severe accumulation of fatty acids alongside a decrease in biogas production and methane concentration. In the analytical data of the digester samples, a typical distribution of fatty acids with exceptionally high acetic acid concentrations could be identified. This typical fatty acid pattern can be used as a rapid identification parameter pointing to the cause of the process troubles and enable a fast implication of countermeasures. The results of the study show that more attention needs to be paid to feedstock storage and feedstock conservation before their application to anaerobic digesters. This is all the more important since first studies indicate that the occurrence of mycotoxins will likely increase in Europe due to the ongoing climate change.

Keywords : Anaerobic digestion, Biogas, Feedstock conservation, Fungal mycotoxins, Inhibition, process failure
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