

End-of-Life Options for NatureFlex™

At Futamura, we are committed to pioneering renewable packaging solutions that align with the global drive towards a fully circular economy.

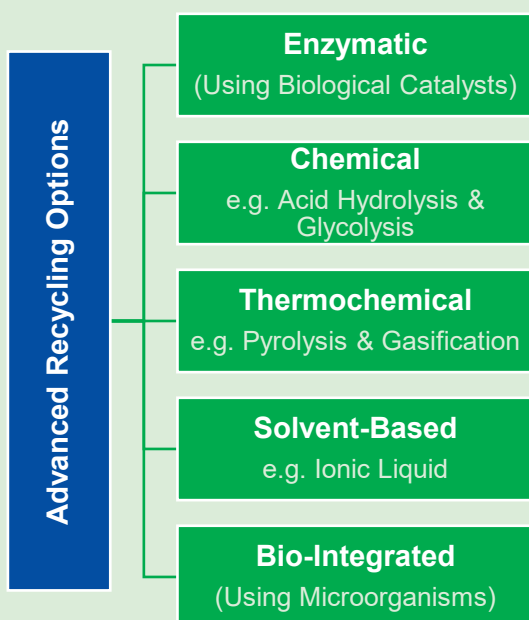
While our NatureFlex™ films were intentionally designed with an end-of-life (EOL) focus on composting and anaerobic digestion, we recognise that a multi-pathway approach to sustainable waste management is essential. As such, we are actively pursuing emerging recycling technologies to expand the EOL possibilities for our products.

Recycling Options for NatureFlex™

As a non-thermoplastic material, NatureFlex™ does not melt, meaning it is not compatible with standard mechanical recycling processes.

NatureFlex™ is not recommended for incorporation into paper recycling on its own, but it can be used in combination with paper as a window patch, liner or similar, to increase the cellulosic renewable content without significantly impacting the paper recycling process.

A range of advanced recycling technologies are emerging to react to the plethora of materials that require recycling. We expect NatureFlex™ to be compatible with several of these solutions.



Guidance documentation is expected to be published by the European Commission in 2028 surrounding the most appropriate recycling technologies for each packaging material category.

At Futamura internally, we have already begun exploring advanced recycling techniques. Examples include enzymatic and chemical recycling techniques, to convert our films into high-value products or green chemicals.

Our internal research efforts have yielded promising results, demonstrating the potential for NatureFlex™ to be recycled into valuable outputs.

We do appreciate that scalability is key to enable effective waste management.

To this end, we are collaborating with external companies that specialise in advanced recycling technologies. By pooling resources and expertise, we aim to be compatible with scalable solutions that can integrate seamlessly with recycling infrastructures.

Additionally, we aspire to collate a range of case studies to demonstrate the recyclability of NatureFlex™.

Current NatureFlex™ Certifications

Sourcing and Renewability

NatureFlex™ films are derived from renewable sources and have been tested according to **ASTM D6866** for biobased content (measured by ¹⁴C analysis), confirming that standard NatureFlex™ grades contain at least 90% biobased content.

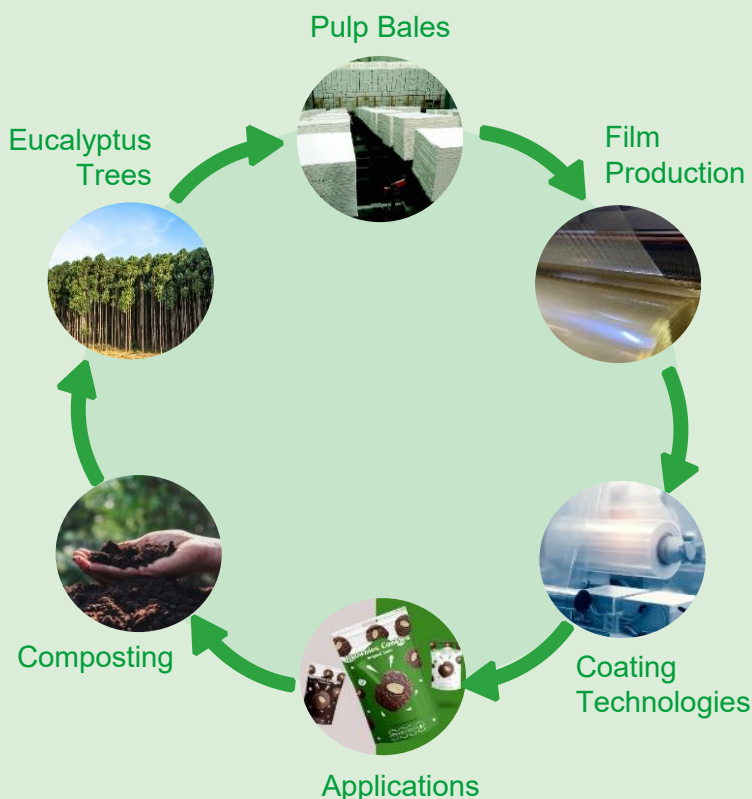
Futamura supports responsible forestry practices, and our pulp is sourced from FSC™ or PEFC certified plantations. Certification is referenced per product. For FSC™ certified film, the film is made of FSC™ certified and other controlled material.



