# PREFERMENTATION AND SEQUENCING BATCH REACTOR TREATMENT OF FARM DAIRY EFFLUENT FOR BIOLOGICAL NUTRIENT REMOVAL

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# ABSTRACT

In order to meet the requirements of regional councils' Water Quality Plans implemented under the Resource Management Act (1991), many farmers in New Zealand are now irrigating effluent farm dairy effluent. However there are situations where irrigation is not practicable and it is considered that a sequencing batch reactor (SBR) treatment system may provide a highly treated effluent able to be discharged directly to waterways.

The objectives of this research were to develop an SBR operating strategy to optimise biological nutrient removal from farm dairy effluent, monitor the effectiveness of a pilot-scale SBR at removing nitrogen and phosphorus, and assess whether the untreated effluent could be made more readily biodegradable by prefermentation.

An operating strategy was designed to enable biological nutrient removal, with the aim of achieving low phosphorus, ammonia and nitrate effluent concentrations. The SBR operating strategy is Fill, Anaerobic, Aerobic I, Anoxic, Aerobic II, Settle, and Decant.

Phosphorus is released in the anaerobic phase, using the readily biodegradable carbon. The first aerobic phase is used for nitrification and phosphorus uptake. Remaining readily biodegradable carbon is also oxidised thus the denitrification occurring in the anoxic phase depends entirely on endogenous carbon. The final aerobic phase operates as a polisher.

The results show that the SBR did not achieve biological nutrient removal: there was no apparent reduction in nitrogen and phosphorus levels in the effluent. The most likely reason for the SBR's failure to operate as expected is that it was operated on settled effluent rather than raw farm dairy effluent.

The prefermentation trial aimed to increase the readily biodegradable carbon to improve phosphorus removal. The results showed that the optimal time for prefermentation of raw farm dairy effluent at 20°C was eight to ten days, when VFA oxygen demand peaked at about 2,100 mg/L. The prefermentation trial showed a lag phase of 0 to 2 days. The VFA proportions obtained in this experiment were 1.0 : 0.3 : 0.14 : 0.08 acetic : propionic : butyric : valeric acids.

The SBR is likely to operate as part of a total treatment system, designed to enhance BNR and provide a high quality effluent. It is considered that screened farm dairy effluent would be held in a prefermentation pond with a hydraulic retention time of at least 8 to 10 days. Prefermented effluent would be treated in the SBR. The effluent would then be polished using wetlands.

## KEYWORDS:

Sequencing batch reactor; prefermentation; farm dairy effluent; nitrogen removal; phosphorus removal; volatile fatty acids.

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