Research Institute:

PTS München
Hess-Str. 134
80797 München

Internet: www.ptspaper.de

Head of the research institute:

Dr. Frank Miletzky

Project leader:

Dr.-Ing. Benjamin Simstich
Tel: 089 / 12146-388
Fax: 089 / 12146-36
E-Mail: benjamin.simstich@ptspaper.de

Research area: General aims

Environmental technology // Water

Key words:

Membrane, MBR, thermophilic aerobic, wastewater

TITLE:

Further development of thermophilic MBR technology to control limescale and temperature in the circuit water of paper mills (TMBR Kalk)

Background/Problem area

A membrane bioreactor (MBR) employs an activated sludge reactor as well as an ultrafiltration unit (pore size of 0.04 – 0.2 microns) to retain solids and micro-organisms in the activated sludge tanks of the biological treatment stage. The ultrafiltration module thus replaces the final sedimentation stage. The topic of the research project is experiments with a thermophilic aerobic MBR (TMBR) at 50 °C. This new and innovative use of submerged MBR modules to treat paper industry circuit wastewater was already studied in previous IGF 16062 “Thermophiler MBR”. Thermophilic degradation, compared to the mesophilic process, showed the advantages of a lower sludge yield and higher degradation rates. The elimination rates regarding COD and BOD were comparable to conventional aerobic wastewater treatment. The system proved to be reliable in order to save energy and water by treating hot partial flows from the stock preparation/deinking of deinking mills.

Surprisingly good results were achieved in terms of limescale stability: at inflow concentrations of 100-180 mg/l of calcium only 30-40 % of the calcium was detected in the outflow permeate. However, even if most of the calcium precipitated as CaCO3 in the reactor, virtually no scaling on the membrane surface was observed, as could be expected from recent experience or research. For mesophilic, conventional MBR applications at medium or high water hardness, severe scaling is the main problem of the technology itself. In the previous IGF 16062, no chemical cleaning was necessary during any of the trials. It seems as if the operation of a MBR at thermophilic conditions gives the technology a opportunity for applications in the paper industry. Further research was planned to verify this effect at higher calcium concentrations and to study the chemical background of precipitation in this process.

Objectives/Research results

The overall objective is to develop methods and modes of operation to control the CaCO3 elimination of the process and to study the precipitation phenomena focused on thermophilic aerobic treatment and to compare it with conventional mesophilic operation. This provides an opportunity for the overall water circuit in paper mills to control limescale concentration and temperature.

The studies were performed using two lab scale MBR plants in the PTS laboratory. Both plants can be operated simultaneously but with different settings in terms of feedwater, temperature, flux, volume, pH. Extensive trial and analysis protocols are performed involving the evaluation of the main performance parameters of the biological process, membrane filtration and several other parameters. During simultaneous operation at mesophilic and thermophilic conditions, the processes was compared with respect to flux, EPS concentrations, biocoenosis (FISH Analysis), behaviour of CaCO3, pH and additional parameters. The differences in precipitation of CaCO3 at 25° and 50 °C were studied at several ranges of pH. In addition, trials with a flocculation agent to increase the sludge floc size were successfully conducted. A comparison of TMBR operation in one-stage and two-stage reactor system is actually on-going and will be evaluated in terms of pH differences and lime scale.

Application/Economic benefits

The state of the art has proven TMBR to be a promising technology with economic benefits compared to aerobic end-of-pipe treatment or existing process integrated circuit water treatment methods. The major advantages are a low sludge yield, a high quality permeate at 50 °C, high process stability at fluctuations of feed water parameters and a lower nutrient demand. In this project, the limescale control will develop an additional advantage for the end user in paper mills.

By investigating and developing new technologies, the paper industry has an opportunity to meet the challenges of the future when further closure of the water circuits and lower energy consumption may be needed. Transfer of the expected results could lead to a totally new application of a technology which has already been approved as an end-of-pipe solution at mesophilic operating conditions. For SMEs in the environmental technology sector, economic benefits will emerge from the development of a new application of membrane technology in the industry.

Period of time: 01.09.2012 – 28.02.2015

Remarks

The research project IGF 17030N is being funded by the Federal Ministry of Economic Affairs and Energy (BMWi).