Sustainable Water Integrated Management:
Support Mechanism (SWIM-SM)

Mécanisme de Soutien
à la Gestion Intégrée Durable de l'Eau

آلية دعم الإدارة المستدامة والمتكاملة للمياه

Project funded by the European Union
Projet financé par la Commission Européenne
مشروع ممول من الاتحاد الأوروبي

Nitrification and Denitrification

Introduction

The term nitrification describes the biological process whereby free and saline ammonia (FSA) are oxidized to nitrite and nitrate. Nitrification is mediated by specific chemical autotrophic organisms with behavioural characteristics that differ significantly from the heterotrophic (OHO) ones. Whereas the OHOs obtain their carbon (anabolism) and energy (catabolism)requirements for biomass synthesis from the same organic compound(s), the autotrophic nitrifying organisms obtain their carbon requirement (anabolism) from dissolved CO2 and their energy requirement (catabolism) for biomass synthesis from oxidizing ammonia to nitrite (known as ammonia oxidizing organisms) and nitrite to nitrate (known as nitrite oxidizing organisms). This difference results in the autotrophic nitrifiers having much lower biomass growth than the OHOs. Nitrification is a prerequisite for denitrification -without it biological nitrogen removal is not possible. Once nitrification takes place, nitrogen removal by denitrification becomes possible and should be included even when the removal of nitrogen is not required. This chapter aims to review the kinetics of nitrification and denitrification, to highlight the factors that influence these biological processes, their interaction, and to set out the procedure for designing a nitrogen removal activated sludge system.

Time Framework for the Course:

Aims of the Course

- To introduce the different components and constraints of activated sludge systems performing organic matter removal.
- To describe the transformations that take place in activated sludge biological reactors designed for organic matter removal as a function of the wastewater characteristics and particularly in terms of their biodegradability.
- To present the principles and fundamentals of the steady-state model for the design of activated sludge models performing organic matter removal.
- To provide guidance for the selection of relevant parameters for the operation and control of activated sludge systems achieving organic matter removal.

Learning Objectives

- After the completion of this chapter, the participant will be able to:
    - Apply the knowledge on biological wastewater treatment processes and engineering on the design and critical assessment of wastewater treatment systems and configurations performing biological nitrogen removal as a function of the environmental, operating, and wastewater conditions and characteristics.