Microbiological treatment of wastewater contaminated with phenolic compounds

PhD. Student Dezső Róbert FIKÓ

PhD. Advisor Prof. Dr. Ing. Szabolcs LÁNYI

Abstract

Phenol (Ph) is a recalcitrant aromatic compound, which can be found in many industrial wastewaters such as pharmaceutical-, leather-, phenol-formaldehyde resin-, coal processing- and textile industry. Even at low concentration is toxic to aquatic life, plants and also it has adverse effect on human health, therefore, it is necessary to remove from effluents before evacuation in order to maintain a safe environment for life.

The objective of our research was the isolation and identification of different phenol degrading bacterial strains from extreme habitats and then the investigation of the bioaugmentation potential in order to increase the treatment efficiency of a bioreactor.
In order to achieve the objectives, the bacterial strains were isolated from a landfill leachate treating bioreactor in Cekend (Odorheiu Secuiesc), and from a polluted saline lake in Ocna Mureș.

We identified the bacterial strains and then examined their phenol degradation ability using various phenol concentrations (the initial phenol concentrations was adjusted to 100, 500 or 1000 mg/L). From the two sampling sites we obtained 50 bacterial strains of which 13 strains were able to degrade the phenol at least 100 mg/L initial phenol concentrations. During the identification, we found probably 2 new undescribed bacterial species and 1 new genus for science. After performing a series of examination (determination of metabolic pathways, biokinetic parameters, small reactor studies), the 2 most suitable strains were selected for bioaugmentation tests (*Acinetobacter townerii* CFII-87 and *Acinetobacter guillouiae* CFII-98). A 4 L laboratory scale SBR bioreactor was operated for the treatment of synthetic wastewater. After the reactor reached steady-state the phenol content of the influent synthetic wastewater was increased gradually every week (500, 750, 1000, 1500, 2000, 3000, 4000 mg/L and in the end 1500 mg/L) during operation and the reactor and effluent main indicators (COD, TN, NH_4^+, NO_3^-, TP, PO_4^{3-}, Ph) were measured daily. When we reach the 4000 mg/L influent phenol concentration, all the above-mentioned parameters increased significantly in the effluent, foaming was observed in the reactor, the system crashed due to the high toxicity of phenol.

In order to examine the behavior of the specific bacterial strains in the reactor and their phenol degradation ability in wastewater, the reactor was inoculated with the two *Acinetobacter* strains. After one day from the bioaugmentation, the COD, TN, and Ph values decrease dramatically, the system started to recover, and after one week all the effluent parameters showed a high degree of improvement. In conclusion, we can say the bioaugmentation was successful, contributed to the troubleshooting and improved significantly the removal efficiency of the bioreactor.