# Biodegradable material with adjustable degradation rate

## Development status

**Phase 2**

**Feasibility study.** There is a realistic design of the technology and the initial tests in the laboratory are leading to the specification of the technology requirements and its capabilities.

## IP protection status

Granted patent of the Czech Republic No. 309864

## Partnering strategy

*Collaboration, licensing*

## Institution

Univerzita Tomáše Bati ve Zlíně
Tomas Bata University in Zlín

**Tomas Bata University in Zlín**

## Challenge

The continuous development and innovation of biodegradable plastics based on poly(3-hydroxybutyric acid) (PHB) is a key topic in the field of environmental sustainability as it helps to reduce the amount of plastic waste that pollutes our planet. However, the control of the rate of PHB biodegradation, which is important for expanding its usability in practice, is still an unsolved problem from both a technological and an economic point of view. This is because the reagents proposed so far, in combination with specific techniques that are not widely used in the plastics industry, require special equipment and further processing processes are necessary to finalize the product. This motivated us to use a commercially available chemical agent that is generally known in the practice of plastics and for the application of which existing technological equipment can be used. Our goal was to develop a material whose biological decomposition could be purposefully controlled and thus increase its

## Description

The biodegradability of PHB is dependant not only on its chemical structure, but also on its molecular and supramolecular structure, that is, to the arrangement of macromolecules in relation to each other. In the case of PHB, the high crystallinity and stereoregularity, together with the low crystallization rate, result in the formation of spherulitic bodies during the processing. The size of these spherulites can vary widely, from a few microns to one millimetre, depending on PHB purity, additives and treatments. As a part of complex investigation of effects of supramolecular structure, namely of crystal phase morphology on PHB microbial degradation, crystallinity development was found to influence the rate of PHB microbial degradation, with PHB crystal structure influencing the physiological behaviour of PHB-degrading bacteria. Therefore, the control of morphology of the crystalline phase can be used to adjust the PHB biodegradability rate, via the influence of the supramolecular structure on the biodegrading bacteria. The addition of the chemical agent selected by us leads to the restructuring of the polymer chain, which results in a change in the morphology and thus the rate of biological decomposition of PHB. The result of our

research is therefore a material that is biodegradable, but at the same time achieves the required decomposition time, which can be lengthened or shortened at will using chemical treatment. The main advantages of this material are: 1) easy changeability of the rate of biological decomposition 2) easy availability of all necessary components that are currently commonly used 3) simplicity and economic undemanding production of biodegradable material, for which existing technological equipment can be used.

## Commercial opportunity

Biodegradable material with an adjustable rate of biological decomposition according to our solution can be used: - in the packaging industry for the production of biodegradable food packaging; - in agriculture and horticulture for the production of flower pots or spice pots, or mulch films; - for the production of consumer goods such as disposable products of daily use, e.g. trays, cups, plates, cutlery and others; - in special technical applications, such as biodegradable polymers for 3D printing or as part of composite materials.