

American Packaging Summit,

Advancing Compostable Packaging: New Polymer Innovations for a Circular and Sustainable Future

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kuraray

Executive Summary of Compostable Polymer



Agenda

- Introducing a new compostable elastic polymer under development for flexible packaging applications
- How composting and material science contribute to a more sustainable society and waste reduction
- Enhancing PLA performance with new modifiers to improve mechanical properties without compromising transparency and compostability
- Sealants, adhesives, and PSAs: Expanding compostable material use beyond traditional packaging films
- Application proposals for compostable heat-sealants and soft rubber-like goods across industries
- Discussing Kuraray's R&D insights and vision for scalable, eco-conscious packaging innovation

What's Kuraray?

| | |
|---------------------------------------|---|
| Company Name | Kuraray Co., Ltd. |
| President and Representative Director | Hitoshi Kawahara |
| Head Office | Tokiwabashi Tower, 2-6-4, Otemachi, Chiyoda-ku, Tokyo, Japan |
| Major Businesses | Resins, Chemicals, Activated carbon, Dental materials, Fibers, Others |
| Group Companies | 76 consolidated subsidiaries, two equity-method affiliates |
| Major Operations | United States, Germany, Belgium, China, Korea, Singapore, Thailand |

Consolidated data as of December 31, 2024



Established
1926



Employees
(Consolidated)
11,941



Bases
100 companies in **32** countries and regions around the world
countries and regions around the world



Capital
89 billion yen



Net sales
826.9 billion yen



Operating income
85.1 billion yen

What's Kuraray?

Vinyl Acetate

- KURARAY POVAL™ / ELVANOL™ PVOH resin
- EXCEVAL™ special modified PVOH resin
- Optical-use poval film
- Water-soluble PVOH film
- Trosifol™ PVB film
- SentryGlas™ ionomer sheet for structural glazing
- Mowital™ PVB resin
- EVAL™ EVOH resin
- ~~PLANTIC™ biomass derived gas barrier material~~

Isoprene

- SEPTON™ / HYBRAR™ thermoplastic elastomer
- Isoprene chemicals
- KURARAY LIQUID RUBBER
- GENESTAR™ heat-resistant polyamide resin

Functional Materials

- Methacrylic resin
- Activated carbon
- Dental materials
- High-performance hollow-fiber membrane module

Fibers and Textiles

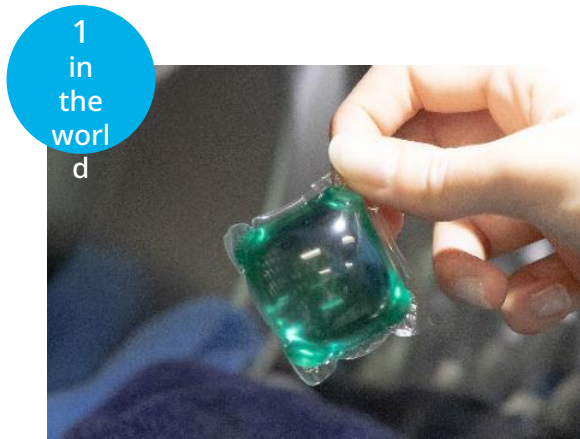
- KURALON™ / KURALON K-II™ PVA fiber
- VECTRAN™ liquid crystal polymer fiber
- CLARINO™ man-made leather
- MAGIC TAPE™ hook-and-loop fastener
- Polyester

New Businesses

- Semiconductor polishing pad (CMP pad)
- SCAPOVA™ PVA microcarriers

Kuraray's solution for packaging

Kuraray are contributing to sustainable packaging globally, especially with various kinds of film technology.



1
in
the
world

KURARAY POVAL™

Polyvinyl alcohol (PVOH) resin

- Water soluble, oil resistance
- BPI-certified compostable



1
in
the
world

EVAL™

Ethylene vinyl alcohol copolymer (EVOH) resin

- Gas barrier
- Designing recyclable packaging, will not disrupt polyolefin recycling streams



PLANTIC™

Biomass-derived gas barrier material

- Biobased and TUV-certified Home & Industrial compostable

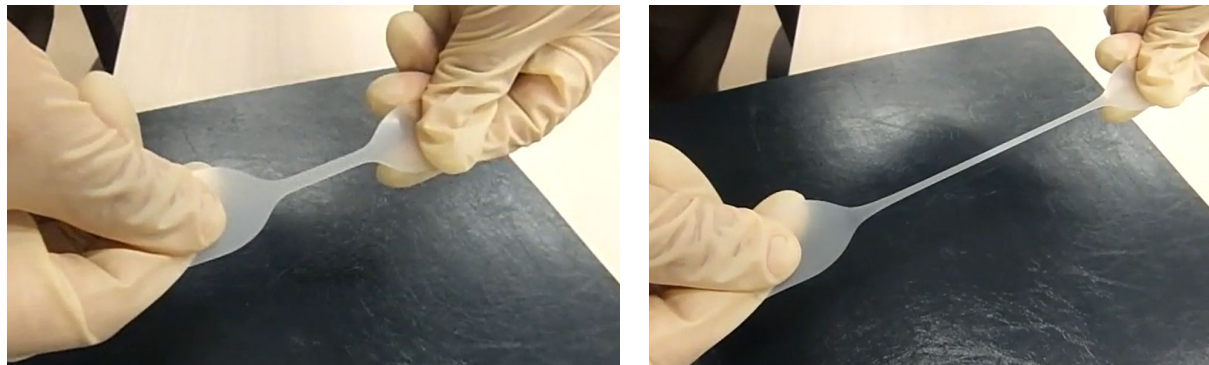
Today's subject - Compostable Polymer (Under Development)

What's compostable Polymer?

