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Boosting
European Citizens'
Knowledge and Awareness
of Bio-Economy
Research and Innovation

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INFO

webinar jest nagrywany

nagranie wideo, prezentacja oraz materiały dodatkowe będą dostępne na stronie: http://www.kopernik.org.pl/projekty-specjalne/projekty-europejskie/bloom/

Q&A – pytania i odpowiedzi odbędą się w drugiej części webinaru, pytania zadajemy w czacie używając funkcji „zadaj pytanie” ☺

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BIOPLASTIK – alternatywa dla tworzyw sztucznych

ANTROPOCEN

Paul J. Crutzen

The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature?
Will Steffen; Paul J Crutzen; John R McNeill
Ambio; Dec 2007; 36, 8; Sciences Module
pg. 614

Article Will Steffen, Paul J. Crutzen and John R. McNeill

The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature?

We explore the development of the Anthropocene, the current epoch in which humans and our societies have become a global geophysical force. The Anthropocene began around 1800 with the onset of industrialization, the central feature of which was the enormous expansion in the use of fossil fuels. We use atmospheric carbon dioxide concentration as a single, simple indicator to track the progression of the Anthropocene. From a preindustrial value of 270–275 ppm, atmospheric carbon dioxide had risen to about 310 ppm by 1950. Since then the human enterprise has experienced a remarkable explosion, the Great Acceleration, with significant consequences for Earth System functioning. Atmospheric CO_2 concentration has risen from 310 to 380 ppm since 1950, with about half of the total rise since the preindustrial era occurring in just the last 30 years. The Great Acceleration is reaching criticality. Whatever unfolds, the next few decades will surely be a tipping point in the evolution of the Anthropocene.

INTRODUCTION

Global warming and many other human-driven changes to the environment are raising concerns about the future of Earth's environment and its ability to provide the services required to maintain viable human civilizations. The consequences of this unintended experiment of humankind on its own life support system are hotly debated, but worst-case scenarios paint a gloomy picture for the future of contemporary societies.

Underlying global change (Box 1) are human-driven alterations of *i)* the biological fabric of the Earth; *ii)* the stocks and flows of major elements in the planetary machinery such as nitrogen, carbon, phosphorus, and silicon; and *iii)* the energy balance at the Earth's surface (2). The term *Anthropocene* (Box 2) suggests that the Earth has now left its natural geological epoch, the present interglacial state called the Holocene. Human activities have become so pervasive and profound that they rival the great forces of Nature and are pushing the Earth into planetary *terra incognita*. The Earth is rapidly moving into a less biologically diverse, less forested, much warmer, and probably wetter and stormier state.

The phenomenon of global change represents a profound shift in the relationship between humans and the rest of nature. Interest in this fundamental issue has escalated rapidly in the international research community, leading to innovative new research projects like Integrated History and future of People on Earth (IHOPE) (8). The objective of this paper is to explore one aspect of the IHOPE research agenda—the evolution of humans and our societies from hunter-gatherers to a global geophysical force.

To address this objective, we examine the trajectory of the human enterprise through time, from the arrival of humans on Earth through the present and into the next centuries. Our analysis is based on a few critical questions:

– Is the imprint of human activity on the environment discernible at the global scale? How has this imprint evolved through time?
– How does the magnitude and rate of human impact compare with the natural variability of the Earth's environment? Are human effects similar to or greater than the great forces of nature in terms of their influence on Earth System functioning?
– What are the socioeconomic, cultural, political, and technological developments that change the relationship between human societies and the rest of nature and lead to accelerating impacts on the Earth System?

Pre-Anthropocene Events

Before the advent of agriculture about 10 000–12 000 years ago, humans lived in small groups as hunter-gatherers. In recent centuries, under the influence of noble savage myths, it was often thought that preagricultural humans lived in idyllic harmony with their environment. Recent research has painted a rather different picture, producing evidence of widespread human impact on the environment through predation and the modification of landscapes, often through use of fire (9). However, as the examples below show, the human imprint on environment may have been discernible at local, regional, and even continental scales, but preindustrial humans did not have the technological or organizational capability to match or dominate the great forces of nature.

The mastery of fire by our ancestors provided humankind with a powerful monopolistic tool unavailable to other species, that put us firmly on the long path towards the Anthropocene. Remnants of charcoal from human hearths indicate that the first use of fire by our bipedal ancestors, belonging to the genus *Homo erectus*, occurred a couple of million years ago. Use of fire followed the earlier development of stone tool and weapon making, another major step in the trajectory of the human enterprise.

Early humans used the considerable power of fire to their advantage (9). Fire kept dangerous animals at a respectful distance, especially during the night, and helped in hunting protein-rich, more easily digestible food. The diet of our ancestors changed from mainly vegetarian to omnivorous, a shift that led to enhanced physical and mental capabilities. Hominid brain size nearly tripled up to an average volume of about 1300 cm^3, and gave humans the largest ratio between brain and body size of any species (10). As a consequence, spoken and then, about 10 000 years ago, written language could begin to develop, promoting communication and transfer of knowledge within and between generations of humans, efficient accumulation of knowledge, and social learning over many thousands of years in an impressive catalytic process, involving many human brains and their discoveries and innovations. This power is minimal in other species.

