

Rethinking bioplastics

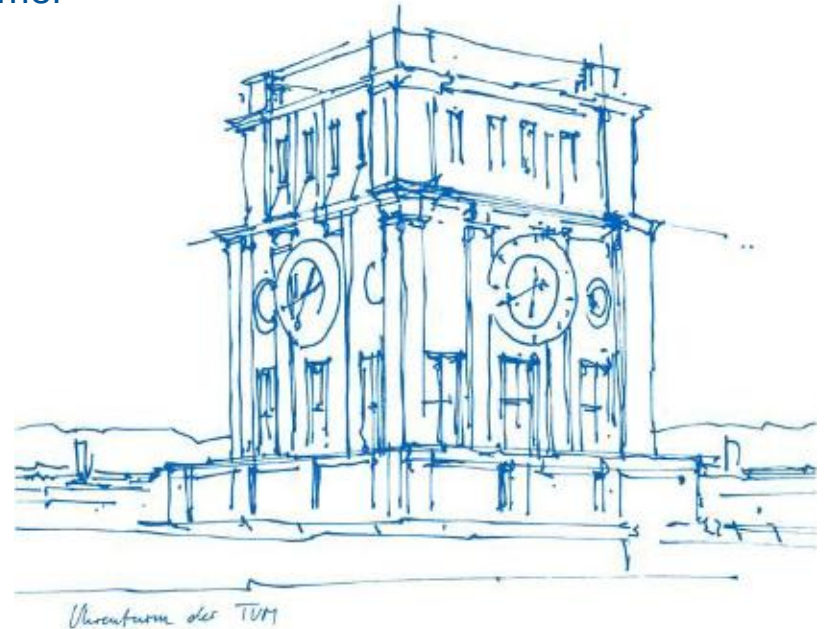
A new way to tune PHB — without changing the monomer

Prof. Dr. Volker Sieber

Chair of Chemistry of Biogenic Resources

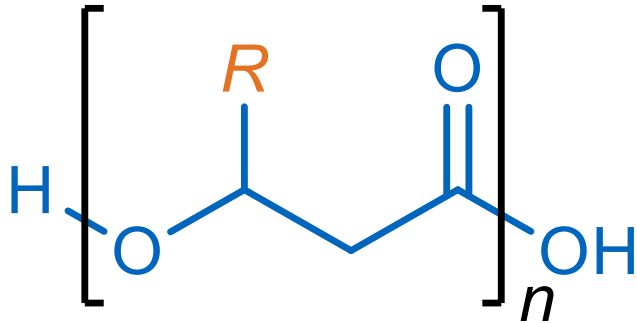
TUM Campus Straubing for Biotechnology and Sustainability

Future of BioPackaging 2026 | 1 October 2026



PHAs — you already know this family

Thirty years of development, one lever: change the side chain.



PHB

$R = \text{CH}_3$

stiff, brittle

PHBV

+ 3HV

softer

PHBH

+ 3HHx

tougher, pricier

P3HB4HB

+ 4HB

flexible

Every step means a second monomer — a second feedstock, and a higher price.

What the family has not fixed

PHB melts where it starts to decompose.



- **No processing window**

melting $\approx$ decomposition

- **Brittle**

< 5 % elongation at break

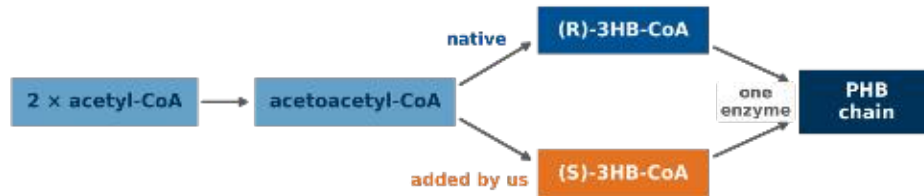
- **No regrind**

chains shorten every cycle

Copolymers soften this — they do not remove it.

The question, and the chemistry

The building block exists in two mirror-image forms. Cells were thought to use only one.

