Antimicrobial resistance gene transfer in wastewater treatment models

Abstract

Multiresistant bacteria are a severe problem to modern healthcare. The problem is increasing and development of novel technologies to cope with this critical situation is a necessity. Solutions include novel antibiotic drugs as well as reducing the spread of resistance genes in the environment. Wastewater treatment plants (WWTP) are nodal points where much of the contaminated material is passing. Wastewater treatment plants are producing large amounts of sludge. The processing of genes in the mixture is poorly known, constituting a serious limitation since microorganisms can carry resistance genes in the WWTP-process.

Mathematic models for AMR transfer have successfully been developed for the fate and effect of AMR in wastewater systems. As far as we know, no attempts have been made to model the dynamics of AMR genes, and their release and uptake kinetics. Moreover, an AMR model formulated in terms of the wastewater (ASM models) and wastewater sludge treatment (the ADM model) regime and compatible to their structures is lacking. In this work, we present a simple model for AMR gene transfer compatible with the classical modeling regime, and use results from genetic tracer studies described for identification and initial analysis of a transport and fate model for genetic elements.