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Research area: General aims
Environmental technology // Water

Key words:
Anaerobic treatment, additives, pellet morphology

Title: Examining the influence of additives on microbiology and in connection with sludge degeneration phenomena in anaerobic sludge of the paper industry

Background/Problem area

Process failures in anaerobic reactors are a thing of the past. Phenomena of sludge degeneration have recently been on the increase, however, especially in EGSB reactors (expanded granular sludge bed). These phenomena occur as pellet flotation, pellet disintegration and the formation of fine-particle sludge. In most cases a loss of biomass from the reactor is observed.

Additives are suspected to be the trigger of these phenomena. They may have inhibitory effects on the biomass biocenosis itself on the one hand, and may constrain substrate and biogas transfers by forming layers or precipitates on the pellet surface on the other hand. Knowledge about the effects of additives on physical-chemical sludge characteristics has not been available so far.

Concerning the microbial composition of anaerobic sludge populations in paper industry treatment plants, only superficial knowledge based on the microorganism evolution tree is available. Advanced information about the particular species associated with each microorganism group in anaerobic sludge of UASB and EGSB reactors should help to understand connections between anaerobic degradation and the involved microorganisms. By means of this information, disturbances in the anaerobic treatment process may be understood and solved earlier in the process.

Objectives/Research results

Project aim is to develop a complete and detailed cause, analytics and provisions task list in order to solve problems in anaerobic treatment plants, especially EGSB reactors, due to sludge flotation and degeneration. This task list should be structured like a fault tree, containing all results and existing experience which has been gathered and structured.

The influence of additives on sludge performance will be examined and evaluated by means of batch tests. The impact of chemical additives will be monitored via visible and verifiable effects on/changes in microbial sludge morphology, to draw conclusions about potential origins of the problem.

Advanced findings regarding the microbial composition of anaerobic sludge and influence on anaerobic degradation processes are expected from this project. Differences between sludge from conventional UASB and EGSB reactors will be documented, and the impact on plant operation reported.

Ten waste water treatment plants (wwtp) with in total 14 anaerobic reactors had been studied. Water and sludge samples were investigated and operational data evaluated. Most of these wwtps reported anaerobic sludge flotation or degeneration problems. In some cases operational problems seemed to be the cause of sludge flotation and degeneration.

Twelve additives at different concentrations and additive mixtures have been examined by anaerobic semi-continuous batch tests so far. Especially one cationic polyacryl amide used as single additive has shown heavy flotation effects. In combination with other additives only minor flotation effects have been observed.

Microbiological population analyses show similar composition of the biocenosis of UASB and EGSB reactors. Microscopic investigations showed different sludge morphologies for high performance anaerobic reactors and conventional UASB reactors.

Application/Economic benefits

All wwtp operating anaerobic treatment stages may experience disturbances in the treatment process. Anaerobic sludge degeneration problems are not limited to the paper industry. Analogous to the aerobic activated sludge process, such trouble covers several industrial sectors. Plant operators will welcome concepts for problem solving and the prevention of sludge degeneration phenomena in order to avoid unplanned costs for continuous pellet sludge addition, sludge disposal and, at the worst, significantly higher effluent discharge fees.

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Remarks

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