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Research area: General aims

Resource saving // -

Key words:

AOP, ozone, UV, ultrasound, peroxide, reuse, water saving

TITLE:

Reducing fresh water consumption in high water volume consuming industries by recycling AOP-treated effluents

Background/Problem area

Advanced waste water (WW) treatment by ozone has a number of advantages compared to other technologies, and very good results and experiences have been and are being achieved. Reducing the organic load by up to 90 % by combining with a subsequent biological low-load stage was possible, reduction of 50 % and below was economically worthwhile. To make the advantages of advanced WW treatment by ozone attractive to SMEs, further cost cutting was needed. This might be achieved by combining ozone with H_2O_2, UV or ultrasound (US). New water sources have been required in regions with a lack of fresh water. No proper solution had been available. The reuse and subsequent use of AOP-treated effluents instead of (only) fresh water could solve this problem and would bring about considerable cost reductions.

Objectives/Research results

The project aimed at making available new water sources for high water volume consuming industries like the pulp and paper and textile sectors by the reuse and subsequent use of treated WW from the pulp and paper, textile and food industries as well as municipal WW. The key to reuse and subsequent use was to improve the efficiency of AOP treatment to ensure optimum water quality and to show the possible use of the treated water. Laboratory AOP trials and degradation tests have been performed with fully biologically treated paper mill WW (outlet clarifier). Even treating the “outlet clarifier” biologically led to a COD elimination of 25%. The biological COD elimination can be enhanced by AOP pre-treatment. AOP treatment and a subsequent biological stage together result in COD elimination rates of up to 60%. The highest elimination rates were achieved by processes using ozone. Toxicity tests (fish egg, algae, daphnia and luminous bacteria) have shown no toxic effect of paper mill waste water, neither before nor after AOP treatment. The trials have led to a variety of water qualities which can be reused in production processes. Simulation has shown that the reuse of AOP-treated WW from paper mills, food processing industry and municipal wastewater in paper production process only slightly influences the process water quality. The influences decreased with increasing process water load, almost no changes were observed when municipal wastewater was used. Sheet former trials were performed to assess the impact of water reuse on paper quality (colour, mechanical properties). The use of both AOP-treated food processing and municipal WW gives the same colour coordinates of handsheets as the use of paper mill’s white water. Paper whiteness was only slightly impaired when not fully decolourised paper mill WW was reused. Thus, the reuse of this water for papermaking should be considered by mills producing brown papers. The strength properties of the paper were not impaired by the reuse of any AOP-treated WW.

Due to the highest COD elimination rates by processes using ozone combined with subsequent biodegradation, specific operation costs for these processes are comparatively low and amount to about 3 €/kg COD_{eli}.

Application/Economic benefits

The project results have the following direct economic effects for high water-demand industry. Firstly, application of new solutions for advanced wastewater treatment will decrease the costs of direct abstraction of fresh water or water from public water supply and will reduce the costs for wastewater discharge. Increased treatment efficiency leads to considerable energy savings. Reuse and subsequent use of treated wastewater will also lower the risk of unexpected cut-downs in the supply of drinking water due to failures in the distribution system and will also lower the pressure on drinking water withdrawals from the public water supply. The technology aims to find end-users among enterprises in the target group, especially in water-stressed countries and in countries with stricter environmental legislation. Many European companies including SMEs are involved in the industrial sector related to water. These activities follow the IPPC Directive concerning integrated pollution and prevention control that addresses industrial installations with high pollution potential. In industry, the total environmental expenditures (as a percentage of total expenditures) within manufacturing to all domains (air, wastewater, waste and non-core domains) vary from 0.1 to 1.5%; for the target industries (food, pulp & paper and textile) between 0.2 and 0.4%. In this respect, there is a considerable market for companies to provide services and applications for wastewater treatment in industry considering the fact that pollution treatment investments still prevail to pollution prevention investments in most EU countries

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Remarks

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