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Development of highly degradable polyester-based multi-lock type bio-tough polymer and its fibers

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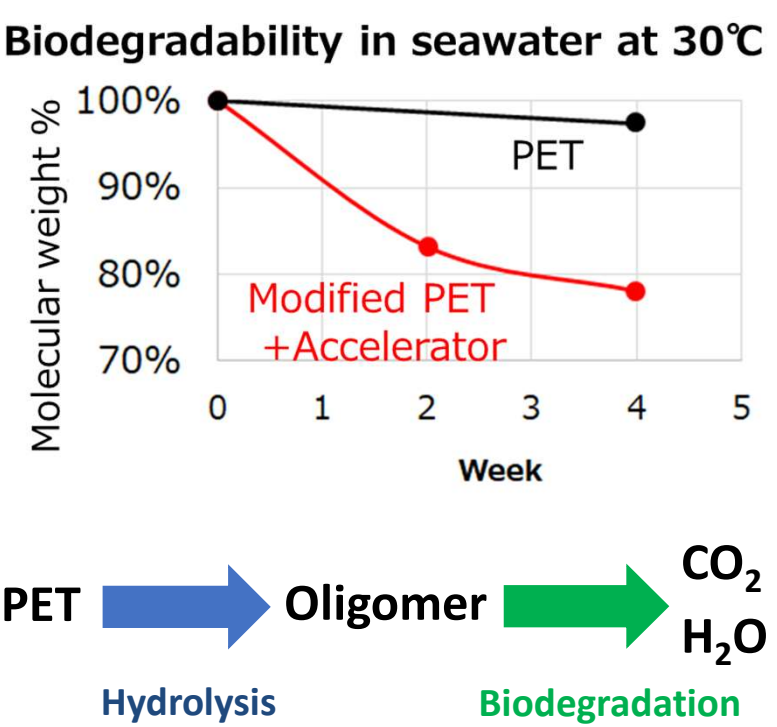
Our goal is to develop the new aromatic polyester polymers and their fibers that are stable during ordinary use and, start the decomposition by specific trigger. This polymer and fiber are applied new multi-lock type decomposition, non-edible bio-based monomers and polymer toughening technology.

[Technology]

1) Copolymer design and bio-based monomer
2) Decomposition accelerator technology
3) Release control of decomposition accelerators

We aim to realize the epoch-making marine biodegradable aromatic polyester polymers and their fibers in which hydrolysis (primary decomposition) and biodegradation of oligomers (secondary decomposition) are controlled.



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1. Final target in 2029

- To develop the aromatic polyester polymer and its fibers that easily decompose by multi-lock type decomposition and are applied the bio-based & toughening technology.
- This fiber has a marine degradability certification
- Teijin starts commercial production from 2030.
- Development of bio-based monomer production technology is completed.

2. R&D Items/ Contents

"Challenge" : Easily decompose , Bio-based & Toughening technology.

⇒ "Solution": Control the hydrolysis and Biodegradation by …

(1) Degradable design of polymer chain and bio-based monomer
(2) Decomposition accelerator / Toughening agents
(3) Release control of decomposition accelerators by fiber structure

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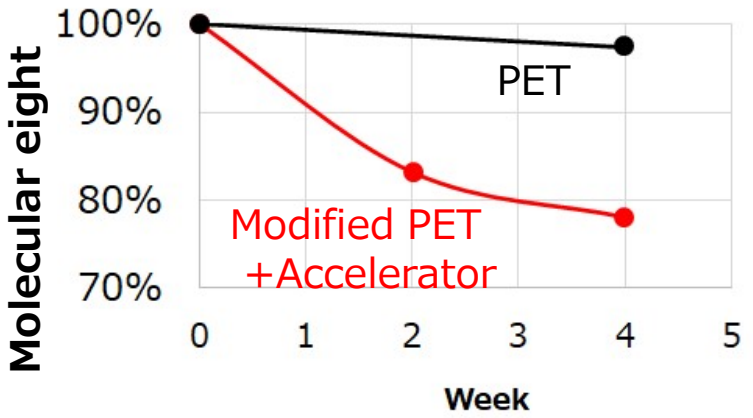
3. Current Achievements

