

MUTAGENICITY ASSESSMENT OF BIO-BASED COMPOSITES TO SUPPORT SAFE AND SUSTAINABLE MATERIAL DEVELOPMENT



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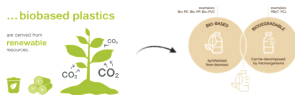
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Introduction

Unlike conventional plastics, which are derived from fossil oil, bio-based plastics are derived from renewable resources.



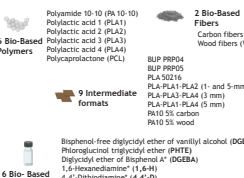
Objectives

To assess the mutagenic potential of bio-based materials using the Ames bacterial reverse mutation test (OECD 471), to support their biological safety evaluation for applications involving human contact.

Methodology

Eluate and leachate preparation

Tested materials:



According to: DIN 3841-4 in a 10:1 ratio (V:W) and CEN/TS15863 in 8 cm³/cm².



$$M.R. = \frac{S.R. + I.R.}{S.R. (Negative control)}$$

M.R. = Mutagenicity Ratio

S.R. = Spontaneous Revertants

I.R. = Induced Revertants

Interpretation:
M.R. > 2 - Potentially mutagenic
M.R. < 2 - No mutagenic

Strain	M.R. < 2	Strain	M.R. < 2
TA98 Bio-Based Polymer	✓	TA100 Bio-Based Polymer	✓
Bio-Based Fibers	✓	Bio-Based Fibers	✓
Intermediate formats	✓	Intermediate formats	✓
Bio-Based Resin	✓	Bio-Based Resin	✓
		Carbon Fiber	✗
		DGEBA, CYS, DGEVA	✗

Mutagenicity of a range of concentrations (mg/L) of six Bio-Based resins to *Salmonella typhimurium* TA100 strain. Abbreviations of resins stand for: DGEBA - diglycidyl ether of Bisphenol A; PHTe - Phloroglucinol triglycidyl ether; CYS - Cystamine; DGEVA - Bisphenol-free diglycidyl ether of vanillin alcohol; 1,6-H - 1,6-hexanediolamine; 4,4'-D - 4,4-dithiodiamine. Bold indicates the validation criterion. *Strong evidence of mutagenicity.

Conc.	DGEBA			PHTe			CYS			DGEVA			Fibers (%) Carbon Fibers		
	Revert.	MR	MR	Revert.	MR	MR	Revert.	MR	MR	Revert.	MR	MR	Revert.	MR	MR
1.56	251.0 ± 21.2	2.26	138.3 ± 6.4	118	264.0 ± 17.6	2.47	226.3 ± 45.3	2.04	277.7 ± 19.1	2.13					
3.13	259.3 ± 13.3	2.34	120.0 ± 6.0	118	277.7 ± 44.0	2.60	263.3 ± 29.5	2.37	277.7 ± 7.80	2.61					
6.25	271.0 ± 28.6	2.44	149.0 ± 9.6	118	280.7 ± 27.7	2.62	249.7 ± 11.7	2.29	287.7 ± 20.4	2.64					
12.5	255.0 ± 25.7	2.30	128.0 ± 15.1	109	312.3 ± 10.8	2.92	267.7 ± 36.8	2.41	229.7 ± 47.8	2.15					
25	260.7 ± 25.0	2.35	117.0 ± 8.6	110	279.3 ± 10.6	2.61	248.7 ± 18.1	2.24	195.3 ± 22.7	1.83					
50	235.0 ± 19.2	2.12	101.0 ± 9.0	106	299.3 ± 15.3	2.80	272.3 ± 36.7	2.45	196.3 ± 21.2	1.83					
100	284.0 ± 32.7	2.58	140.0 ± 11.0	112	266.7 ± 20.4	2.68	258.3 ± 14.7	2.33	225.3 ± 38.1	2.14					
Positive control (His+)	861.0 ± 154	8	987.0 ± 113	9	861.0 ± 154	8	861.0 ± 154	8	861.0 ± 154	8					
Solvent control (His-)	111.0 ± 9.30		110.0 ± 9.10		111.0 ± 9.30		111.0 ± 9.3		111.0 ± 9.30						
Negative control (His-)	107.0 ± 12.6		117.0 ± 8.80		107.0 ± 12.6		107.0 ± 12.6		107.0 ± 12.6						

Conclusions

- These findings show that bio-based origin alone does not guarantee biological safety, as some renewable materials or their released constituents may still exhibit genotoxic effects;
- The absence of mutagenic activity in several of the tested materials highlights the potential of safer bio-based alternatives for future applications (e.g. PHTe);
- Early genotoxicity screening supports safer-by-design development of sustainable materials.



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