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LAS BIODEGRADATION AND SAFETY IN SEDIMENTS

Trace amounts of linear alkylbenzene sulfonate (LAS) present after wastewater treatment adsorb onto sediments near treatment plants and subsequently biodegrade. This removal process contributes to high safety margins. Studies conducted on river sediment samples taken near activated sludge treatment plants show only low levels of LAS present, and lab tests confirm that the levels detected have no effects on sediment-dwelling species.

- In laboratory experiments, LAS adsorbed to river sediments biodegrades rapidly and at the same rate as LAS dissolved in river water.(1) Real world monitoring studies confirm that sediment-absorbed LAS is effectively biodegraded.(1)

- The LAS adsorbed to sediment has significantly less availability to organisms thereby reducing its toxicity.(2-5)

- Comparing the lowest concentration of LAS in water found to change the feeding (filtration) rate in a seven-day test in saltwater mussels (1 milligram LAS per liter of water, 1 mg/L or 1 part per million, ppm) to that found with sediments (281 milligrams LAS per kilogram dry weight of sediment, 281 mg/kg or 281 ppm) shows that 280-fold higher concentrations of LAS are required to produce the same effect in sediment as in water.(6)

- Comparing the safe level, or no observed adverse effect concentration (NOAEC), for LAS in water for long-term survival of midges (2.4 mg/L, 2.4 ppm) to that in sediment (319 mg/kg, 319 ppm) shows that 130-fold higher concentrations of LAS are required to produce the same effect in sediment as in water.(7)

- Half-life refers to the amount of time it takes for half of a chemical substance to biodegrade, or break down, completely. The half-life for LAS in aerobic sediments near sewage treatment plants ranges from less than one day to 5.9 days.(1, 8)

- Results of recent U.S. monitoring studies also indicate that effective sewage treatment will remove 96 to 99 percent of LAS from wastewater, greatly reducing the amount that enters sediments and eliminating environmental impacts.(9-10) Similar results were observed in Europe, where LAS removal in activate sludge sewage treatment plants of five countries ranged from 98.5 - 99.9%.(11)

- The safety margin for LAS in sediments can be calculated by comparing predicted LAS levels in sediments (predicted environmental concentrations, PECs) to those levels which would not cause harm to the organisms living in the sediments (predicted no effect concentrations, PNECs). The safety margin is the PNEC divided by the PEC . Any material with a safety margin greater than one is considered safe for the environment.

- For LAS, the PECs are based on real world monitoring studies -- actual measured environmental concentrations -- not predicted values.

- PNECs are based on concentrations at which no adverse effects are observed, the NOAECs. For the study with saltwater mussels,(6) the effect observed with LAS in sediments, an increase in the rate of feeding, is not an adverse effect and so testing of LAS concentrations in sediment higher than 281 ppm would be required to determine the NOAEC.

- Considerable PEC and PNEC data has been reported in the 2013 HERA Report on LAS(18). A sludge PNEC of 49 $g/kg_{dw\ sludge}$ and a sediment PNEC of 23.8 $mg/kg/_{dw\ sediment}$ were cited along with a STP PNEC of 5.5 mg/l.

- PNEC/PEC values for LAS may be calculated from the data given in the 2013 HERA Report. These values are 3.2, 4.5 and 20 for LAS in sludge, sediments and STPs, respectively. All of these values are well above a value of 1.00, indicating that LAS poses no real environmental threat in these environmental compartments.(18)

- A 80-day chronic test found that the NOAEC for LAS to a freshwater mussel was greater than 750 mg/kg. The lowest NOAEC for LAS in sediment is the value of 319 mg/kg observed with saltwater mussels.(6-7)

- U.S. sediments collected under worst-case conditions (areas with low water flow and low effluent dilution) immediately below less efficient tricking filter sewage treatment plants had LAS concentrations ranging from 0.2 to 340 mg/kg.(9-10) Since eight of the nine sediments had LAS concentrations less than 200 mg/kg, most sediments were below levels that could have any harmful effect on the most sensitive sediment-swelling species tested. Consequently, even these worst case sediments generally have margins of safety greater than one and pose little risk to sediment-dwelling organisms.

- U.S. sediments collected under these same worst-case conditions immediately below activated sludge sewage treatment plants had concentrations of LAS ranging from 0.3 to 3.8 mg/kg,(9-10) at least 83 to greater than 1500 times lower than levels that could have any harmful effect on the most sensitive sediment-dwelling species tested.

- Sediments from sampling sites under typical conditions (with average water flow and effluent dilution) show that much lower concentrations of LAS are more typical. Thirty-two of thirty-three Mississippi River sediment samples had LAS concentrations less than 1 mg/kg.(12) The one exception, a sediment with 20 mg/kg LAS, was found in a drainage canal carrying undiluted effluent from the sewage treatment plant of a large city (Minneapolis, Minnesota) to the Mississippi River. Even in this example, the margin of safety is in excess of 15, indicating that worst case Mississippi River sediments pose little risk to sediment-dwelling organisms.

- European studies on sediment samples show similar results to those from the Mississippi river. In a study of sediments near activated sludge treatment plant discharge points in four European countries, LAS levels in 15 sediment samples ranged from 0.2 to 5.3 mg/kg.[11] LAS levels in two additional sediment samples were higher, 12-35 mg/kg, due to periodic discharge from storm water tanks of untreated sewage.[11]

- LAS levels in marine sediments are low. Sediments adjacent to an underwater sewage discharge pipe off the coast of Spain averaged 0.1 mg/kg LAS.[13] Fifty meters from the discharge, LAS concentrations in sediments were below the detection limit of 0.03 mg/kg.

- Even in the worst case example, where the sediments were periodically contaminated with untreated sewage, the margin of safety is in excess of 8, indicating that sediment levels in Europe pose little risk to sediment-dwelling organisms.

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