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Retardation of Biodegradation of Linear Alkyl Benzene Sulphonate by a Sublethal Concentration of Mercuric Chloride

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Environmental xenobiotics are usually classified into persistent and biodegradable ones. However, this may not be universally true, since biochemical capacity of ecosystems species may vary with species diversity and versatility. This may differ in different locations decided by geoclimatic factors. Prolonged exposure of organisms causing primary degradation to the toxic xenobiotics may lead to metabolic adaptation to survive the chemical stress. Also under multiple toxicant stress, the normal biodegrading capacity may be impaired by the effect of one toxicant on the organisms per se or on the enzymes causing degradation. If such inhibition of biodegradation occurs in ecosystem, even normally biodegradable chemicals may tend to accumulate.

To test this view, model experiments were conducted with LAS (Linear alkyl benzene sulphonate) a biodegradable surfactant and mercuric chloride. Since the purpose of the study was to test the degradation under natural conditions, no attempt was made to identify the micro-organisms involved.

MATERIALS AND METHODS

Linear alkyl benzene sulphonate (LAS) from Indian Petrochemicals Ltd., Baroda, was used for biodegradation. Chemicals except LAS used were from BDH (England), E. Merck (West Germany) and Himedia, Bombay (India).

For preparation of inoculum, water was collected from the river Gomti, at Lucknow, U.P., aerated and used as such. Standard procedure based on AFNOR T 73260 as described by Gard-Terech and Palla (1986) was employed. The medium taken in 500 mL bottles, contained 300 mL of fresh natural water, 0.5 g/L of beef extract, 3.3 g/L peptone, 6 g/L of anhydrous D-glucose and 0.218 g/L of

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$Na_2HPO_4.2H_2O$. The bottles were incubated in the dark for a period of 3 days at 25 °C under aeration. The experiments were run in triplicates.

At 0 hr, 0.75 mL of 20 mg/mL LAS solution to be tested was added to the inoculum making final concentration of the tested products 150 mg/L. To test the effect of metal 0.25 mg/L $HgCl_2$ in combination with LAS at 150 mg/L concentration was added. Controls in all the cases were devoid of test materials. 0.2 mL of the incubated medium was taken at time 0, 24, 48, 72, 96, 120 and 144 hr and the final volume was made upto 20 mL with water.

Each sample was processed for the MBAS (Methylene blue active substance) analytical procedure for quantification of anionic active substance in the system, as described by American Public Health Association (1985). In this, the anionic substance was measured through the formation of colored complex formed between alkyl chain and methylene blue. The chromogenic complex was extracted from chloroform and estimated on a Bausch and Lomb Spectronic 1001 at 652 nm as described by American Public Health Association (1985).

RESULTS AND DISCUSSION

The biodegradation profile for LAS, with and without $HgCl_2$ is shown in Fig. 1. During the first 48 hr the biodegradation of LAS was 50% and at 80 hr it reached a plateau where about 70% was transformed. After addition of $HgCl_2$ in LAS at 0 hr there was no change in biodegradation but at 80 hr it reached a plateau of 50%, showing reduction in biodegradation. Thus, the biodegradation of LAS was substantially decreased by the presence of Hg^{2+} in the system.

Degradation of LAS through microbial activity is influenced by temperature and water current (litz et al 1987). Biodegradation of LAS leads to a rapid decrease in its acute toxicity to several fish species and marine algae (Swisher, 1964; Takimoto et al 1982; Gard-Terech and Palla, 1984). So if the biodegradation of it is inhibited as shown above LAS can persist in ecosystems causing ecotoxicological problems (Lal et al 1983; Chawla et al 1989). The effect of Hg^{2+} could be by either reducing the number of organisms or by inhibiting the enzymes invovled. The enhanced uptake of ^{203}Hg and several other pollutants in presence of LAS may also influence biodegradation capacity of ecosystems (Misra et al 1989). Apart from this, decrease in dissolved oxygen caused by LAS (Lal et al 1984) could decrease oxidative biotransformation. Toxic heavy

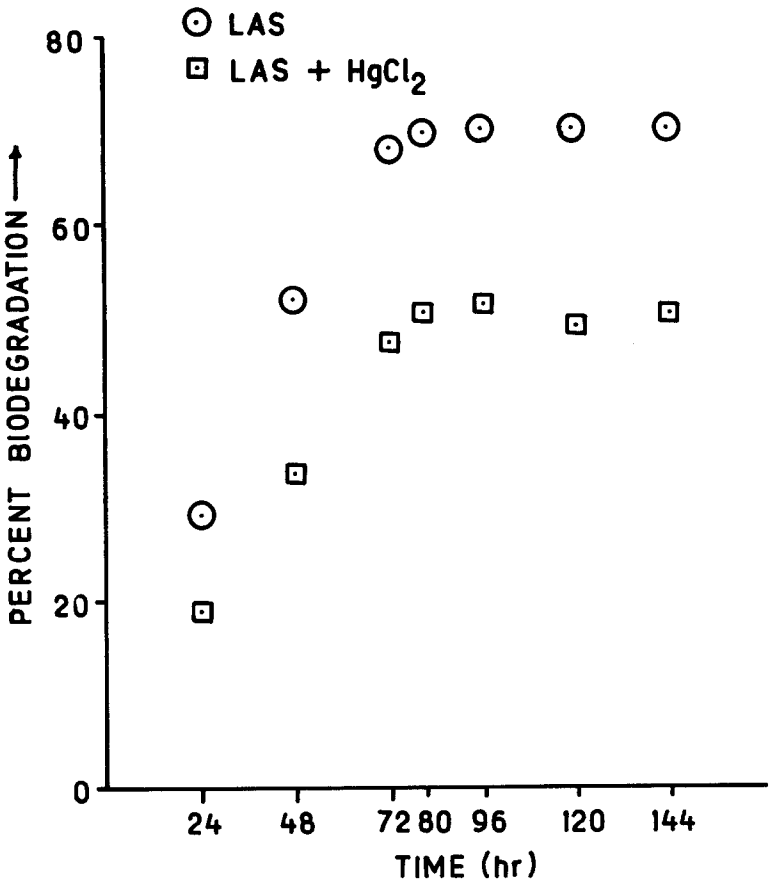

Figure 1. Graph showing the effect of $HgCl_2$ on the percent biodegradation (compared with controls) of LAS at different time intervals.

metals, if simultaneously present in sufficient amounts to inhibit the xenobiotic metabolizing enzymes could lead to build up of organic pollutants. Thus even a biodegradable compound could become recalcitrant because of the inhibition of biotransformation capacity of ecosystem under multiple chemical stress.

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