In current market, there are few elastic options in compostable materials.

Kuraray's compostable polymer will enable you to design various uncharted compostable packaging. Because:

- Industrial compost-ready
- Elastic properties similar to conventional TPEs (Thermoplastic Elastomer)
- 30-50% bio-based



How composting contributes to realizing a sustainable society

The U.S. Environmental Protection Agency (EPA) suggests that composting will contribute to

- reduction of CH₄ gas through anaerobic decomposition in landfill
- reduction of waste



Compostable materials play a crucial role in diverting organic waste from landfills and achieving zero waste, particularly in the following applications where recycling is difficult:

- dirty packaging with food residues
- functional packaging made up of multiple kinds of materials

Compostable Packaging Proposals

Application Proposals

- 1) PLA's impact modifier which can maintain compostability, transparency and stiffness
- 2) Compostable Sealant & Adhesive
- 3) Compostable soft rubber goods



Compostable Packaging Proposals – PLA Modifier

Polylactic acid (PLA) is one of the most popular compostable resin derived from corn starch or sugarcane.

Today it is utilized for various packaging, especially for foodservices.

Clamshell

Extruded & Vacuum formed PLA sheet



Cutlery

Injection molded PLA



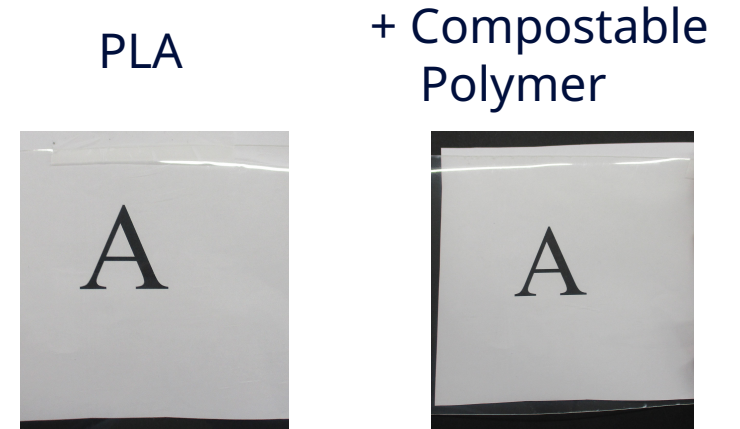
PLA has excellent transparency, smooth texture, odorless, and so on. However, sometimes PLA's brittleness limits its possibility.

Compostable Packaging Proposals – PLA Modifier

Kuraray’s Compostable Polymer can improve **impact resistance** of PLA with maintaining **transparency** and even **all-compostability**.

Evaluation of PLA Extruded Sheet (~300µm)

| PLA Additives | [phr] | Impact Resistance | Transparency |
|---|----------|-------------------|--------------|
| (None) | - | Poor | Good |
| Compostable Polymer | 7 | Good | Good |
| PBAT | 10 | Good | Poor |
| Acrylic core-shell resin (non-compostable) | 10 | Good | Good |



Compostable Packaging Proposals – Sealant & Adhesive

Compostable Polymer also can be utilized for sealant & adhesive applications. It will contribute to design 100% compostable packaging.

Compostable Labeling Tape

Hot melt PSA (Pressure Sensitive Adhesive)



