ECOTOXICITY ELEMENTS
TOXICITY TO TERRESTRIAL ORGANISMS
Soil invertebrates: *Folsomia candida*, *Enchytraeus albidus*

PAPER REVIEWED

Gejlsbjerg, B., Klinge, C., Samsøe-Petersen, L., Madsen, T. 2001. Toxicity of linear alkylbenzene sulfonates and nonylphenol in sludge-amended soil. Environmental Toxicology and Chemistry, 20, 2709-2716.

TEST SUBSTANCE

- ($C_{11.6}$) LAS (EniChem Augusta Industriale, Milan, Italy).

✏ Remarks: The neat material was 14 % (w/w) active $C_{11.6}$ LAS in an aqueous sodium salt solution, average molecular weight = 342 g/mol, distribution of the linear alkyl chains: C_{10} 14 %, C_{11} 34 %, C_{12} 31 %, C_{13} 20 %. All data expressed in mg LAS (active substance) / kg d.w. soil-sludge mixture.

METHOD

• Laboratory	DHI Water and Environment, Department of Ecotoxicology, Denmark.
• Objectives	To determine the effects of sludge-associated LAS on the soil invertebrates *Folsomia candida* (springtail) and *Enchytraeus albidus* (potworm). Additional objectives not reviewed in this summary: to determine the effects of 4-nonylphenol on these soil invertebrates.
• Method/guideline followed	Springtail *Folsomia candida*: ISO 11267 (ISO 1999a). Enchytraeid *Enchytraeus albidus*: ISO WD 16387 (ISO 1999b).
• Test substrate/application	• Soil: a natural coarse sandy soil collected from the upper 20 cm of an agricultural field at Jyndevad, Denmark. Defaunation by sieving (1 mm mesh), heating at 60 °C (24 h), and freezing at -70 °C (24 h). Description of the soil characteristics in the reviewed paper. • Sludge: dewatered activated sludge (28 % dry matter (w/w), collected at a WWTP in Lundtofte, Denmark, was used, after sieving (4 mm mesh) and defaunation at -70 °C (24 h) for the experiments with *F. candida*. The sludge was not defaunated for the experiments with *E. albidus*.

	LAS was dissolved in demineralized water and added to individual subsamples of sludge (24 h of equilibration at 4 °C), which were then mixed with soil to a final sludge:soil ratio of 1:20 (d.w.).
• GLP	Likely not.
• Year (study performed)	≤ 2001.
• Species/strain/supplier	*F. candida*: laboratory reared, supplier and collection site not mentioned. *Enchytraeus albidus*: provided by ECT Oecotoxikologie (Floersheim, Germany). Acclimation to the test soil not mentioned.
• Analytical monitoring	Nominal concentrations in the test were not measured. However, a separate experiment (without animals) was set up with two concentrations not used in the animal testing (250 and 1000 mg LAS / kg d.w.) to measure degradation during the test.
• Exposure period	*F. candida*: 28 days. *E. albidus*: 21 days for adult survival, 42 days for reproduction.
• Endpoints	Mortality and reproduction.
• Statistical methods	NOEC, LOEC with Student's *t*-test. LCx were estimated with probit analysis, ECx were estimated with nonlinear regression (not further detailed).

✏ Remarks: /

RESULTS

• Nominal concentrations	*F. candida*: 0, 125, 250, 500, 1000, 2500, 4000 mg LAS / kg soil-sludge mixture (d.w.). *E. albidus*: 0, 750, 1500, 2250, 3000 mg LAS / kg soil-sludge mixture (d.w.).
• Measured concentrations	Degradation after 21 to 28 days was less than 15 % in the separate experiment without animals.
• NOEC, LOEC, EC50, EC10, LC50, LC10	See Table 1.

Table 1: NOEC, LOEC, ECx and LCx values (mg LAS / kg d.w.) for *F. candida* and *E. albidus* exposed to LAS.

Species	Parameter	NOEC[a]	LOEC[a]	EC10 or LC10	EC50 or LC50
F. candida	Adult survival	1000	2500	750	1338
	Reproduction	500	1000	480	1437
E. albidus	Adult survival	<750	750	511	1400
	Reproduction	750	1500	447	1143

[a] NOEC and LOEC were calculated with a Student's t-test and this is not valid in this case.

Remarks: No raw toxicity data available (only NOEC, LOEC, ECx, LCx). NOECs and LOECs were calculated with a Student's t-test, which is an unvalid test in this case.

CONCLUSIONS

The toxicity of LAS was similar for both organisms, with reproduction of *E. albidus* as most sensitive endpoint (EC10 = 447 mg / kg sludge-soil mixture (d.w.). It is mentioned that the addition of LAS to sludge might mobilize other toxic compounds from the sludge. The authors conclude that the enhanced toxicity noticed is probably due to the higher availability of these mobilized compounds rather than to a direct effect of LAS in sludge itself.

RELIABILITY

Klimisch score	2a (acceptable, well-documented publication which meets basic scientific principles; comparable to ISO (1999a, 1999b).

REFERENCES

ISO. 1999a. Soil quality – Inhibition of reproduction of Collembola (*Folsomia candida*) by soil pollutants. ISO 11267, Geneva, Switzerland.

ISO. 1999b. Soil quality – Effects of pollutants on Enchytraeidae (*Enchytraeus* sp.) – Determination of effects on reproduction. WD 16387, version 2/99. Geneva, Switzerland.