Japan-UNIDO Multi-stakeholder Cooperation Dialogue

“Partnering for Africa’s Challenge on Plastic Litter”

KANEKA Biodegradable Polymer™ PHBH™
(Compostable & Marine Degradable)

Contributing to resolving growing plastic pollution issues by offering 100% plant-based biodegradable polymers

KANEKA CORPORATION

2019.10.7
Characteristics and Life Cycle of PHBH™

✓ PHBH™ produced by microbial fermentation from plant oils.

Life cycle of PHBH™

PHBH™ accumulated in microorganisms (Electron micrograph)

CO₂
Water

Plant oil

Fermentation

Processing

Degradation

PHBH™

Product

Example of Use

Example of Use

Characteristics of PHBH™

➢ 100% bio-based
➢ Producing by fermentation
➢ Biodegradable

Poly (3-hydroxybutyrate-co-3-hydroxyhexanate) PHBH™
Discarded plastic causes
- Land pollution
- Marine pollution (microplastic problem)

Tighter regulation of plastics in Europe and other regions

Characteristics of PHBH™
- 100% plant-based
- Producing by fermentation
- Biodegradable

PHBH™ is a biodegradable polymer that is produced by microbial fermentation from plant oils.

<table>
<thead>
<tr>
<th>Raw material</th>
<th>Biodegradability</th>
<th>Biodegradable</th>
<th>Non-Biodegradable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bio-based</td>
<td>PHBH™ PLA (Polyactic acid) Starch etc.</td>
<td>Bio-PE Bio-PA Bio-PC etc.</td>
<td></td>
</tr>
<tr>
<td>Fossil-based</td>
<td>PBS PBSA PBAT</td>
<td>PE PA PC ABS</td>
<td></td>
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</tbody>
</table>

Obtained the “OK Biodegradable MARINE” certificate
Expanding applications as a marine material

In November 2017, we obtained “OK Biodegradable MARINE” certification for PHBH. Our biodegradable polymer PHBH™ has registered as a Food Contact Material in EU Commission (Europe), FDA※1 (U.S.) and JHOSPA※2 (Japan).

These achievements enable us to use it as marine materials, food packaging materials and compost bags. We will accelerate the development of new biomass-based products with biodegradable property.

Requirements of Seawater Test
- Biodegradation: >90% (within 6 months, 30°C)
- Disintegration: <10% remains with a 2.0mm sieve (within 12 weeks, 30°C)

“OK Biodegradable MARINE” certification granted by VINCOTTE, an international certification body

Approval

<table>
<thead>
<tr>
<th>Bio-based</th>
<th>(Europe/Japan)</th>
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<table>
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<tr>
<th>Biodegradable</th>
<th>(Europe/U.S./Japan)</th>
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<table>
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<tr>
<th>Compost (Industrial)</th>
<th>(Europe)</th>
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<table>
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<tr>
<th>Compost (Home)</th>
<th>(Europe)</th>
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<table>
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<tr>
<th>Marine</th>
<th>(Europe)</th>
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<table>
<thead>
<tr>
<th>Soil</th>
<th>(Europe)</th>
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</table>

※Europe: TÜV AUSTRIA BELGIUM, U.S.: Biodegradable Products Institute, Japan:JBPA: Japan BioPlastics Association

※1: Food and Drug Administration, ※2: Japan Hygienic Olefin and Styrene Plastics Association

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Joint development of products using PHBH™ and related initiatives are now under way in earnest

New straws for "SEVEN CAFÉ" run by Seven-Eleven Japan Co., Ltd. and other group companies will be introduced to the market by the autumn of 2019. (news release issued on April 15, 2019)

Advance joint development of cosmetics containers with Shiseido Company, Limited (news release issued on April 24, 2019)

Advance project to promote widespread use of Biodegradable Polymer shopping bags in the Republic of Kenya (news release issued on September 4, 2018)

The problem of ocean pollution caused by plastic waste was covered in G20 Ministerial Meeting on Energy Transitions and Global Environment for Sustainable Growth, Biodegradable materials attract attention. (June 15-16 & 28-29, 2019)

Other than the above, we have received and are currently addressing inquiries and requests for joint development from around the world.
Status of Progress on JICA Project in Kenya

Background in Kenya
The number of single-use plastic shopping bags kept increasing, causing social problems such as insufficient capabilities of waste disposal plants and illegal dumping. Kenya enacted “Plastic Bag Ban Law” in 2017, banning plastic bags. Unfortunately, appropriate alternatives are not available. New problems are arising such as less convenience to consumers and plastic bags production shut-down.

Project Description
Contributing to resolve the above problems in Kenya through enhancement of understanding and promoting widespread use of biodegradable polymer shopping bags as alternatives.

<table>
<thead>
<tr>
<th>Items to be implemented</th>
<th>Progress</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. To support Kenya authority to bring the certification and labeling system for biodegradability</td>
<td>KEBS※1 set the standard of biodegradability this April. NEMA※2 understood FT-IR is useful for detection of fake products.</td>
</tr>
<tr>
<td>2. Technical trainings to produce biodegradable polymer shopping bags</td>
<td>Bobmil [KE] made PHBH™ based compounds’ bin liners in their existing machine by our trainings.</td>
</tr>
<tr>
<td>3. Implement of biodegradability test in Kenya</td>
<td>We are working out details with Japanese and Kenyan academia※3.</td>
</tr>
</tbody>
</table>

PHBH™ has biodegradability equal to or higher than that of cellulose which is a component of paper.
Biodegradability of PHBH™ in Sea Water

Biological oxygen demand (BOD) (Calculate from oxygen demand)
Tested by The National Institute of Advanced Industrial Science and Technology

Seawater immersion test (Measure from weight loss)
Tested by Kaneka

✓ PHBH™ biodegrades into CO₂ and H₂O in seawater (Biodegradation rate depending on conditions)
Biodegradability of PHBH™ in Seawater

Seawater Immersion Test

Temperature: 23°C
Seawater: Takasago, Hyogo

*Biodegradation behavior shown here is a typical test result at Kaneka. Disintegration speed will vary depending on natural conditions.
Biodegradability of PHBH™ in Soil

Sample setting

Sample size:
10cm x 10cm
20μm in thickness

Before covering soil

Surface

soil

Samples

soil

Bottom

Started from April 2018 in Nairobi, Kenya (monthly mean temp. for that period is 18-22°C.)

<table>
<thead>
<tr>
<th>Start</th>
<th>1 month</th>
<th>2 months</th>
<th>4 months</th>
<th>6 months</th>
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<tbody>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
<td><img src="image3.png" alt="Image" /></td>
<td><img src="image4.png" alt="Image" /></td>
<td><img src="image5.png" alt="Image" /></td>
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✓ PHBH™ biodegrades in soil
(Biodegradation rate depending on conditions)

*Biodegradation behavior shown here is a typical test result at Kaneka. Disintegration speed will vary depending on natural conditions.

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