

Development of an Organotin Removal Process Utilizing Marine Bioremediation

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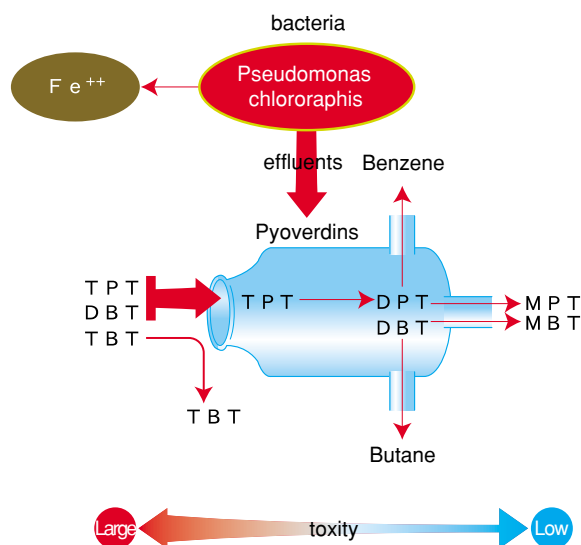
Tin and organotins are toxic to a wide variety of marine organisms at levels present in polluted environments and thus may be an ecological and safety problem. Organotin compounds have been used as biocides in antifouling paints applied to the surface of ship bottoms and fishing nets. The various environmental problems produced by organotins are demonstrated by that triphenyltin (TPT) being degraded with a culture solution of the bacteria *Pseudomonas chlororaphis*, and that TPT, diphenyltin (DPT) and dibutyltin (DBT) being broken down to monophenyltin (MPT) and monobutyltin (MBT) with the yellow compounds from *P. chlororaphis*.

The identify of the yellow compounds obtained from *P. chlororaphis* was confirmed by the UV and spectrum, NMR spectrums, fast atom bombardment mass spectrometry (FAB-MS) and amino acid analysis. The yellow substances gave a molecular peak at $m/z=1161$ and have similar UV spectra ($\lambda_{max}=400nm$) to pyoverdine from *P. fluorescens*. The acid hydrolysis of the yellow compounds indicated that they are constituted of three amino acids, possessing 2 mol of serine, 2 mol of lysine and 1 mol of

glycine. Analysis of a 47% HI hydrolysate revealed 2 mol of hydroxyornithine (HOornithine). The pyoverdine structure shows a fluorescent chromophore, which is a quinoline derivatives, and a peptide arm of seven amino acid residues.

The TPT, DPT and DBT in sea water were degraded to monophenyltin and monobutyltin., respectively. Degradation of TPT, DPT and DBT in water can be faster than that in sea water. Optimum degradation was at pH 7-8.5 and a temperature of 30°C. The Fe and Al remarkably inhibited degradation activity. These results suggested that pyoverdine could function as a catalyst not only in a metal-free state, but also in a metal-chelating state.

We investigated an immobilization technique for *P. chlororaphis* to remove the organotin compounds in the environments. Cells were immobilized in 2% alginate beads, and pyoverdine production by the immobilized cells was studied in sea water. The results suggested that immobilized cells could be applied to the *in situ* bioremediation of organotin.



Degradation pathway of organotin by pyoverdins
 1: TPT and DPT were degraded to phenyltin with the release of benzene.
 2: DBT was degraded to butyltin with the release of butane.
 3: TPT, DPT and TBT are many more orders of magnitude more toxic than phenyl- and butyltin.