Among the earliest impacts of humans on the Earth's biota are the late Pleistocene megafauna extinctions, a wave of extinctions during the last ice age extending from the woolly mammoth in northern Eurasia to giant wombats in Australia (11–13). A similar wave of extinctions was observed later in the Americas. Although there has been vigorous debate about the

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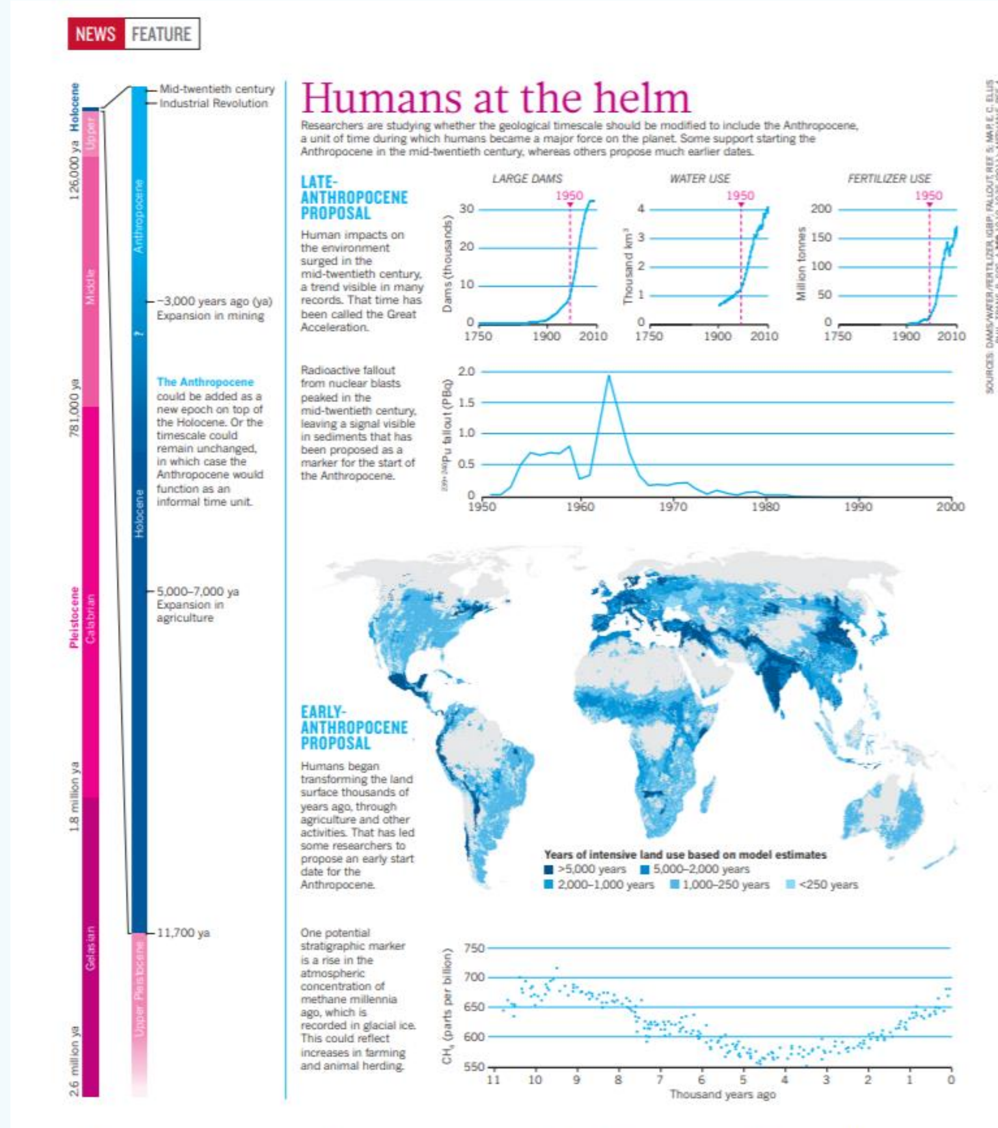
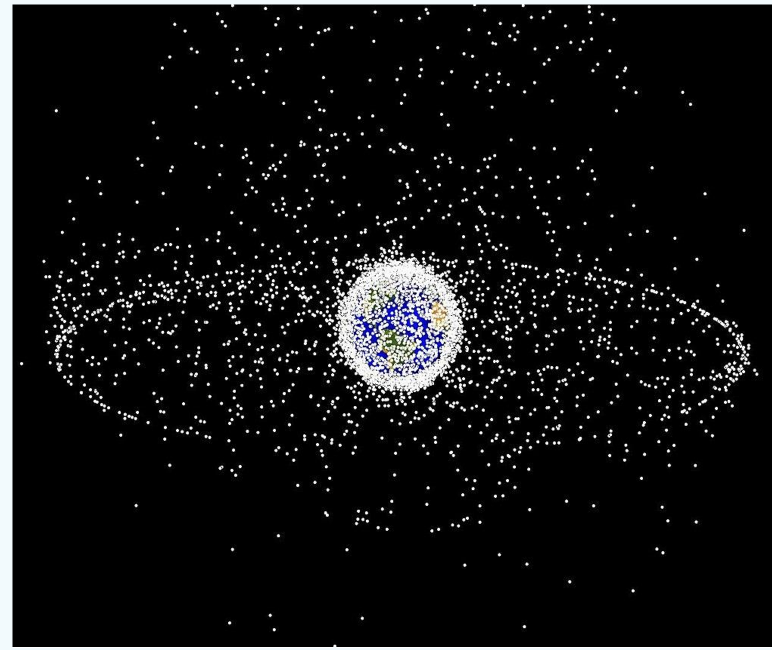


http://www.burdu976.com/phs/portfolio/nature-the-human-epoch/

https://www.nature.com/news/polopoly_fs/1.17085!/menu/main/topColumns/topLeftColumn/pdf/519144a.pdf

WIELKA PACYFICZNA PLAMA ŚMIECI

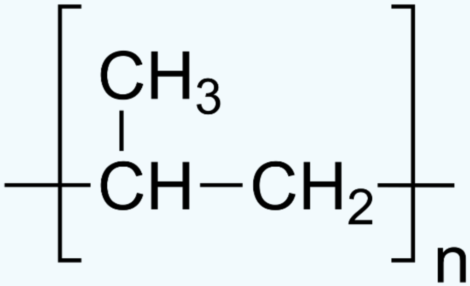
KOSMICZNE ŚMIECI



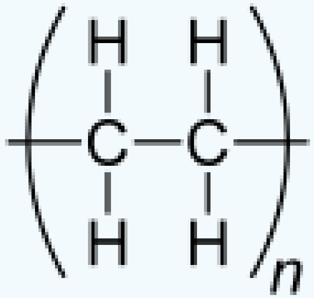
ANTROPOCEN – (EPOKA CZŁOWIEKA)