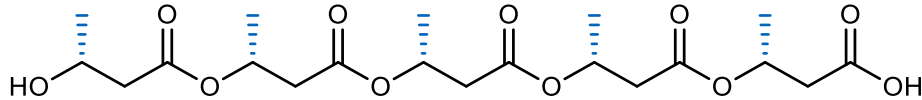


Our hypothesis
The limit is not the enzyme
— it is the supply.

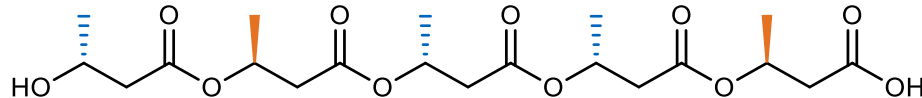
The cell accepted both

Both forms go into the same chain — and the regular pattern breaks.

Conventional PHB — every unit the same way



Our PHB — some units flipped at random



6.84 %

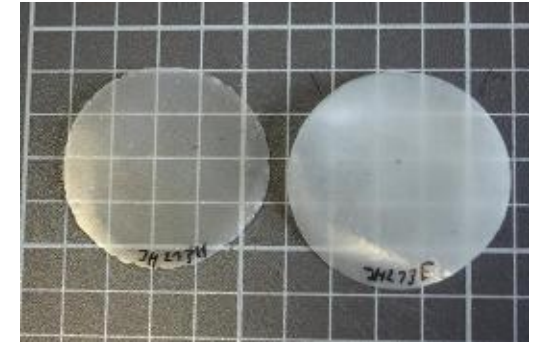
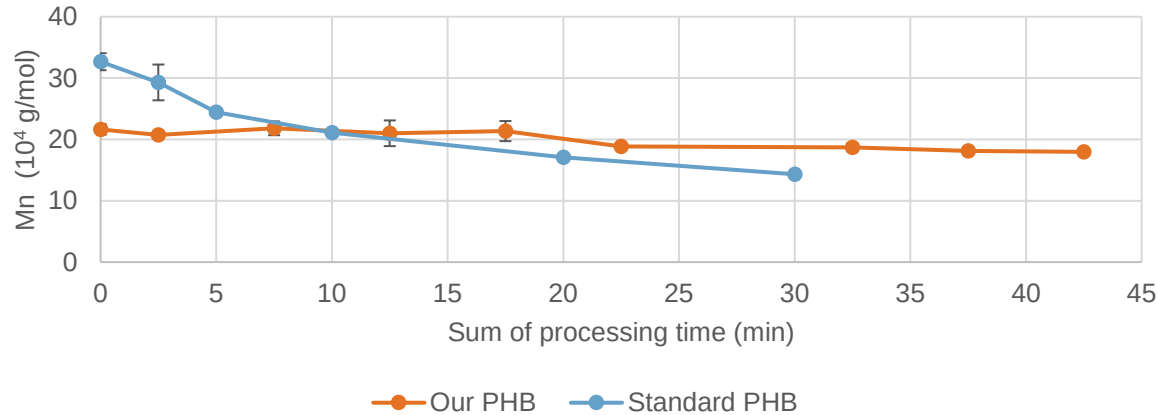
(S)-units in the polymer

11.8 %

meso dyads — matches 12.7 % predicted for random

Incorporation is random — a stereoirregular chain, made biologically for the first time.

Mechanics and processing



25 °C

more room before decomposition — widening the processing window.

Clear, not opaque

processed at 130 °C instead of 170 °C, at the same thickness

Single-use material → material you can regrind.

Where this stands

Proof of concept — published, patented, and looking for partners.

● PROVEN

Stereoirregular PHB made microbially, at bioreactor scale, from glucose alone.

● THE LIMIT

Yield is about a third of conventional PHB — the synthase still prefers (R).

● NEXT

A less selective synthase, and control over the (S) fraction.

Looking for partners for scaling and processing trials.



Open access

Biomacromolecules
2026

WO2026099499

Prof. Dr. Volker Sieber
sieber@tum.de
Chair of Chemistry of Biogenic Resources,
TUM