

Biokinetics of nitrogen transformation in soil biofilm systems

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Among the various treatments that enable reuse or groundwater recharge of secondary wastewater effluents, Soil Aquifer Treatment (SAT) is a common and highly cost effective technology to purify secondary effluent for reuse. Soluble organic and nitrogenous compounds utilized by the biofilm communities fostered on the soil substratum. The kinetics of the process is highly complex and involves multiple microbial nitrogen and carbon transformations, simultaneously. The availability of oxygen is a fundamental parameter that influences and defines the microbial niche conditions and the dominant reactions thus catalyzed. In this research hydrogen peroxide was investigated as an oxygen source to stimulate aerobic activity at the simulated SAT.

In the classes we learned about the various bio-reactions of the nitrogen cycle, specifying the new trends and discoveries enabled by molecular methodologies. Then, the significance of the carbon/nitrogen ratio in the secondary effluent in the matter of process design was discussed and the effect on the dynamics of the process was presented, in parallel to microbial community structure analysis. Further, the effect of hydrogen peroxide addition on performance and the competition for oxygen at the system was shown as a function of soil column depth and flow hydraulics. Results of the chemical and microbial functional groups profiles were presented. In addition, a model, developed by using a set of simulating algorithms, was taught while results obtained a comprehensive and deep process analysis.

Using the biokinetics thus obtained in complement with molecular microbial ecology and functional data, a comparison of the effect of using hydrogen peroxide as an oxygen source in soil treatments was determined and shown to enable higher efficiency of effluent purification while lowering the cost of raising water quality and water reuse.