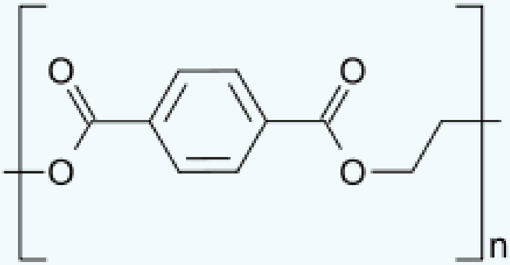
PLASTIK (POLIMERY SYNTETYCZNE) - PRODUKOWANE Z ROPY NAFTOWEJ



Polipropylen, PP



Polietylen, PE

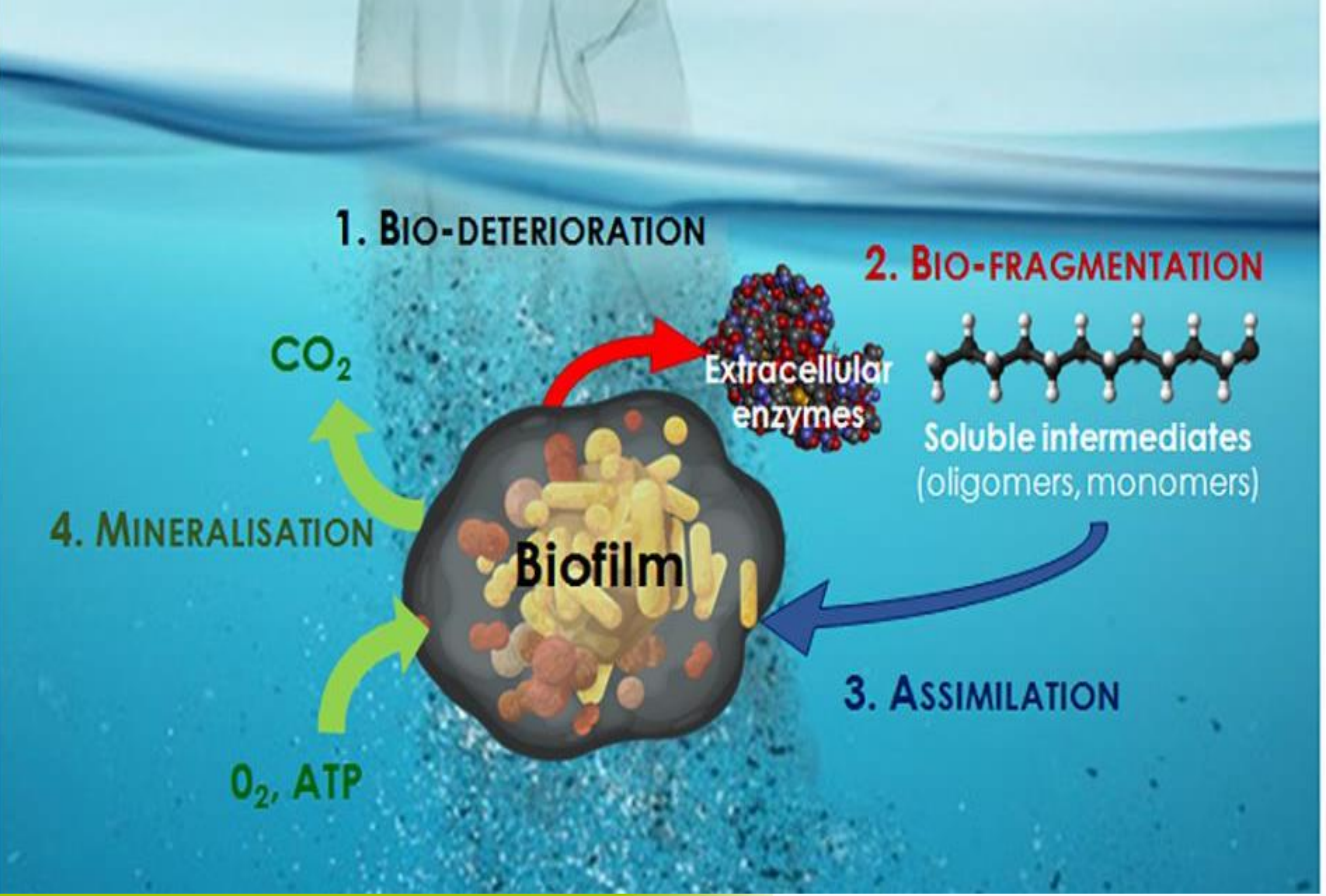


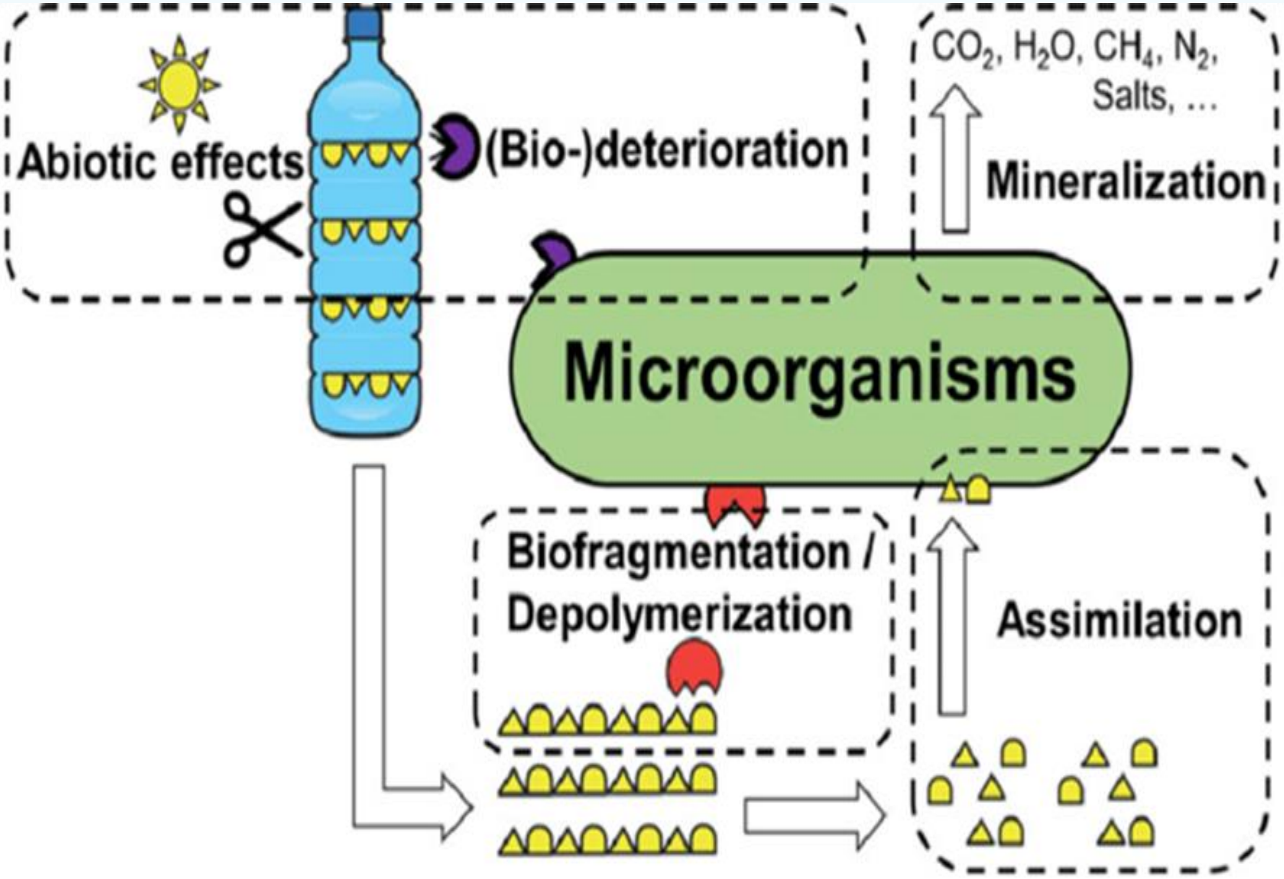
Poli(tereftalan etylenu), PET

Polietylen (PE) i polipropylen (PP) stanowią około 92% całkowitej produkcji tworzyw sztucznych. PE jest w dużej mierze wykorzystywany w opakowaniach, co stanowi około 40% całkowitego zapotrzebowania na produkty z tworzyw sztucznych.

źródło: www.plasticseurope.org

RODZAJE TWORZYW SZTUCZNYCH (OZNACZENIA)


1. Bio-deterioration
2. Bio-fragmentation
Extracellular enzymes
Soluble intermediates
(oligomers, monomers)
CO_2
4. Mineralisation
Biofilm
3. Assimilation
O_2, ATP


Abiotic effects
(Bio-)deterioration
CO2, H2O, CH4, N2,
Salts, ...
Mineralization
Microorganisms
Biofragmentation /
Depolymerization
Assimilation

LARWY OWADÓW JEDZĄCE POLIETYLEN

MĄCZNIK MŁYNAREK
(*Tenebrio molitor*)

OMACNICA SPICHRZANKA
(*Plodia interpunctella*)

BARCIAK WIĘKSZY
(*Galleria mellonella*)


