Bioremediation and Sustainable Environmental Technologies—2017. Fourth International Symposium on Bioremediation and Sustainable Environmental Technologies (Miami, FL; May 2017). ©2017 Battelle Memorial Institute, Columbus, OH, www.battelle.org/biosymp. A. Barton and S. Rosansky (Chairs)

A Novel Approach in the Biodegradation of Low Concentration Water Pollutant, Diethylhexyl Phthalate Using Self-Aligned Facile Nanoparticles

Namasivayam Vasudevan (nvasu30@gmail.com) and
Annamalai Jayshree(jayshreeannamalai@yahoo.com)
(Centre for Environmental Studies, CEG campus, Anna University, Chennai, India)

Background/Objectives. Phthalate esters (PEs) are potential endocrine disrupting chemicals (EDC) encountered in all media of the environment. These esters of benzo-carboxylic acid are used in the manufacture of PVC and other plastic products readily leach into the environment, since not covalently bond to the polymer matrixes.The detected concentration of diethylhexyl phthalate(DEHP), a high-molecular weight PE in surface water ranges from 0.1 – 0.50 mgL^{-1} and maximum permissible limit is set to be 6 ppm in drinking water. Studies suggest that prenatal low dose exposure (10 $mg\ kg^{-1}\ day^{-1}$) to these PEs are capable of inducing developmental and behavioural abnormalities. Considering the need and constraint of ineffective remediation of low concentrated DEHP in surface water, nanoparticles are incorporated to enhance biodegradation. The objectives include:assessment of bacterial strain to metabolize and degrade PEs at minimal level; synthesis of facile self-aligned nanoparticles (SA-NPs) onto bacterial cell matrix; and analyse the effect of SA-NPs on degradation and toxicity to bacterial strain.

Approach/Activities. An efficient bacterial strain was isolated and used for the degradation of DEHP. Bacterial growth and time of degradation was assessed at low concentration of DEHP (10, 50, 100, 500 and 1000 µg/L). To the 24 hours culture grown in optimal minimal level of DEPH, 0.1 mM silver nitrate was added and reduction of silver ions to SA-NPs was determined based on excitation surface plasmons and intensity of peak at 421 nm. Further characterization of surface morphology, rate of enhancement in degradation and effects on bacterial cell were examined using UV/Vis spectroscopy, scanning electron microscopy (SEM), transmission electron microscopy (TEM), X-ray diffraction spectroscopy (XRD), Fourier transmission infrared spectroscopy (FTIR) and gas chromatography (GC).

Results/Lessons Learned. The optimal minimal level of DEHP degradation by the isolated bacterial strain was determined to be 100 µg/L, the complete degradation was obtained in five days. UV/Vis scan of SA-NPs showed highly symmetric single band absorption maxima at 421 nm with no further change in intensity was observed after 48 hours. From the GC analysis, SA-NPs were found to enhance degradation by decreasing the days required for complete degradation in 3 days. Further XRD, FTIR, SEM and TEM images confirmed synthesis of SA-NPs onto bacterial cell matrix. The rate degradation might have been enhanced due improved surface area, adherence of substrate to cell surface and toxicity resistance to AgNPs by the isolated bacterial strain.