

## Executive Summary

This manual describes techniques to identify and evaluate technological options for application at municipal wastewater treatment plants (MWWTPs) for the removal of total ammonia-nitrogen (the sum of un-ionized ammonia-nitrogen and ammonium nitrogen) from wastewaters. The report is intended to serve as an information source and decision-support tool to assist municipal engineers, managers and senior process staff at MWWTPs. It discusses the assessment of site-specific treatment requirements and the determination of appropriate approaches for facility upgrading. This can include applications involving the upgrade of existing MWWTPs through process optimization, retrofitting and/or expansion or the selection of suitable new technologies for application as greenfield, replacement or add-on installations.

Detailed descriptions are given of a wide range of processes for ammonia removal, with particular emphasis on various available biological nitrification technologies. This includes activated sludge process configurations that can also achieve total nitrogen and/or biological phosphorus removal. Important process-specific technical considerations, design and operational aspects, advantages and limitations, and order-of-magnitude costs for the different processes are provided. Only those treatment processes that have been proven on the full scale or at the large pilot scale in locations with climatic conditions similar to those for Canadian MWWTP applications have been considered. For the purposes of the manual, a target monthly average effluent concentration of <5 mg/L of total  $\text{NH}_3\text{-N}$  has been used as a criteria for process selection and sizing.

The report covers issues such as the need for the generation of pertinent wastewater and treatment process characterization data, the possible requirement for treatability testing and/or pilot plant studies, and available techniques for assessing existing treatment process capacity, capabilities and optimization potential or the requirement for more extensive upgrading. On the basis of process and site-specific factors and considerations that are outlined, and the use of two screening matrix tables that are presented, the municipal engineer will be able to conduct a preliminary identification of suitable upgrade options for enhanced removal of total  $\text{NH}_3\text{-N}$ . The screening matrices outline specific upgrade categories and various associated measures which are cross-referenced with the particular level of treatment utilized at an existing facility. Process options for consideration in new greenfield applications are also addressed. This information provides a useful preliminary indication of potential solutions for various cases involving either small, medium or large flow applications, that require enhanced ammonia removal capabilities. This includes consideration to lagoon process upgrading in cold climate applications.

With the information provided in this manual, the municipal engineer will obtain the technical background needed to initiate the preliminary phase of a MWWTP upgrade project. This includes the identification of potential remedial options, criteria for the selection of engineering consultants and the ability to work effectively with the consultant(s) to select and design the most suitable process for the particular MWWTP. Actual potential upgrade alternatives for improved ammonia removal will have to be evaluated and demonstrated on a case-by-case basis to meet a MWWTP's effluent objectives, leading to the selection of the most appropriate measure(s).