THE FATE OF METHANE IN A NEW ZEALAND PULP AND PAPER MILL WASTEWATER TREATMENT SYSTEM

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John Mark Lalunio Manzano

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Abstract

The wastewater produced by Carter Holt Harvey's Kinleith pulp and paper mill in Tokoroa is currently treated by a series of aerobic ponds, designed to remove organic pollutants. The treatment system has experienced increases in Biological Oxygen Demand (BOD, a measure of organic pollution strength) at the outlet. The increases in BOD happened when no significant changes in wastewater influent flow and/or characteristics were recorded. The surge in BOD has caused the outlet discharge limit to be exceeded in the past. Based on previous studies, we believe that aerobic oxidation of methane (CH_4), by microorganisms called methanotrophs, can cause the generation of methanol (a compound that can cause an increase in BOD load in waste streams), under conditions that repress the further conversion of methanol into biomass and carbon dioxide (CO_2). The overall objectives of this project therefore were:

- To determine if the biosynthesis of CH_4 can occur in the treatment system
- To determine if the subsequent biological aerobic CH_4 oxidation to methanol can occur in the treatment system
- Whether enough methanol can be generated to affect the treatment system's performance in terms of BOD removal.

Evidence was found that confirmed CH_4 was formed in the pond sediments across the entire treatment system (with rates significantly higher near the inlet). CH_4 is therefore available in the treatment system for aerobic CH_4 oxidation.

The presence of aerobic conditions and the absence of dissolved CH_4 in the water column (part of the pond where wastewater flows above the sediment), showed that aerobic CH_4 oxidation can occur in the water column of the treatment system (except at the oxygen limited inlet). Laboratory testing also confirmed that aerobic CH_4 oxidation can occur and methanotrophs are present (albeit in small numbers) in the water column.

A model was used to determine if aerobic CH_4 oxidation to methanol can cause the BOD increase at the outlet. The model found that the rates (CH_4 production in the sediment and CH_4 oxidation in the water column) needed to cause the surge in BOD was significantly higher than the maximum rates calculated from laboratory tests of

samples collected from the treatment system. Aerobic CH_4 oxidation was therefore unlikely to cause the BOD increase at the outlet.

It is possible that the BOD increase is due to benthic feedback (anaerobic sludge layer becomes buoyant, suddenly releasing soluble compounds into the aerobic water column of a pond). The BOD increase experienced at the outlet followed similar characteristics associated with benthic feedback (event was random, occurred at a pond with an oxygen limited sludge layer and aerobic water column). If the cause of the BOD increase needs to be determined in the future, further investigation into benthic feedback is recommended.

To conclude, aerobic CH_4 oxidation to methanol can occur in the treatment system, but is unlikely to cause the BOD increase at the outlet of the treatment system.

The technical capabilities and knowledge developed during the project will likely benefit those in the pulp mill industry. Methods and techniques have been developed to investigate the generation and fate of CH_4 within a pulp mill aerated pond.

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