Synergistic Interactions of Fungal Enzymes and Bacteria on Polyurethane (PUR) Biodegradation

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Background/Objectives. Increasing polyurethane (PUR) waste is a global health crisis, as it has caused adverse effects on public health and ecosystem. Biodegradation of PUR has been reported and the degradation process is slow. To better manage PUR pollution, it is important to better understand microorganisms involving in PUR biodegradation. This study characterized PUR-degrading community in the marine environment, isolate PUR-degrading cultures from estuary sediments and, examined PUR degradation efficiency by a combination of the fungal enzymes and the bacteria.

Approach/Activities. A model PUR substrate, Impranil, was used for the isolation of presumptive PUR degraders from estuary sediments. The identities of the isolates were determined based on 16S rRNA genes or internal transcribed spacer region sequences. The isolates were screened for their ability to use Imparnil as a sole carbon (C) or a sole nitrogen (N) source. Degradation of Impranil was determined by Fourier transform infrared (FTIR) and detection of esterase activity in the spent medium. PUR foam degradation test was performed using a combination of fungal enzymes and the bacterial strain or using the bacterial isolate only. Changes of PUR were determined using FTIR and scanning electron microscopy (SEM). Production of metabolites was also determined.

Results/Lessons Learned. PUR-utilizing fungal and bacterial strains were isolated from the marine environment. A clear halo and esterase activity were observed in the medium when they were grown on Impranil as C or N sources. FTIR analysis revealed loss of ester and urethane bonds in Impranil. A novel culture consisting of the fungal enzymes and the bacteria showed significant degradation efficiency, resulting pits and cracks of the surface and a decrease of the major bonds in the PUR. Also, based on the results that biofilm appeared and value-added metabolites such as adipic acid and diethylene glycol were released, would indicate positive effect of fungal enzymes on bacterial degradation.