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Research area: General aims

Environmental technology // Water

Key words:

Effluents, residual COD, temperature

Title:

Predicting temperature-dependent residual COD release to avoid exceeding the COD limit

Background/Problem area

The raw materials and additives that are used corresponding to the end products, as well as the various stages in the pulp preparation process, involving intensive mechanical and chemical procedures, result in the residual COD found in the treated effluents from paper and pulp mills. Process water loop closure and the energy-related optimisation of papermaking systems lead to elevated process temperatures which increase the productivity of paper machines. Current insights on the effect of these elevated process temperatures on the process water and effluent loads are not available. Hence, there is a need for research concerning the temperature impact on the release of organic substances (COD) from the fibrous raw materials, particularly the biologically non-degradable fraction of the COD (also referred to as residual COD). This information is essential if one has to be able to predict the outcome of such measures as energy optimisation, returning biologically-treated effluents back to the production process and the use of advanced effluent treatment procedures.

Objective/Research results

The objective of the research project is to evaluate the impact of water circuit temperature on the residual organic load in the effluents from the papermaking process, and also to avoid temperature-related increases in the residual COD load. Three foci of research have been defined:

1.) Selection and characterisation of representative fibrous raw materials (mechanical pulp, chemical pulp and RCF pulp) with respect to COD release. Outlining a suitable study methodology entailing variations in filtrate volume, outlet and final stock consistencies etc., to ensure reproducibility.

2.) Detection of the temperature impact on the residual organic load of relevant process stages (pulping, refining, disperging) in both laboratory and pilot trials. The temperature will be varied from 20°C to 60°C, and the stock consistency from 2% to 8%. Stock filtrates will be taken to determine COD, biodegradability and BOD_5, and LC-OCD analysis will be conducted on selected samples to further characterise the residual COD.

3.) The impact of the pulp used, the stage in the papermaking process being considered, process temperature and stock consistency on COD, residual COD and BOD_5, will be determined during the individual test series, and derived parameters like specific COD, specific residual COD, residual COD/COD ratio and BOD_5/COD ratio will also be calculated prognosis bases of system load. The analysis is conducted according to statistical principles in experimental design (by means of appropriate software). Ultimately, the change in residual COD can be predicted for typical cases based on the calculation models designed by using the aforesaid soft-ware tool.

After selection of raw materials the filtrate preparation conditions for the determination of residual COD were elaborated. To ensure conditions similar to the production process the soaking time was set to 12 h and the filtrates of higher stock consistencies were taken after dilution to 2%. Initial results showed that significant differences for selected pulps were observed in the three process stages considered. In contrast to a generally temperature-dependent increase of residual COD value in pulping (between 0,5 – 2,5 g/kg), the temperature as well as the energy input had a subtractive effect on residual COD in mechanical pulp grinding.

Application/ Economic benefits

Energy-related potential savings combined with economic advantages include improved productivity, reduction in the quantities of bleaching chemicals and biocides used, and also a notable decrease in the steam consumption. To achieve these benefits, the effects of temperature increases on the residual organic load must be predicted accurately so that exceeding the legal limits does not offset the economic advantages obtained. For a mill with integrated mechanical pulp production, for example, the installation of a heat exchanger in the pulp production circuit and raising the system temperature by 8-10°C can result in cost savings of about 2 € to 6 € per ton of end product.

Project period: 01.02.2006 – 31.01.2008

Remarks

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