

Assessment of potential endocrine effects of building product eluates



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Introduction

Endocrine disruptors are substances that interfere with the endocrine system; they may be present in many building products and can cause health problems even in minute quantities. Since these products are not adequately tested for hormonal effects before being brought to market, a systematic approach for risk assessment is urgently needed. The research project aims to develop testing methods for assessing the endocrine effects of building products based on the EU technical specification DIN CEN/TS 17459:2023-02. While this pre-standard currently tests for the release of hazardous substances and evaluates ecotoxicological effects, it does not account for hormonal effects. In two work packages, a literature review was conducted on suitable endocrine tests and hormone-active substances in exterior building products; based on this, 20 building products were selected and practically tested using the four effect- and non-animal based methods (NAM/EBM)—ER, anti-AR, anti-TR-CALUX, and anti-PR CALUX—for female, male-, progesterone- and thyroid hormone-like effects. Therefore, eluates have been prepared from the 20 selected construction products in accordance with DIN CEN/TS 17459 and tested for endocrine effects using the four different assays. Products that exhibit endocrine activities will undergo an expanded battery of tests, including established ecotoxicological and genotoxicological assays as well as a Daphnia reproduction test, to better interpret the results. In addition, chemical analysis of these eluates will be conducted; depending on the available information regarding the product formulation, either a comprehensive non-target screening or a targeted quantitative determination of the relevant constituents will be performed. The goal is to develop scientifically sound recommendations for expanding the testing standard and to formulate proposals for integrating endocrine assessments into the ecolabel Blue Angel's procurement criteria in order to improve consumer protection and identify safe products.

Results of CALUX-Reporter Gene-Assays

Product Description	ER α (Estrogen Activity)	anti-AR (anti-Androgen Activity)	anti-PR (anti-Progesteron Activity)	anti-TR β (anti-Thyroid Activity)
	(pg 17 β -estradiol eq./ml migrate)	(ug Flutamide eq./ml migrate)	(pg Ru486 eq./ml migrate)	(ug Diclazuril eq./ml migrate)
Fall protection mat	0.23 LOQ 0.12	0.020 LOQ 0.0094	12 LOQ 11	< LOQ
Protective layer (Building protection mat)	0.27 LOQ 0.13	0.018 LOQ 0.015	17 LOQ 12	< LOQ
Epoxy resin-based 2-component grout	2.4 LOQ 0.13	0.68 LOQ 0.010	200 LOQ 12	< LOQ
Epoxy resin-based 3-component grout	1.4 LOQ 0.12	0.41 LOQ 0.0099	220 LOQ 12	0.030 LOQ 0.0075
Spray cork	< LOQ	< LOQ	33 LOQ 12	< LOQ
Cork granulate	< LOQ	< LOQ	3100 LOQ 11	< LOQ
WPC Wood-plastic composites	< LOQ	< LOQ	< LOQ	< LOQ
Pond liner	< LOQ	< LOQ	< LOQ	< LOQ
Construction film	< LOQ	< LOQ	< LOQ	< LOQ
Greenhouse film	< LOQ	< LOQ	< LOQ	< LOQ
Latex paint	< LOQ	0.059 LOQ 0.010	59 LOQ 12	0.050 LOQ 0.0078
Exterior facade plaster	< LOQ	1.4 LOQ 0.010	1100 LOQ 12	< LOQ
Spray paint	< LOQ	< LOQ	< LOQ	< LOQ
Wood filler	< LOQ	0.14 LOQ 0.0096	82 LOQ 11	< LOQ
Plastic primer	< LOQ	< LOQ	< LOQ	< LOQ
Joint sealant	< LOQ	< LOQ	32 LOQ 11	< LOQ
Sealant cream	< LOQ	< LOQ	< LOQ	< LOQ
Artificial turf green	< LOQ	< LOQ	< LOQ	< LOQ
Artificial turf black	0.95 LOQ 0.12	< LOQ	< LOQ	< LOQ
Polycarbonate	< LOQ	< LOQ	15 LOQ 12	< LOQ

Results

- Literature research: numerous substances in building products with endocrine effects (e.g. BPA, PFAS, phthalates)
- Cork granulate: Extremely high anti-PR activity
- Exterior facade plaster: Heavily contaminated with anti-PR and anti-AR
- Epoxy-based grouting systems: Elevated values across multiple parameters
- Anti-Progestin & Anti-Androgen activities dominate (most sensitive bioassays)
- Estrogenic activity is toxicologically most relevant when detected
- Co-occurrence: Estrogenic effects often accompanied by anti-AR effects