0
1
cm

GRZYBY

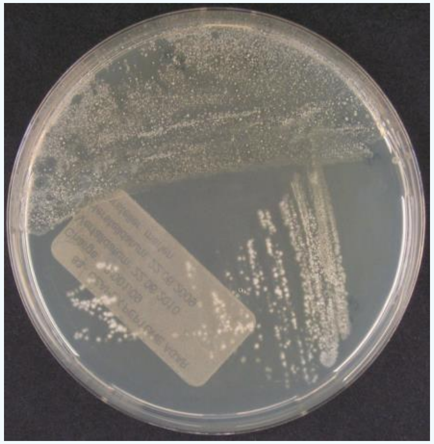
Fusarium solani

Aspergillus oryzae

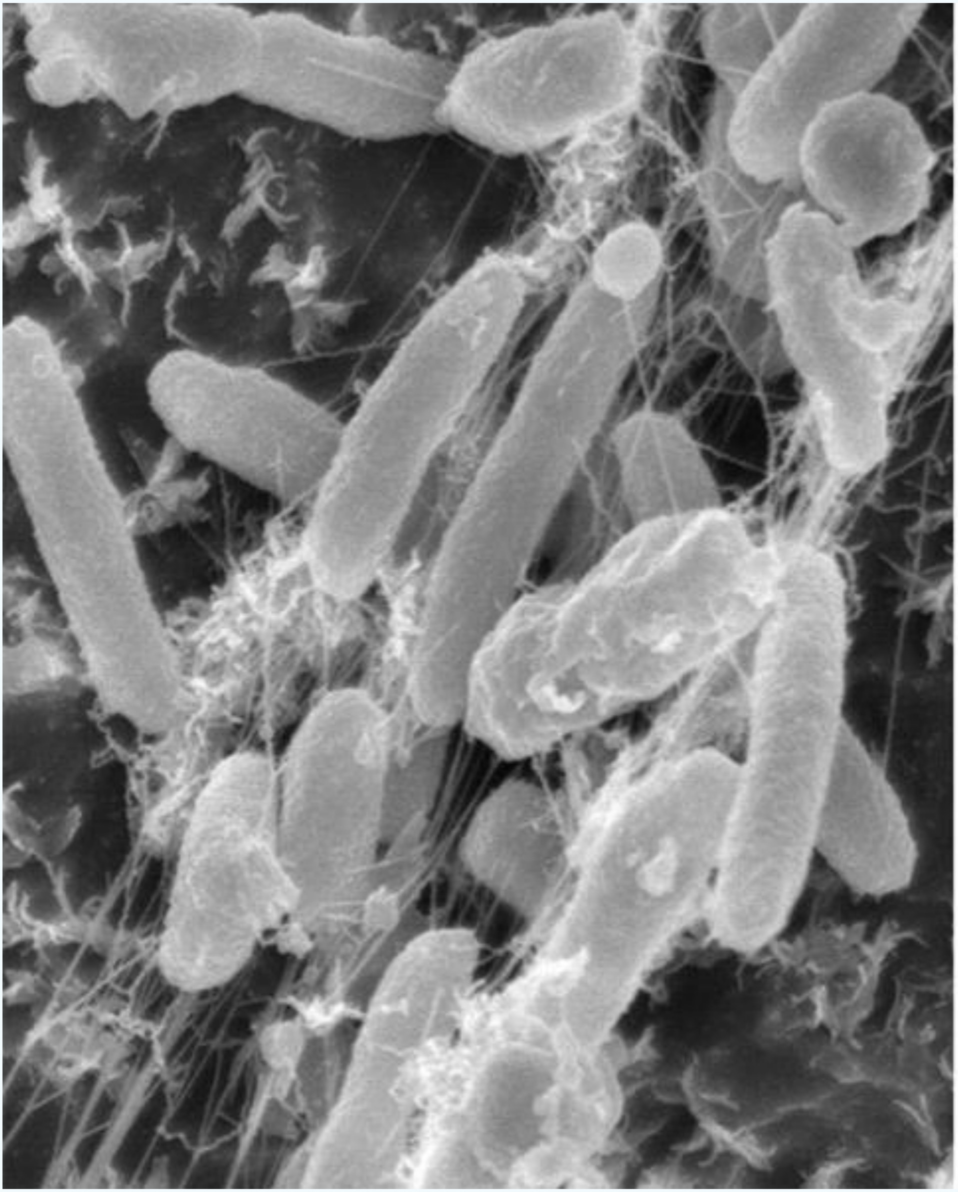
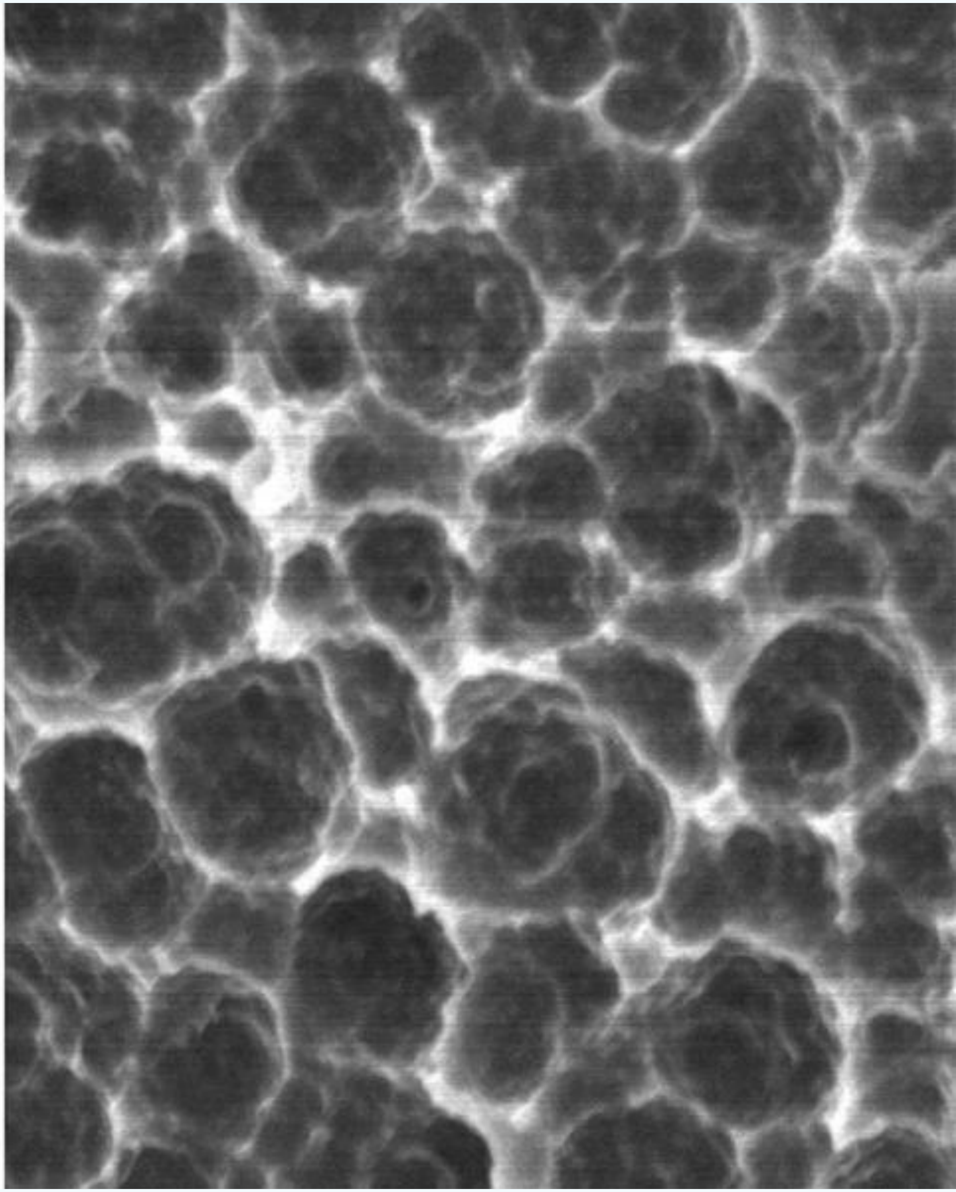
PROMIENIOWCE

