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Biological Removal of Nitrogen Compounds at a Coke-Oven Effluent Stream

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ABSTRACT

The steel company SSAB in Oxelösund, Sweden operates a coke-oven plant and has since a long time operated an activated sludge plant for treatment of effluent water. Along with more stringent requirements on discharge quality, especially focusing on nitrogen compounds and a new consent value for total nitrogen discharge (< 30 ppm of total N) the company decided to operate a pilot plant facility to investigate two major issues: 1) To define the conditions and restrictions for nitrification of ammonia nitrogen in the water; 2) To find out how efficiently a denitrification would perform. In order to find answers to these questions SSAB hired a pilot plant for testing. The test facility is based on a single sludge activated sludge reactor system for biological nutrient removal, with a reactor volume of 3.8 m³. After a test period of 5 months it was possible to draw reliable conclusions regarding the performance. The untreated wastewater has a high content of total nitrogen, around 240 ppm. The major nitrogen part is ammonia nitrogen, but an important fraction is found as thiocyanate nitrogen. The following main conclusions were drawn from the test operation: · It was found to be crucial that the solids retention time (SRT) was kept at a sufficiently high level. During the successful operation the SRT was in the range of 40 - 50 days; · It is desirable to have an equalization basin upstream the main biological reactor to meet short time peak loads, defined as both flow and pollution; · The major toxic risks for the biological process were high thiocyanate and ammonia concentrations in the raw wastewater; · The system showed however a good microbiological capacity to acclimatize to the prevailing conditions after the needed time; · The tests did not include an optimization of the oxygen supply with respect to nitrification; however it was evident that the oxygen level was sufficient to maintain a complete nitrification at normal operating conditions; · Once the nitrification was established it was also possible to reach a high degree of denitrification—as long as an external carbon source was applied; · It was found that both the cyanide nitrogen and especially the thiocyanate nitrogen were reduced by the process. The cyanide reduction is probably related both to precipitation by ferrous ions and biological transformation.

KEYWORDS

Single Stage Activated Sludge; Pilot Plant; Nitrification; Coke-Oven Plant; Toxicity Risks; Solids Retention Time

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