Methods

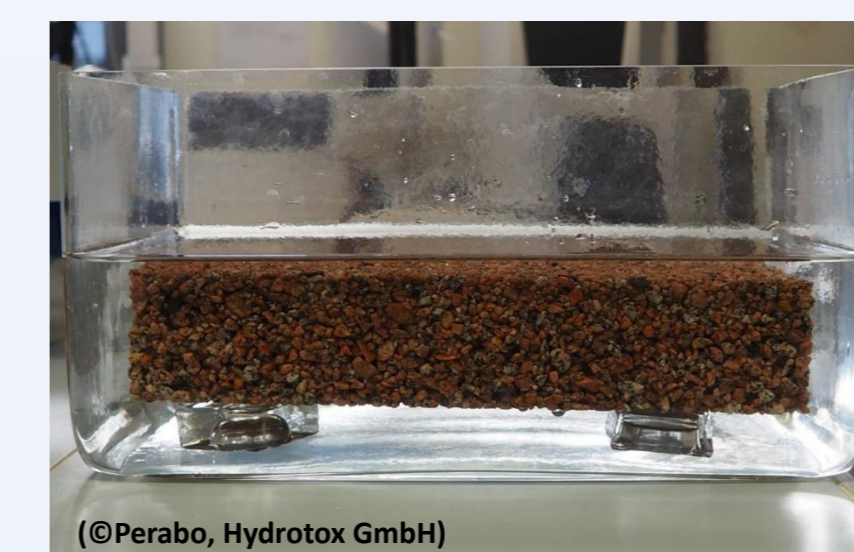
Product selection

- Literature review on endocrine-disrupting substances in building products
- 20 building products from various product groups that are frequently used in outdoor applications and contain potentially endocrine-disrupting substances

Leaching tests

Technical specification DIN CEN/TS 17459 „Determination of ecotoxicity of construction product eluates“

Horizontal dynamic surface leaching test DIN EN 16637-2



- Monolithic, plate-like or foil-like building products
- L/A = 25 L/m²
- Elution with deion. Water (< 5 μ S/cm)
- Without agitation
- Eluates after 6 h and 18 h

Horizontal up-flow percolation test DIN EN 16637-3



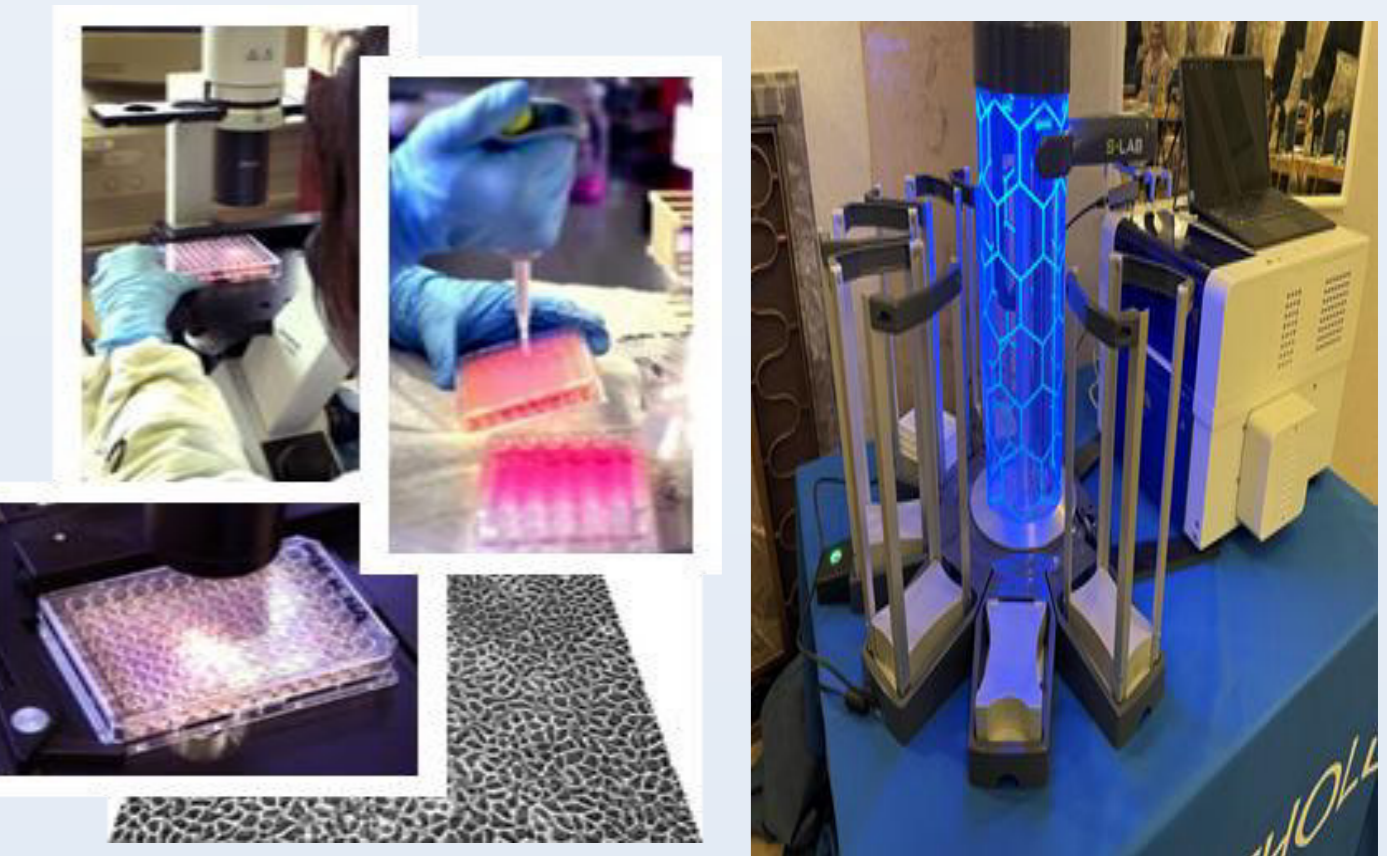
- Granular building products
- L/S = 2 L/kg
- Elution with deion. Water (< 5 μ S/cm)
- Particle size < 4 mm
- Flow rate 1.63 ml/min for columns with 10 cm inner diameter