Thermomonosporaceae

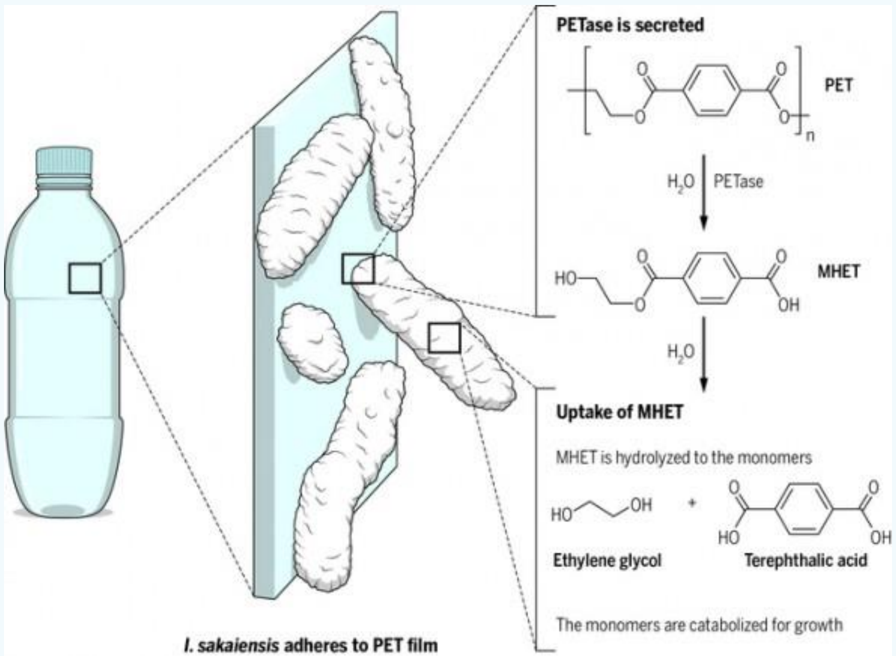
BAKTERIE

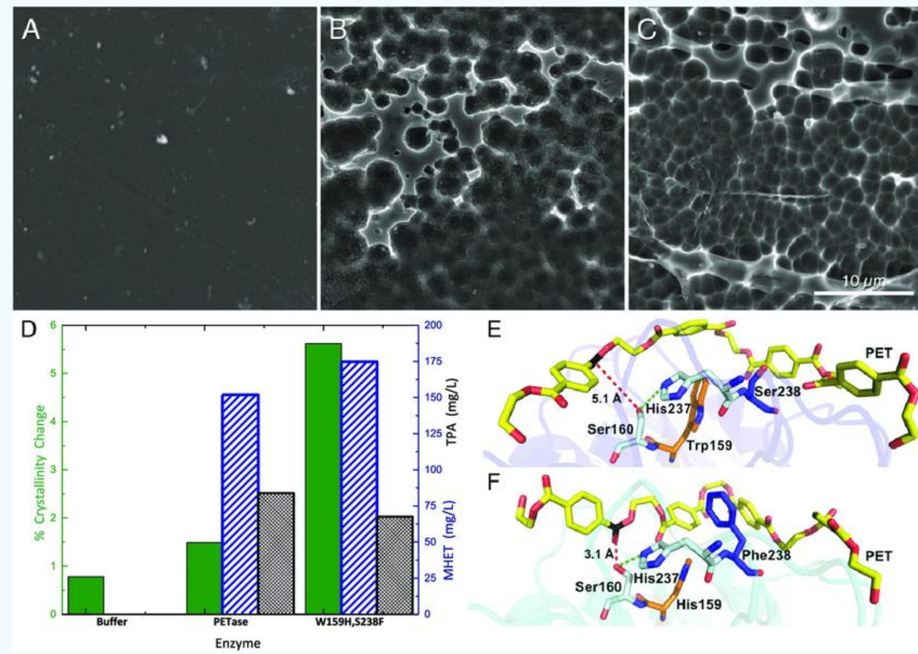


Thermobifida fusca

Jak bakterie *Ideonella sakaiensis* rozkładają PET





https://www.bbc.com/news/science-environment-43783631

https://www.nature.com/articles/s41467-019-09326-3

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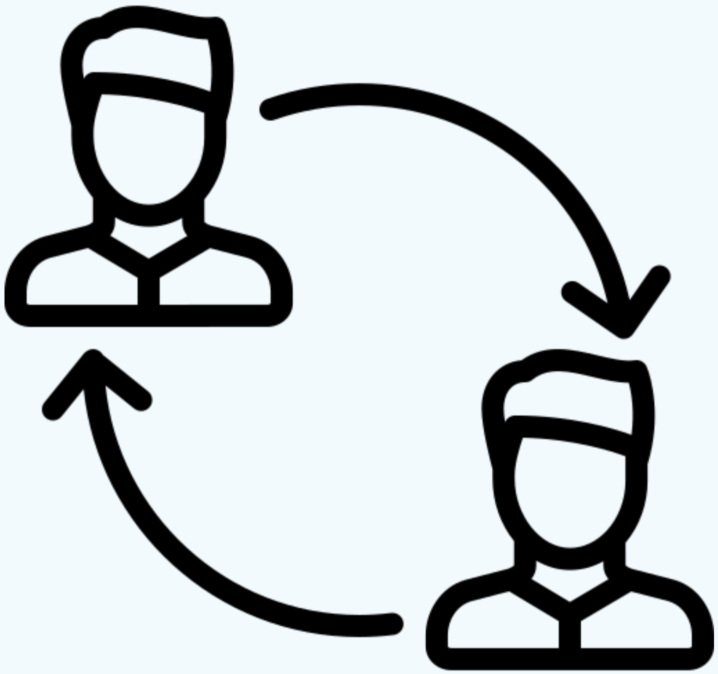
Petazelle - Karolina Sulich – Austriackie Forum Kultury

http://www.karolinasulich.com/petazelle



PLASTIK Z BAKTERII

Materiał zapasowy, który bakterie gromadzą w warunkach stresu środowiskowego – warunki łatwe do osiągnięcia w laboratorium

