Development of a wastewater treatment process with the use of symbiotic algae-bacteria biomass for paper mill wastewater

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Relevant cost factors in waste water treatment are in particular energy consumption and sludge disposal. New concepts for waste water treatment with reduced costs or even with the potential for economic benefit are expected to generate great advantages, especially for Small and Medium Enterprises (SME) with low budgets.

In the paper industry the conventional way for treating incoming effluents is biological purification. Biological wastewater (by sole bacterial activity) is state of the art in Europe. A lot of different, more or less specialized, treatment technologies are commercially available. However there are limits which cannot so far be overcome with the sole use of bacteria: Priority, endocrine, inhibitory or refractory substances, residual COD, nutrients, for example cannot be removed by bacteria alone.

Multiple technologies for advanced effluent treatment, (evaporation, membrane filtration, oxidation, precipitation...) are in the focus of research for some years. Unfortunately most of these technologies entail high investment and operating costs. Especially SME can hardly afford to implement highly sophisticated effluent treatment concepts to improve their effluent quality.

The issue of algae is gaining worldwide importance: Algae are seen to have great potential for effluent treatment, the production of energy and biofuels, as raw material or to reduce greenhouse gases, and have many possible applications.

In this work, the potential of algae for the paper industry and related industrial sectors will be investigated. The aim is to establish suitable concepts for this purpose and determine their cost-efficiency potential.

In this work it was possible to reproduce the results from the former work with synthetic wastewater and also the COD removal was possible until 1000 mg/l for a retention time of 2 days. The nitrogen removal was higher in comparison to an activated sludge process. The DOC (dissolved organic carbon) removal rates were between 89% and 97%. For the same Total Nitrogen dosage of 67 mg/l the removal increased (56% - 82%) with the increasing DOC concentrations.

Two different kinds of wastewater from paper industry were investigated during the work. For the first wastewater with a COD of over 1400 mg/l it was only possible to treat with only a smaller load. However it was possible to increase the retention time in the Sequencing Batch Reactor to treat the wastewater with an efficiency up to 95%. The second wastewater was from paper mill wastewater treatment plants second biological step. This wastewater had already been biologically degraded to a DOC of 150 – 170 mg/l) and nutrients were also added. The DOC removal achieved in the system was 80% with a retention time of 2 days; however the main algae in the system changed during the operation to Cyanobacteria with longer chains.

As a result it has been seen that the symbiotic algae bacteria system can be used for paper mill industry as an alternative treatment method depending on the concentration of the paper mill wastewater. The needed system area is higher than an activated sludge process but the operational costs seem to be lower.

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