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**Research area: General aims**

Environmental technology // Water

**Key words:**

Effluent treatment, TN<sub>b</sub>, organic nitrogen, paper industry

**TITLE:****Derivation, characterisation and development of organic nitrogen compounds in biological waste water treatment plants in paper mills using virgin fibres****Background/Problem area**

The current revision of the Waste Water Ordinance may require replacement of the parameter N<sub>total</sub> by TN<sub>b</sub>. TN<sub>b</sub> analysis is capable of detecting organic nitrogen compounds which would otherwise not be detected using N<sub>total</sub> analysis. The replacement has become necessary for economic reasons. Organic N-compounds are available as nutrients and may therefore cause eutrophication in receiving waters.

Paper mill effluents contain organic and inorganic N-compounds. The main source of organic N-compounds is additives, e.g. retention, flocculation and wet strength agents as well as optical brighteners and colouring agents. These compounds are not directly available in most cases, they have to be metabolised beforehand.

Actually, an unknown part of N<sub>organic</sub> is oxidised during biological effluent treatment. Therefore an unknown concentration of organic N-compounds in the discharged effluent may be oxidised in the receiving water. The future use of TN<sub>b</sub> for effluent discharge control may bring about an increase in discharge expenses due to the additional amounts of N<sub>organic</sub> detected. It is necessary to generate a database for the parameter TN<sub>b</sub> to learn more about the composition of TN<sub>b</sub>, its sources, development and degradation, especially when passing through the waste water treatment plant (wwtp). This knowledge may then be used to establish measures to reduce organic N-compounds and meet future TN<sub>b</sub> limit values.

**Objectives/Research results**

The project objective is to develop measures for reducing nitrogen compounds in the effluents of paper mills using virgin fibres. This will make it possible to observe future nitrogen limit values on the basis of TN<sub>b</sub>.

The first step involved was undertaking a data survey to obtain comprehensive nitrogen parameter data from paper mills. 147 paper mills received a questionnaire asking for information about legal guidelines, analysis of N-parameter and N-elimination and problems in wastewater treatment. 41 paper mills sent an answer - which means that 33% of the paper and board production in Germany were covered, but only 14 paper mills using virgin fibres. Data analysis of the survey showed that meeting the limit value may be a problem especially in some paper mills using recovered paper or producing wood free and specialty papers. TN<sub>b</sub> values of tested effluents amounted to 6 mg/l on average.

In the next step a method had to be established to measure TN<sub>b</sub> in aerobic and anaerobic sludge, which is necessary for balancing the amount of nitrogen in the wwtp. The final method is based on TKN digestion.

Operational data of the wwtp, production data and additive use of the selected paper mills were evaluated. In six sampling series per paper mill, samples were taken before and after each stage of the wwtp, from fresh water and sludge, and characterised concerning nitrogen parameters and organic load. It was found that the share of N<sub>organic</sub> of TN<sub>b</sub> in the final effluent varied between 25 and 80 % from mill to mill. In some mills considerable fluctuations were found as well. The following amounts of nitrogen were measured: fresh water: about 2 mg TN<sub>b</sub>/l, raw materials: 1.5 mg N/mg TR and below, aerobic sludge: 30 and 65 mg N/mg TR, measured as TKN, varying from mill to mill.

**Application/Economic benefits**

The introduction of TN<sub>b</sub> limit values into waste water legislation may bring about higher discharge costs. Knowledge concerning the origin, development and conversion of TN<sub>b</sub>-compounds, especially when passing through waste water treatment plant, should allow measures to be taken that will prevent higher TN<sub>b</sub>-concentrations in paper mill effluents. In the best-case scenario, examination costs could be set off against effluent discharge fees. Discharge costs of more than 100,000 Euros may be saved. Especially paper mills using virgin fibres or producing specialty papers have to worry about great variability in N-loads due to additive application. Plant operators will welcome the knowledge and concepts for preventing or reducing organic nitrogen compounds in order to avoid unplanned costs for significantly higher effluent discharge fees.

**Period of time: 01.03.2010 – 31.07.2012**

**Remarks**

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