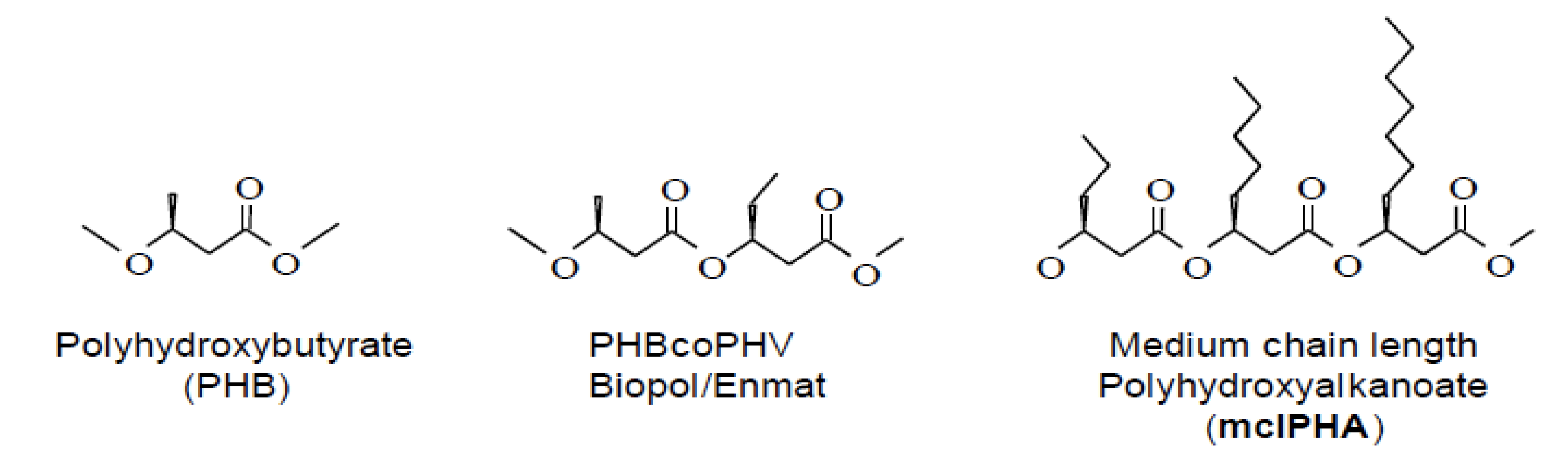
Biodegradowalny

Biozgodny

Bioplastik – PHA (polihydroksyalkaniany)

Zmiana właściwości fizykochemicznych w zależności od budowy łańcuchów bocznych:

- PHB – krótkie łańcuchy – twardy
- Mcl-PHA – długie łańcuchy – elastomer
- Inne PHA mogą nawet przypominać konsystencją płynny miód



