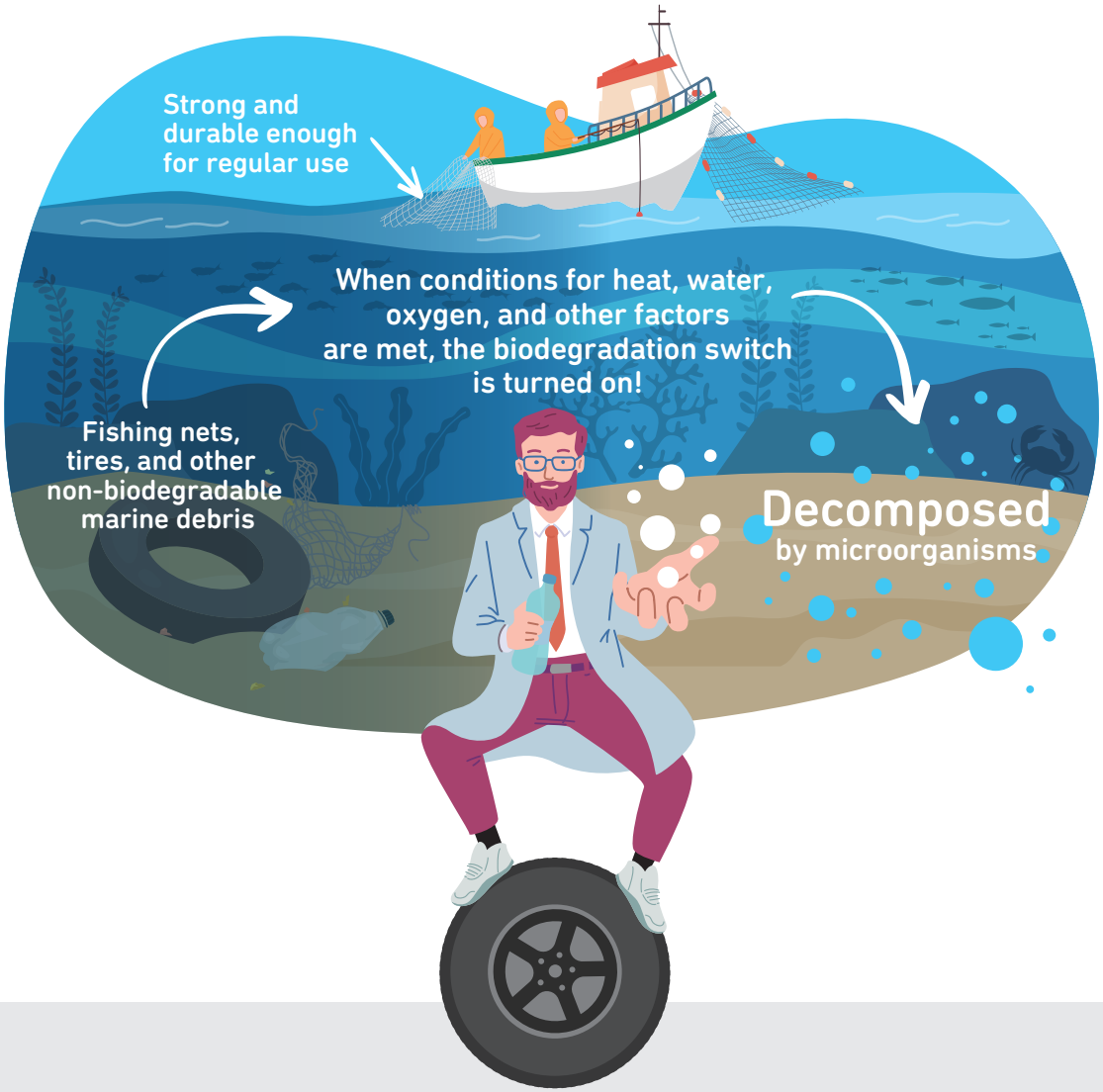
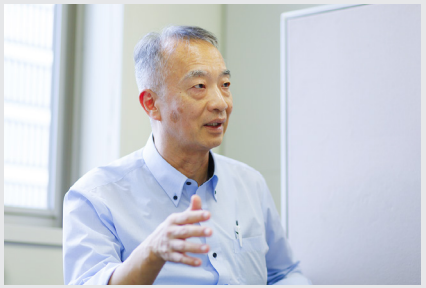
14 PROJECT