Endocrine tests

CALUX-bioassays (Chemical Activated Luciferase gene eXpression)

Cell-based bioassays that measure the activity of substances on specific hormone receptors Effect and non-animal-based

Quantitative: Identification of complex mixture of known and (un)known substances (ISO 19040-3:2018 and OECD TG 458)



Ecotoxicity tests

Algae test ISO 8692

72 h
Raphidocelis subcapitata



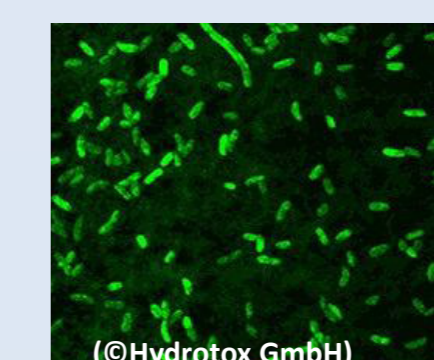
Water flea test ISO 6341

48 h
Daphnia magna



Luminescent bacteria test ISO 11348-2

0,5 h
Allivibrio fischeri



Genotoxicity test

UmuC Test ISO 13829

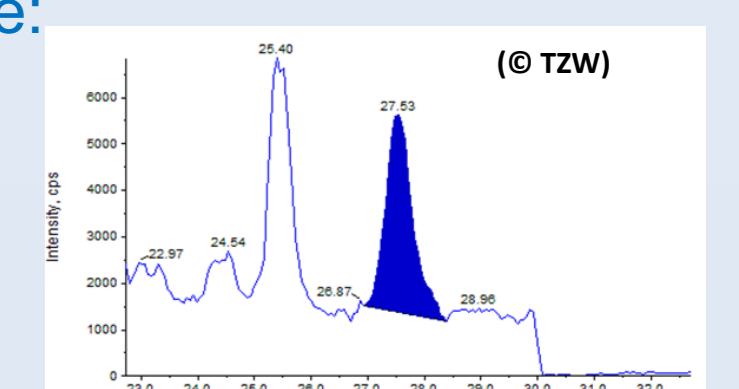
4 h
Salmonella typhimurium
TA1535pSK1002



Chemical analysis

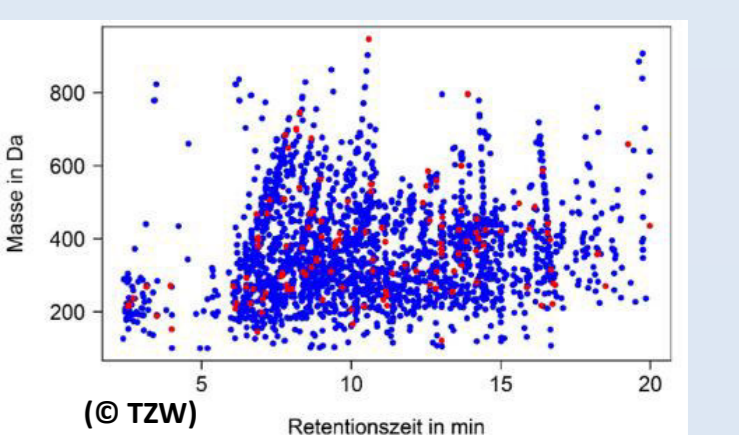
Target-Analytics: LC-ESI-MS/MS

Mostly quantitative:
Content of known substances



Non-Target: LC-ESI-TOF

Mostly qualitative:
Identification of (un)known substances



Reproduction test

Water flea Reproduction test

OECD 211
21 d
Daphnia magna



Outlook and Discussion

- EU Strategy "Toxicfree & Zero Pollution" Non-Animal Methods (NAMs) and High-Throughput Screening (HTPS) play central roles in ensuring safe building products and healthy living environments
- Complex chemical mixtures: Known hazardous substances (BPA, PFAS, plasticizers) and their replacement compounds are virtually unavoidable in the building material cycle
- Persistence of legacy chemicals: Primary contaminants remain prevalent in recycled materials
- Regulatory gaps: Current standards often lack comprehensive & sensitive toxic relevant **effect- and non-animal based (EBM/NAM) toxicity** screening for mixture effects and cumulative exposure