(1) Degradable design of polymer chain and bio-based monomer

i. We completed the design and synthesis of easily degradable PET polymer copolymerized with specific comonomers

ii. Collaborating with academia on development of bio-based monomer

Biodegradability in seawater at 30℃

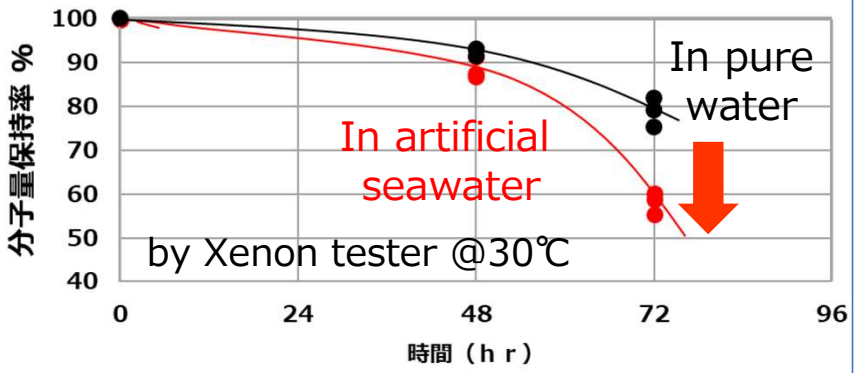


(2) Decomposition accelerator / Toughening agent

i. A new decomposition accelerator has been developed to start decomposition of polymers in large amounts of water.

ii. This decomposition accelerator with the modified polymer (1)-i. can be decompo-sed in 30°C. seawater. (Fig.1)

PET degradation by Photocatalyst



iii. PET polymers with the new photocatalyst (academia technology) promote decomposition in seawater. (Fig.2)

iv. A toughening agent is added to evaluate the mechanical properties.

(3) Release control of decomposition accelerators by fiber structure

- Spinning of these polymer is being carried out. fiber properties and marine biodegradability will be evaluated.

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3. Current Achievements

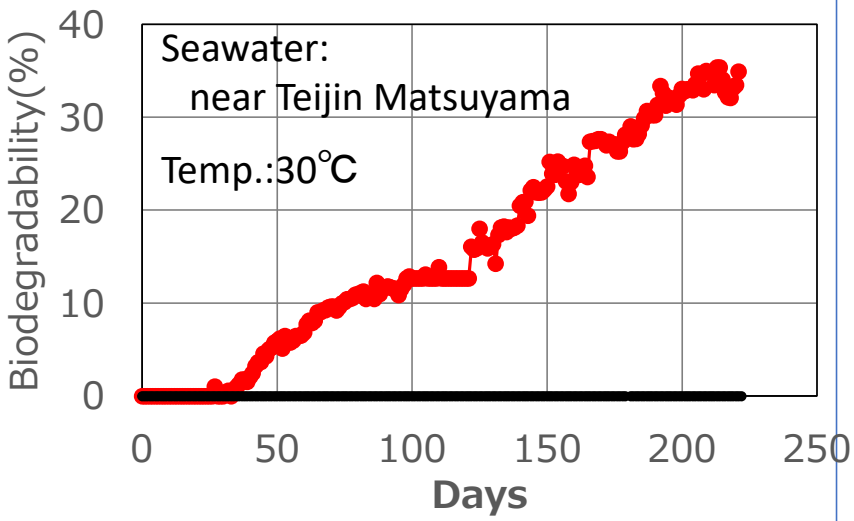
(4) Biodegradability evaluation in seawater

- Marine biodegradability evaluating method was established by using BOD.

(5) Marine biodegradability of PET oligomers

- PET oligomer has marine biodegradability. (see figure)
- Safety assessments of oligomers in sea will be carried out next.

PET oligomer degradation in seawater



4. Summary

- Our new PET copolymer with accelerator has the possibility to be decomposed in seawater.
- We confirmed the possibility of the following multi-lock type decomposition,
  1) PET copolymer ＋Decomposition accelerator [3. (2)-ii]
     ：Large amount of water＋Bacteria
  2) PET copolymer + Specific photocatalyst [3. (2)-iii]
     ：Light + Sea water + Bacteria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