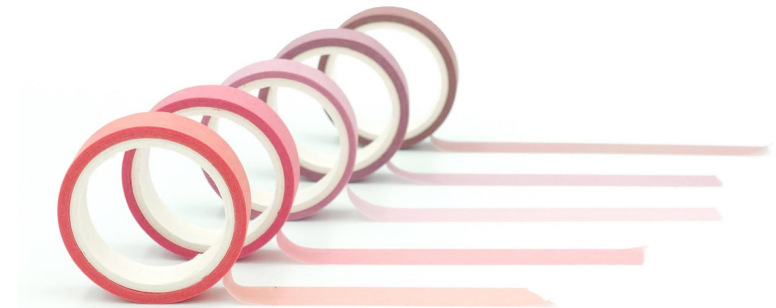
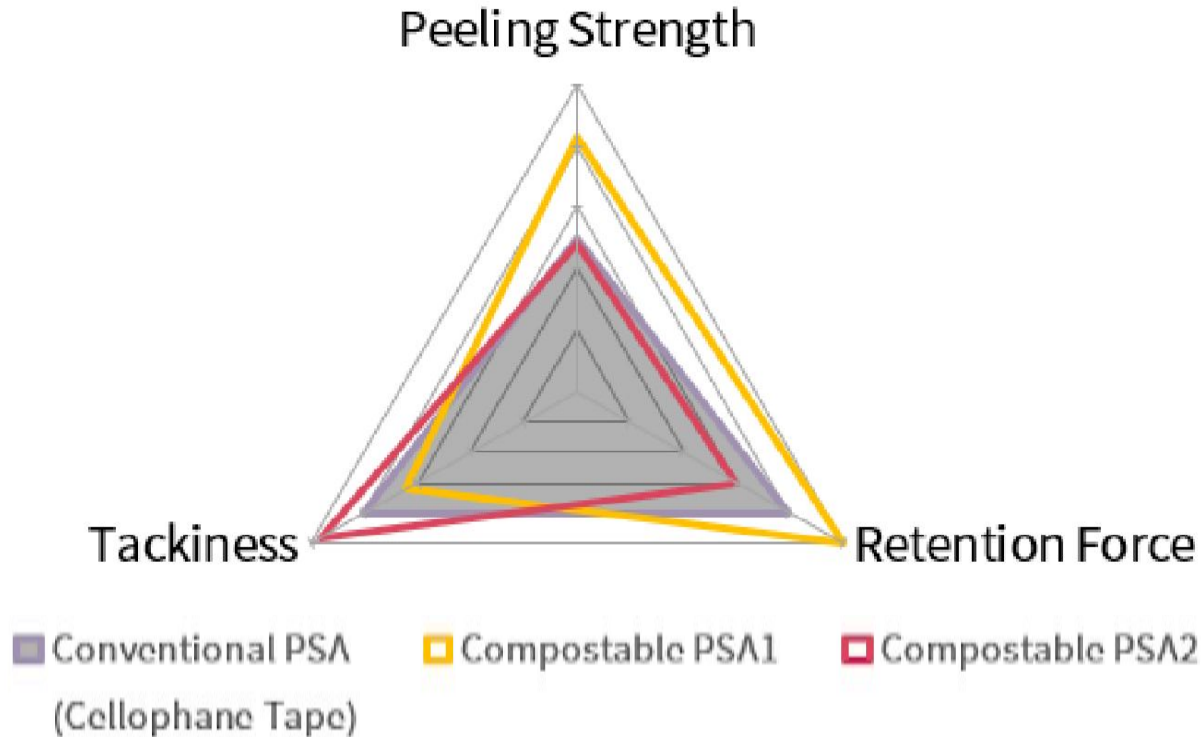
Heat-Sealant

Sealant layer of packaging



Application Proposals - compostable hotmelt PSA (Pressure Sensitive Adhesive)

- Utilizing Compostable Polymer, you could apply a compostable hotmelt PSA with
- Receiving excellent balance of adhesive strength, tackiness and retention force
 - Around 50% biomass contents



Application Proposals - compostable heat-sealant



Compostable Polymer emulsion will enable you to design 100% compostable package with:

- water-based coating process without VOC
- reducing sealant-layer thickness with fine sealability

Comparison of Various Heat Sealants

| | PE Film | PBS Film | PE Emulsion | <i>Compostable Polymer Emulsion</i> |
|------------------------------|-----------|----------|-------------|-------------------------------------|
| Heat Sealability at 120deg.C | OK | OK | OK | OK |
| Hydrolysis Resistance | Excellent | Poor | Excellent | Good |
| Industrial Compostability | No | OK | No | OK |
| Layer Thickness (μm) | 15~40 | 15~40 | 3~8 | 3~8 |

Application Proposals - Compostable soft rubber goods

Compostable Polymer enable you to design various compostable rubber parts. It will broaden the possibilities of compostable packaging.

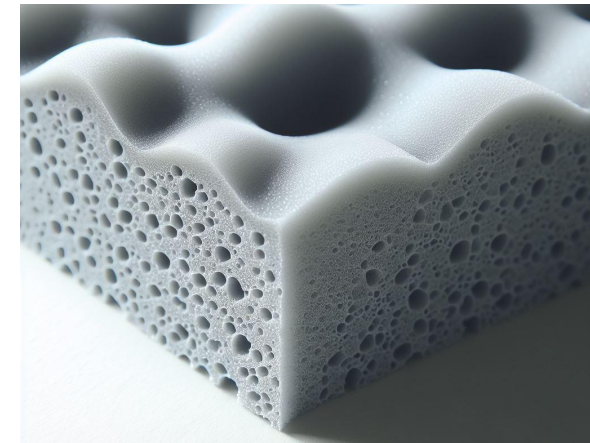
Gasket, O-ring

Capliner of beverage bottles



Foamed Rubber

Cushion parts in containers



Summary



Kuraray's Compostable Polymer gives industry the freedom to creatively design sustainable packaging!

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