Ecotoxicological assessment of the environmental compatibility **of construction products** for outdoor applications

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Introduction

Construction materials may release substances during the construction, use and/or demolition phase, which might harm the environment. Currently, the CEN/TC 351 working group elaborates standards to assess the release of dangerous substances from construction products. For products whose leachates are so complex that the exact composition may only be determined with extensive analytical effort or for which no reliable assessment based on data for individual compounds is possible, direct testing of the leachates in bioassays seems to be a promising approach to assess their ecotoxicological effects.

Our project thus aims at developing a test battery for the ecotoxicological assessment of construction products. In the first stage of the project, we screened 20 construction products from different material groups that are used outdoors and are often in contact with water (e.g., sealants, plastic piping systems and roof covering products). In the next steps of the project, a round robin interlaboratory test including leaching and ecotoxicity tests with three products is planned.

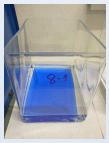
The overall goal is to harmonise ecotoxicological test methods for the implementation of environmental protection requirements for construction products.

Leaching Tests

Leaching test developed/cited by CEN/TC 351 were used with a low liquid/area or liquid/weight ratios to obtain concentrated eluats.

Plane and monolithic construction products → **Horizontal dynamic surface leaching test (DSLT)**

FprCEN/TS 16637-2



- L/A = 20 L/m²
- Elution with deion water (< 5 µS/cm)
- without movement
- Eluates after 6 h and 18 h

Granular construction products → **One stage batch test**

DIN EN 12457-1

- L/S = 2 L/kg
- Elution with deion water (< 5 µS/cm)
- Particle size < 4 mm,
- Rotation for 24 h

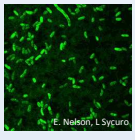
Ecotoxicological tests

Algal test
ISO 8692
72 h
Pseudokirchneriella subcapitata

Water flea test
ISO 6341
48 h
Daphnia magna

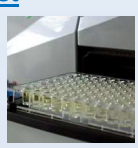
Fish egg test
ISO 15088
48 h
Danio rerio

Luminescent bacteria test
ISO 11348-2
0.5 h
Vibrio fischeri



Genotoxicity test

Umu test
ISO 13829
4 h
Salmonella typhimurium



Biological degradation test

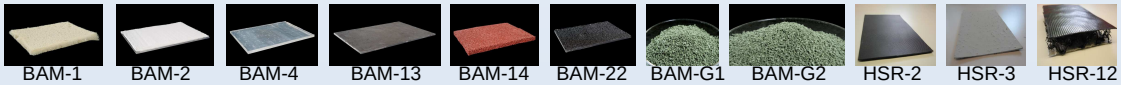
Manometric respirometry test
OECD 301 F
28 days

Results and Discussion

Results were analysed according to the principle of the **lowest ineffective dilution (LID)**:
the lowest dilution level without effects exceeding the test-specific variability is reported as test result.

Dilution level D	1	2	3	4	6	8	12	16
Volume test sample	1	1	1	1	1	1	1	1
Volume dilution water	0	1	2	3	5	7	11	15

Product		Parameters		Ecotoxicological tests				Genotoxicity	Biodegradation	Tentatively identified substances in eluates (GC/MS)
Code	Description of product	TOC	Conductivity	Algae	Daphnia	Fish egg	Bacteria	umu-Test	Respirometric test	
		mg/l	µS/cm	LID_A	LID_D	LID_{Egg}	LID_L	LID_{EU}	% COD	
BAM-1	Polyurethane foam	29	21	32	1	1	≤ 2	1,5		N-phenyl-formamide Phosphoric acid phenylesters Organic phoshates
BAM-2	Sealant (acrylic)	469	280	32	3	1	4	1,5	75	Isobenzofuranone Phthalates
BAM-4	Sealant (acrylic resin)	250	10	24	2	12	16	1,5	77	Long-chained hydrocarbons
BAM-13	Sealant (natural and synthetic resins)	6	18	8	1	1	6	1,5		Isobenzofuranone Phthalates
BAM-14	EPDM (plate-like)	7	25	64	24	3	192	1,5		Mercaptobenzothiazoles & degradation products Thiourea derivatives Phenole derivatives
BAM-22	Polymer modified bituminous coating	44	323	4	2	6	6	1,5	83	Benzothiazolone Phthalates
BAM-G1	EPDM resin (granular)	61	208	192	192	4	1536	1,5	92	Mercaptobenzothiazoles & degradation products Thiourea derivatives Phenole derivatives
BAM-G2	TPES resin (granular)	30	202	16	1	1	64	1,5	44	Mercaptobenzothiazoles & degradation products Thiourea derivatives
HSR-2	EPDM (Roof covering panel)	9	18	16	4	1	128	1,5		
HSR-3	FKS liquid synthetic sealant	95	32	512	3	3	12	1,5	46	
HSR-12	Core: PA monofilament, coating: PP fleece	35	17	3	4	2	8	1,5	97	



- The eluates of 11 out of the 20 products tested showed effects in at least one of the ecotoxicological tests.
- LID ranged from 1 to 1536 and was highest in the algal and bacteria tests.
- Genotoxicity was not observed in any of the eluates.
- Aerobic biological degradation rates vary, but substances in eluates are mostly ready biodegradable.
- Analytical analysis revealed diverse substances that are eluated in leaching tests and might cause the observed effects

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