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Research area: cross sectorial aims
General aims/Environmental technology/Water

Key words:
Small load aeration, sludge degeneration

Title:

Determination of optimum operational parameters to avoid degenerated sludge microbiota in low-load aeration plants

Background situation/Problem area

Approx. 96 % of all effluents from the papermaking process are biologically treated either directly or indirectly. When existing biological waste water treatment plants are cleaned up or new ones built, they are usually equipped with multiple stages and designed to be rather spacious. The 2nd clarification step normally carries a low to very low load (BOD sludge load $B_{TS} < 0,1\text{kg/kgd}$). Many plant managers are forced to carry out nitrification and denitrification in the 2nd clarifying stage in order to eliminate nitrogen compounds in the light of the ever more stringent legal requirements relating to phosphorus and nitrogen. Although there are only few plant managers who are forced to carry out denitrification at the moment, the trend is clearly on the rise. Such conditions more and more frequently result in operating failures resulting in sludge degeneration leading to poor sludge settling conditions and in serious cases resulting in a violation of the legal requirements in biological waste water treatment plants in particular with multi-stage high-load/low-load plants. The importance of these problems is demonstrated by the most recent results of the PTS-VDP "Water and Waste" inquiry, in which the most important problems in the biological treatment processes were polled. Many of the works reported malfunctions due to floating or bulking sludge, foam formation and problems in meeting discharging target values. In future, high-load/low-load plants will have to be employed to a greater extent in order to fulfil mandated requirements. The expected problems make it necessary to determine target values for the optimised operation of low-load aeration plants.

Research objectives/Research results

The objective of this research project is to improve the clarification performance and ensure the stable operation of the 2nd stage of low-load aeration plants. Guidelines and target values should therefore be worked out for the optimised operation of the 2nd clarifying stage of low-load aeration plants, especially for the parameters B_{TS} , t_{TS} , B_R and O_2 , as well as for the nutrient supply and elimination.

Operational studies of 6 waste water treatment plants in recovered paper processing paper mills are to be conducted. Until now 4 anaerobic/aerobic activated sludge plants and 3 PSB/aerobic activated sludge plants have been investigated.

Operational data of the treatment plants were evaluated over a period of minimum 3 months and additional investigations of sludge and water samples were executed. Influences of operating parameters such as sludge volume load, sludge volume index, and others on floc morphology and the quantity of filamentous bacteria were detected by the digital processing of microscopic images.

All plants report at least occasional problems due to bad settling conditions of the activated sludge. The present findings show that an excessive growth of filamentous bacteria causes settling problems only in some of the plants investigated. Special filamentous bacteria, in particular type 0041, appear dominant in such plants. In combined „anaerobic/aerobic“ plants the combination of the most important selection mechanisms of the most frequently occurring filamentous bacteria indicates unbalanced nutritional conditions and an influence of the effluent quality (organic acids, reduced sulphur compounds) from the anaerobic preliminary stage. The floc morphology and structure seem to be the reasons for bad settling properties in other plants. Additional examinations are being accomplished for this purpose.

Application/Economic importance

Optimum operation of a biological waste water treatment plant is necessary to observe limit values according to the law on water. Malfunctions of plant operation due to sludge degeneration and sludge settling problems, respectively, must be avoided at all costs. There is a threat of unstable operating conditions followed by the violation of the legal limit values which in turn frequently leads to a huge increase in waste water duties. In addition, there is also a threat of fines due to the illegal pollution of rivers and lakes. The disposal of degenerated sludge also involves a major outlay and high costs.

Project period: 1st January 2004 – 31st December 2005

Remarks

Research project AiF 13911 is being funded by the Federal Ministry of Economics and Technology.

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