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Evaluation of cold-weather wastewater nitrification technology for removal of polar chemicals of emerging concern from rural Manitoba wastewaters

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ABSTRACT

Aerated lagoons, typically used by small communities, often provide limited removal of wastewater nutrients. Given increasingly stringent wastewater standards, it is imperative that effective, but economical and easy-to-operate, treatment technologies be developed. The Submerged Attached Growth Reactor (SAGR®) is a treatment process developed to perform nitrification near freezing temperatures. Previous tests on full-scale installations have shown that SAGR could consistently remove ammonia to below current Canadian standards and provide additional total suspended solids and biochemical oxygen demand removal. In this study, we evaluated removal of polar chemicals of emerging concern (CECs), including pharmaceuticals, personal care products, and pesticides, at SAGR installations in two Manitoba First Nations communities (MCN and LPFN) under cold winter conditions. Both showed some removal of diclofenac, naproxen, clarithromycin, metoprolol, and trimethoprim, likely by biotransformation. Average naproxen removal was 21% (2.53×10^3 ng L^{-1}) in MCN and 64% (1.58×10^3 ng L^{-1}) in LPFN. Atenolol was well-removed by SAGR, by 80% on average (range of 64%-94%). Clarithromycin, metoprolol, and trimethoprim removal was similar within and between systems, ranging from 54% to 76% ($30.8 - 3.07 \times 10^2$ ng L^{-1} removed). Carbamazepine was detected in nearly all samples, but was not wellremoved, consistent with other treatment studies. Overall, results showed that SAGR technology could moderately remove CECs, while providing the designed treatment performance for other parameters. This work will help to improve our understanding of wastewater treatment in small and/or remote communities with limited infrastructure and challenging cold-weather conditions.