Bioplastik – z czego się produkuje

Oleje roślinne

Cukry

Biomasa

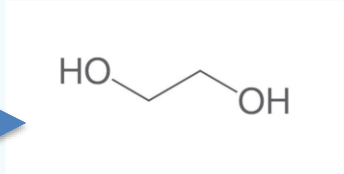
Ścieki komunalne

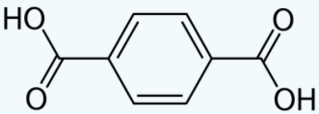
H_2, CO, CO_2
Syngas

Plastiki jak PE, PS, PET

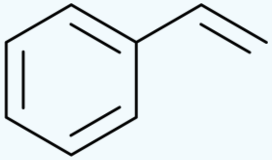
Bioplastik – z czego się produkuje

PET

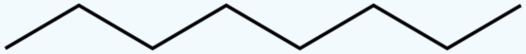




PS



PE, PP



Metody chemiczne → piroliza

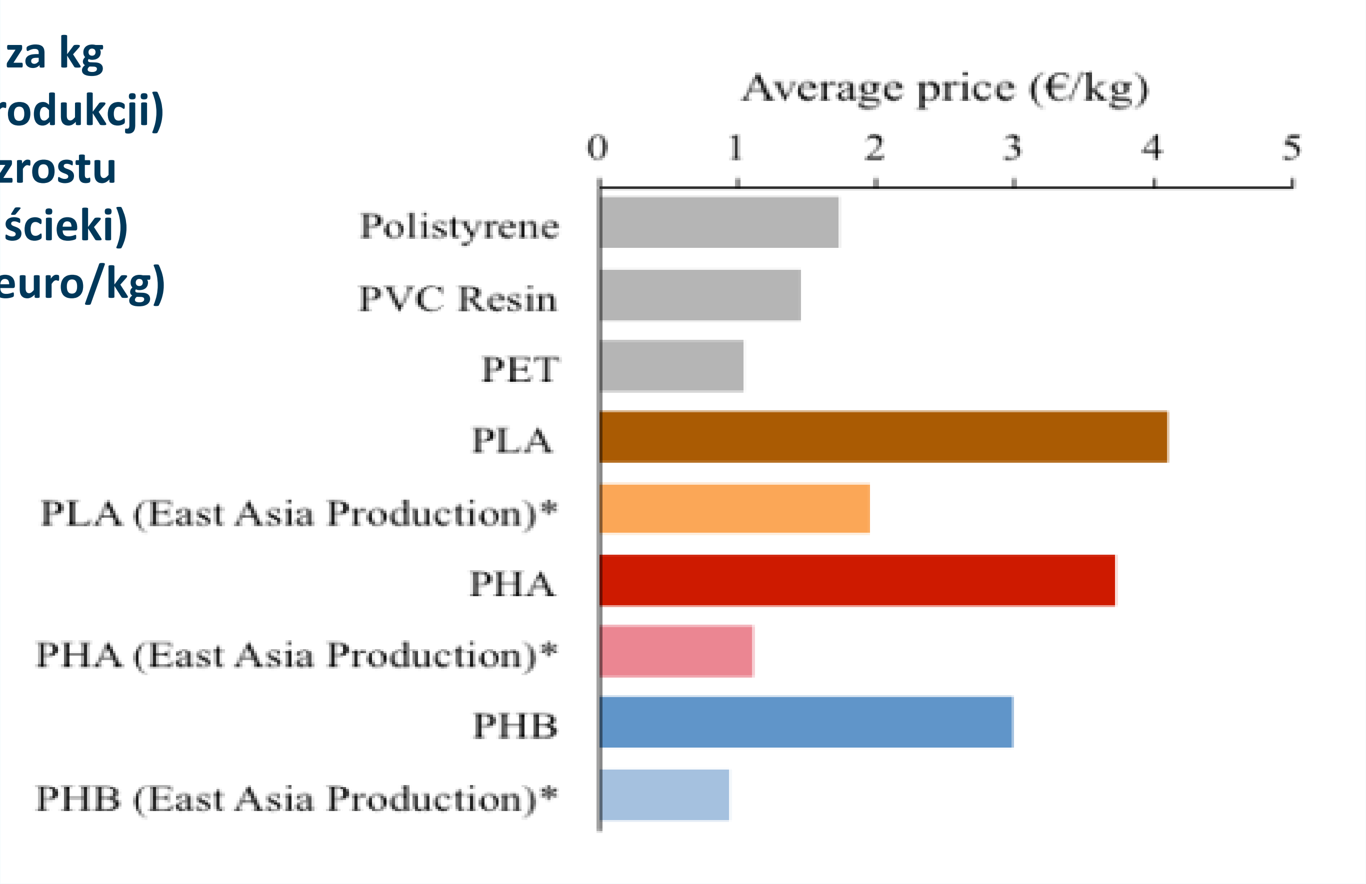
Metody biologiczne/enzymatyczne

Bioplastik – produkcja

Fermentacja -> liofilizacja bakterii -> ekstrakcja np. acetonem -> oczyszczanie w alkoholu -> Suszenie w celu otrzymania surowego materiału (płaty, pelet)

Cena polimerów

Koszt: 1.5 do 4.0 euro za kg
(skala od 1 t – 100 t produkcji)
Zależy od substratu wzrostu bakterii (np. cukier vs ścieki)
(por. PE-PS to 0.9-2.0 euro/kg)



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Bioplastik – zastosowania




Polimery:

- budownictwo, opakowania, rolnictwo, motoryzacja
- implanty medyczne

