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Research area: General aims
Environmental technology // Water

Key words:
Slime formation, biofilms, process technology, microbiology

Subject:
Optimising the process design in paper recycling mills to prevent slime formation in their stock and water systems

Background / Problem area

Slime formation in the wet end is one of the most serious microbial problems in papermaking, jeopardizing process stability and product quality. State-of-the-art slime control concepts are based on the use of biocides. The EU Biocide Directive (98/8/EG), however, demands an approval procedure for all biocide products. Even existing agents and products must pass an evaluation process covering their environmental compatibility and performance in order to be admitted for trading. As a result, a major part of the biocide products currently used will disappear from the market. There is an urgent need for further research into slime formation and its influences, and for novel solutions in the area of slime control.

Objective / Research results

The project aims at identifying the causes of undesired slime formation and of problems such as web breaks and quality defects in the paper. From the results of this investigation, measures are to be derived to optimise the process design in such a way that slime problems are effectively and economically reduced.
Three industrial plants producing paperboard from recycled fibres were examined for extended periods. Raw materials, production rates, web breaks statistics, additives in use and the process management were assessed, as well as organic and microbial loads in the stock and water system. Different measuring devices for slime growth measurement were designed and applied. The composition of biofilms was determined by conventional methods and fluorescence in situ hybridization (FISH), supplemented by biocide performance tests.
All data collected was evaluated by means of multivariate correlation and regression analysis. In this way, the influences on biofilm growth could be identified. A temperature increase of about 31 °C to 36 °C was found to enhance biofilm growth by a factor of 2 to 3. Concomitantly, the process water COD increased by 25 %, and the redox potential dropped. Synergetic effects of these parameters are to be assumed. Biofilm formation in the aerosol region of the paper machine can exceed the formation in the stock and water system. In particular, humidity and fog intensity have strong influences on this.

Application / Economic benefits

To monitor biofilm formation, the total bacterial count is not appropriate. Hand-operated slime measuring devices make it possible to measure biofilm growth with little effort. The device developed for aerosol regions is suitable to easily assess biofilms on machine elements above wires and felts. But the measuring time of these devices is about one week. Online slime sensors can give results already after two to three days. All biofilm growth devices are sensitive towards disruptions such as production breaks.

Suggestions are made to reduce biofilm problems by means of optimized process design. An appropriate plant design allows reducing or avoiding biofilms. Decreasing the organic load of the process water also reduces biofilm formation. Corresponding measures relate to raw materials, water circuit opening, integration of biological cleaning stages into the water circuit, or loop separation along with a counter current design. Temperature is an important factor, too. The temperature optimum for slime formation is above 35 °C. Paper machine boilouts are costly due to the downtimes involved, but very effective. All these measures for biofilm reduction affect other aspects of the paper production process, too, and have to be evaluated for effectiveness and profitability in individual cases.

Project period: 01.07.2003 – 30.06.2005

Remarks

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