

PHA Materials: Natural, Renewable, Recyclable, Circular & Plastic Free

The problem with plastics

At an increasingly alarming speed, humanity is confronted with the issues that arise from the continuous development of synthetic materials based on fossil-feedstocks. Climate change, ocean-plastics pollution and fossil-based resource depletion all pose different threats to our way of existence and that of natural ecosystems.

To date more than 8 billion tons of plastics have been produced¹, of which approximately half was produced in the last two decades. It is estimated that more than 60% of all plastics ever produced have ended up in landfills or in our environment, contributing heavily to value destruction, and pollution.

Circular and sustainable approach with a natural material: PolyHydroxyAlkanoate² (PHA)

PHA² is a versatile class of natural materials and similarly to cellulose (from wood), these polymers occur in nature. Microorganisms produce a wide range of PHAs by consuming natural feedstocks, such as sugars, vegetable oils and even CO₂ and biogas, and convert these into PHAs, which have very similar functional properties to fossil-based plastics.

Because these PHAs are created as part of the metabolism of these microorganisms, in reverse, these PHA materials are also consumable by nature, allowing for composting and biodegradation in marine and other conditions.

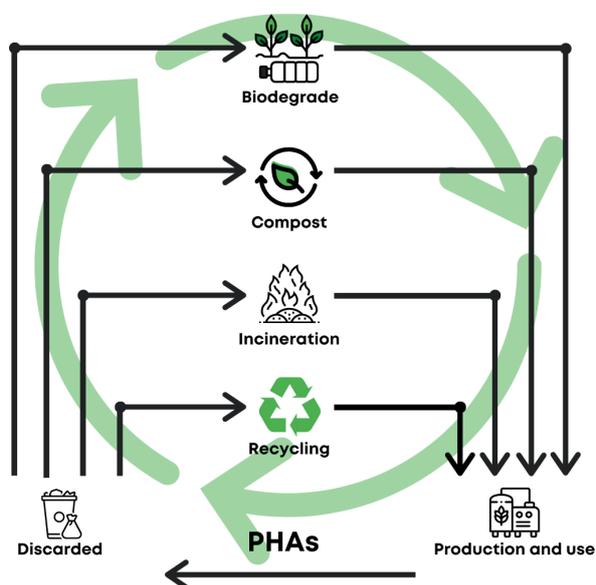


Figure 1 Closing the loop with PHA

These PHAs offer a natural solution to our need for plastic-like materials and deserve a prominent role in our future regenerative, renewable, bio-based and circular product ecosystems.

¹ <https://advances.sciencemag.org/content/3/7/e1700782>

² PHA is a large family of materials, in this context we refer to PHB and its copolymers (P3HB, P4HB, PHBV, PHBH, P3HB4HB, P3HB3HV, P3HB3HV4HV, P3HB3Hx, P3HB3HO, P3HB3HD)

These PHAs offer maximum flexibility on all end-of-life options⁴

Due to their natural occurrence, these PHA materials are fully compatible with nature, meaning that they are home compostable and biodegradable even in marine conditions³. Their biodegradability in various environments is compared to other materials in figure 2.

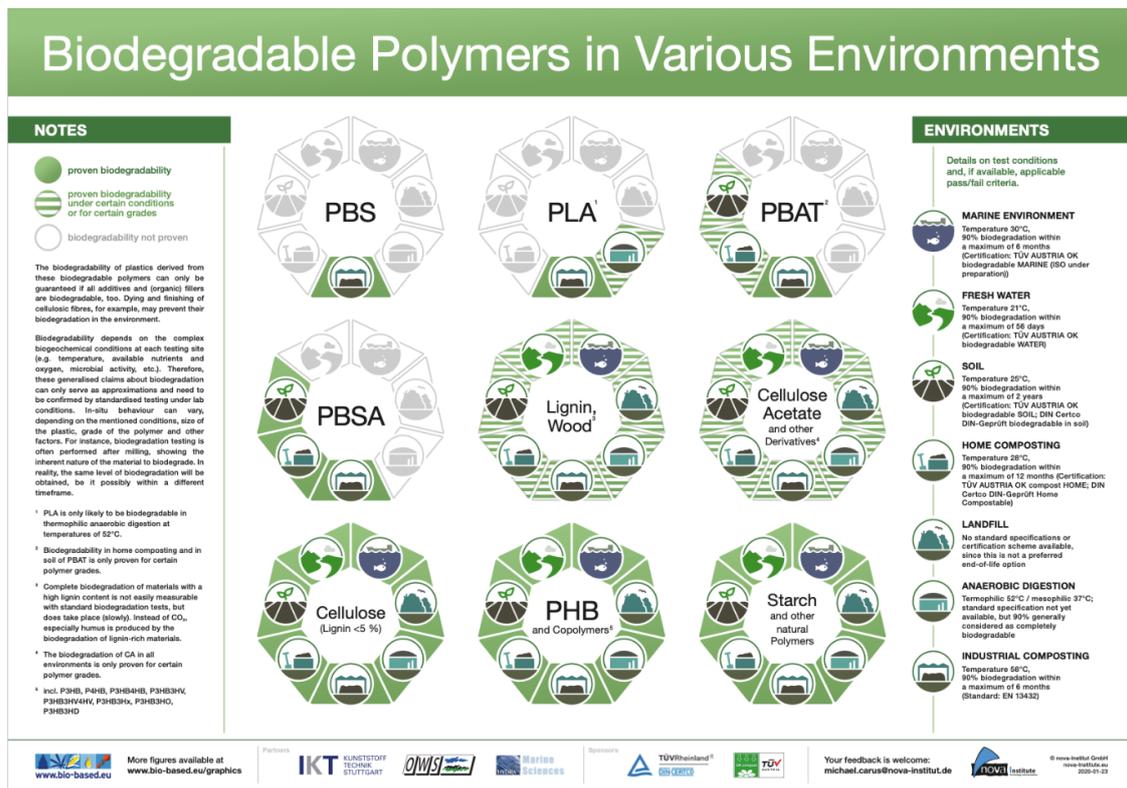


Figure 2 PHA end-of-life options compared to other materials

PHA production with renewable and recycled feedstocks

There are many types of bacteria that produce PHA in nature, by consuming different types of carbon-rich feedstocks. As such, PHA producing bacteria are found near carbon rich sources, such as palm trees and rice paddies.

Today, almost any carbon-rich feedstock can be used to produce PHA-materials, providing a unique opportunity to close the loop for organic and synthetic virgin and recycled feedstocks, such as: biogas from organic waste, synthetic gas from landfills and pyrolysis plants, vegetable oils, used cooking oils and even CO₂.

PHA production mimics natural ecosystems

PHA production happens via fermentation, the same process to make cheese and beer. In this process the natural ecosystem is replicated and optimized for consistency, quality and safety.

In the fermentation process PHA producing bacteria consume the carbon-rich feedstock and synthesize PHA molecules biologically, this is therefore a totally different process than producing fossil-based polymers, which are chemically synthesized. These PHA molecules have exactly the same chemical structure as they appear in nature. After fermentation, the PHA materials are harvested from the bacteria, washed and purified for physical transformation into consumer products.

³ <https://www.nature.com/articles/s41428-020-00396-5>

⁴ Bioplastics Magazine (03/20) Vol.15: What about recycling of PHA-polymers?