New Material, Strong Yet Earth-Friendly, That Returns to the Ocean

Multi-Lock Biopolymers Made From Biomass Break Down in the Ocean

Pollution from plastic waste in our oceans is a serious problem, with warnings that by 2050 the weight of trash in the seas will exceed that of fish. One initiative in the effort to solve this problem involves developing biodegradable materials that decompose naturally with the help of living organisms. While some of these materials have already been put into practical use, the challenge has been to find ones that are both durable and easily broken down. In this project, we are researching ***biodegradable plastic*** made from polymers with sufficient strength for practical use, but that decompose only under certain conditions.





A Sign of Encouragement From an Unexpected Visitor

Dr. ITO Kohzo
Special Appointed Professor, The University of Tokyo
Fellow, National Institute for Materials Science

Although we have succeeded in developing extremely durable polymers, we are taking on the additional challenge of balancing durability and degradability. While conducting the world's largest field test of polymers that degrade in seawater, we had an unexpected, heartwarming encounter. We found squids had spawned in one of the experiment samples! Perhaps this meant the samples were welcome in the natural world. It gave us a sense of hope for the future, one presenting a fusion of technology and nature.

Cool Earth | Clean Earth

New Material, Strong Yet Earth-Friendly, That Returns to the Ocean

» The Difficulty of Achieving Both Durability and Degradability

There are serious concerns about the adverse effects of plastics such as fishing gear, nets, and polymer-coated fertilizers flowing into the sea. Research has been conducted on biodegradability, or the ability of materials to be decomposed naturally by microbes, but there is a trade-off between the strength that materials require for regular use and their ability to be broken down in the natural environment. Ideal biodegradability would mean that fishing gear, nets, or other materials stay strong as long as the material is fulfilling its role, but quickly and completely decomposes if it has unintentionally become marine debris.

» Discovering the Key to Unlock the Solution

In our research, we aim to develop durable yet degradable plastic products and fishing gear for everyday use made from biomass, that is, raw materials derived from living organisms. A turning point came with the discovery of a unique, new material. A dynamic mechanism incorporated into the bonds connecting the

polymers diffuses external forces applied to it. In other words, it's tough! At the same time, it features a decomposition trigger in the form of a multi-lock mechanism. This breaks the polymer bonds, but is initiated only when multiple stimuli in the ocean, such as warmth, oxygen, water, enzymes, certain microorganisms, and catalysts are simultaneously present. The result is a "two-way player" capable of both durability and degradability. Widespread adoption of this new material can contribute tremendously toward solving global environmental problems.

KEYWORD

Biodegradable Plastic

This is a plastic made of a polymer that is decomposable by microorganisms, which turn it into CO_2 and water that are circulated back into the natural environment. For example, this type of plastic can be mixed into a compost pile and broken down by microbes for use as a fertilizer or soil amendment.

FUTURE VISION

2025

Narrow Down the Final Candidates

We are consulting with participating companies to narrow the range of products incorporating new materials and technologies developed by academic institutions. The criteria are whether they address current serious environmental hazards and if adopting them can be expected to have a major impact on society.

2027

Achieve the Required Material Target Values

To manufacture specific final products, the individual companies require the polymer materials to hit certain numerical targets for toughness and degradability. In addition, we will develop manufacturing technologies using inedible biomass as a raw material.

2029

Prototype and Assess Final Products

We will produce prototypes of specific final products that combine durability and degradability and evaluate their performance in real-world situations. We will also focus on establishing technologies for mass production and cost reduction methods to quickly commercialize products after the project ends.

Implementation

The University of Tokyo, Mitsubishi Chemical Corporation, Bridgestone Corporation, Kureha Corporation, Kyushu University, Nagoya University, Yamagata University, Research Institute of Innovative Technology for the Earth (RITE), National Institute of Advanced Industrial Science and Technology (AIST), Ehime University, Institute of Science Tokyo

Project Introduction Video

https://www.youtube.com/watch?v=N-vs_T52F8o&list=PLZH3AKTCrVsVm3UN1x40WW_QK-cEXaoo3