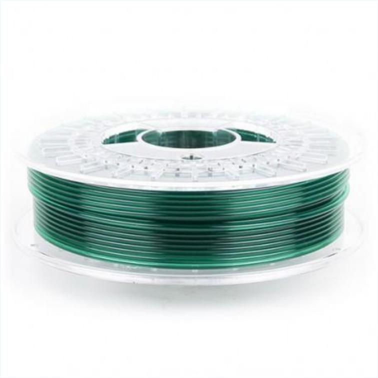
Monomery PHA:

- dodatki do żywności/pasz
- cząsteczki budujące leki



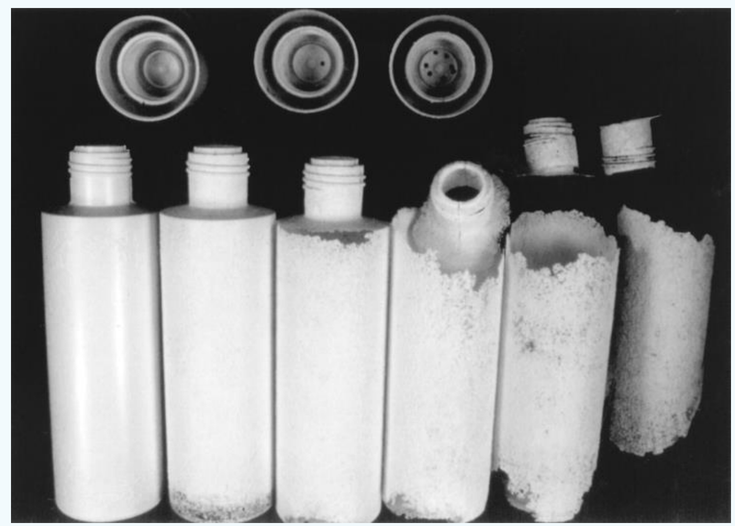



Bioplastik – zastosowania



Bioplastik – zastosowania

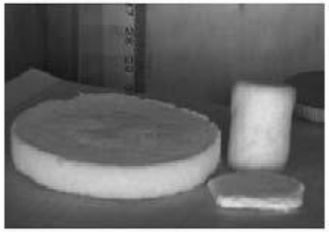
Degradacja P(3HB-3HV) w aerobowych osadach ściekowych. Butelki wykonane z P(3HB-3HV) inkubowano w okresie letnim (średnia temperatura 20°C) w tlenowych osadach ściekowych. Postęp degradacji wykazano w przypadku butelek, które były poddawane temu procesowi przez 0, 2, 4, 6, 8 i 10 tygodni (od lewej do prawej). Fotografia dzięki uprzejmości Dietera Jendrosseka, Georg-August-Universität, Getyngia, Niemcy.

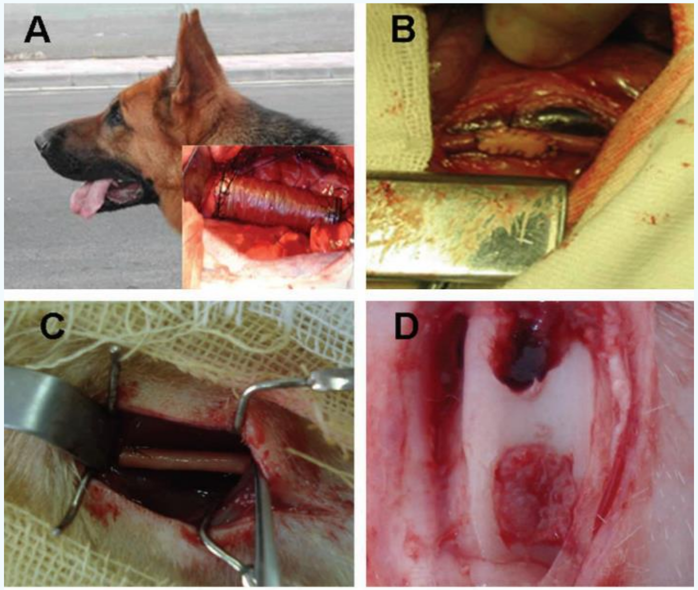


Bioplastik – zastosowania

* Głównie PHB i mieszanki z scl-PHA
* mcl-PHA - tylko do rekonstrukcji zastawek serca i aorty

membrany, granulaty (wypełnienie)
Tabletki z lekami
matryce, stenty, nici chirurgiczne





A) Przełyk
B) Plaster naczyniowy
C) Pokrycie nerwów
D) Sztuczna chrząstka
E) Suplementy diety