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**Research area: General aims**

Environmental technology // Water

**Key words:**

Ozone, activated sludge, settling properties

## Title:
## The use of ozone to improve the properties of activated sludge in the aerobic stages of biological effluent treatment plants

**Background/Problem area**

Effluent treatment in activated sludge plants is the method most commonly used in the pulp and paper industry. In spite of extensive knowledge of the process, the number of operating problems caused by scum and sludge overflow has been on the rise in the past few years. In most cases, excessive growth of filamentous micro-organisms was found to be the cause of the problem.

Due to the complex interrelationships involved in sludge degeneration, it is difficult to develop strategies capable of successfully avoiding and combating sludge degeneration. Oxidative treatment methods, e.g. the use of peroxide or ozone, have been found to be generally effective. The scope of ozone applications ranges from effluent treatment to sludge disintegration. Only little experience has been gathered concerning the use of ozone to improve the properties of activated sludge. What little experience there is indicates that ozonisation is capable, at least in principle, of improving sludge parameters when used on a permanent basis. Furthermore, ozone treatment led to reduced growth of filamentous bacteria, and nitrification was able to be improved in some cases. Urgent problems concerning degenerated sludge require long-term solutions. Oxidative treatment with ozone may be one suitable method

**Objectives/Research results**

The objective of this project is to reliably avoid sludge problems by using ozone to improve the settling properties of activated sludge in the pulp and paper industry.

The optimum ozone dosage, the best dosage point and the most effective method of ozone dosing shall be identified in order to improve sludge properties and avoid sludge problems. Another aim is to improve dewatering properties and thus reduce sludge volumes. In addition, ozonisation is intended to result in a balance of filamentous and flocking bacteria to maintain the continuous trouble-free operation of aerobic treatment steps.

Sludge samples taken from biological stages of three mills were subjected to ozone trials with ozone dosages between 1 and 15 g $O_3$/kg SS for 10 and 60 minutes. It was found that the ozone treatment reduced the sludge volume index by up to 35 %. There was no clear advantage of treating either activated sludge or recirculated sludge. In most trials higher ozone dosages caused a greater effect. Longer ozonisation duration accelerated the filtration process but had no influence on further parameters like settling or sludge volume index. The acceleration of the filtration process and thus the improvement of dewatering properties by ozone treatment were shown by a 70 % higher amount of filtrate at the beginning of the filtration process. Image analysis did not show a clear reaction of the micro-organisms to the ozone treatment. Ozone treatment tends to increase the amount of free filamentous micro-organisms, which are probably separated from the flocks. Sludge activity was tested by dosing glucose equivalent to 500 mg COD/l daily during 3 days. The COD elimination within 24 hours amounted to > 60 %, often to > 80 %. More COD was eliminated by the sludge than has been added in terms of glucose. No impairment by ozone was shown.

**Application/Economic benefits**

Process disruption in biological wastewater treatment plants due to sludge degeneration or settling problems often results in increased costs. When the COD threshold value cannot be observed, the increased rates for effluent discharge can exceed 10,000 €/a, for example, for an SME paper mill. Additional efforts and costs arise from discharging degenerated sludge or from the necessary use of chemicals.

Assuming an effluent volume of 1,200,000 m³/a, measures like weighing down the sludge with talcum or using $H_2O_2$ will give rise to costs of 38,000 – 50,000 €/a. The investment costs to install a filtration plant downstream of the secondary settling tank to intercept sludge overflow can amount to several thousand euros and operating costs between 2 and 4 €Ct/m³.

Assuming an ozone demand of 1.5 g $O_3$/kg SS to improve sludge properties, operating costs of about 41,000 €/a must be expected. This figure is within the range of filtration plants or other measures. If an ozone plant is already integrated in the existing effluent treatment plant, the economic attractiveness of ozone use is enhanced even more.

**Project period: 01.02.2006 – 31.01.2008**

**Remarks**

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