Compostability

NatureFlex™ films were intentionally designed with an end-of-life focus on composting and anaerobic digestion.

They are certified to meet the stringent requirements of both European (**EN 13432**) and American (**ASTM D6400**) standards for industrial composting, and **OK Compost Home** or Din Geprüft (**NF T51-800**) for home composting.



Incineration with Energy Recovery

NatureFlex™ can also be safely incinerated in modern energy recovery plants, where it has a calorific value comparable to wood. When disposed of via incineration in accordance with **the EU Waste Incineration Directive (2000/76/EC)**, NatureFlex generates no harmful emissions, offering another disposal route where other infrastructure may be limited.

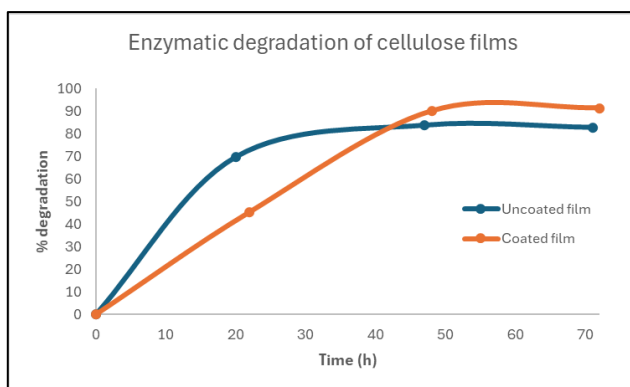
Unlike the incineration of fossil-based plastics, which releases carbon that has been locked away for millions of years, NatureFlex™ is derived from **renewable plant-based sources**. As a result, the carbon released during the incineration of NatureFlex was recently absorbed from the atmosphere by plants, meaning it **does not contribute to a net increase in long-term atmospheric CO₂**.

Advanced Recycling NatureFlex™ - Results To Date March 2026

Enzymatic & Microbial Recycling

Futamura participated in the EU-funded ReBioCycle programme. As part of this work, NatureFlex™ coated and uncoated films were successfully tested in an enzymatic recycling process. Enzymes act as biological catalysts, accelerating specific chemical reactions, including the breakdown of polymer structures. Trials showed:

- **Uncoated NatureFlex™ film degraded within 1 day.**
- **Coated NatureFlex™ film degraded within 2 days.**
- The coating residue can be separated with the potential to be further treated to achieve complete breakdown.



These results demonstrate that both coated and uncoated NatureFlex™ films are compatible with enzymatic recycling pathways. New chemicals and materials can be produced from the resulting sugars.

NatureFlex™ has also demonstrated **successful biodegradation by microbes**, further supporting its compatibility with emerging bio-based recycling systems.

3

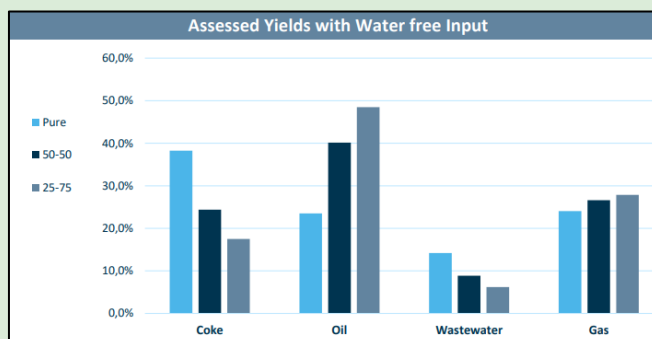
Chemical Recycling - Pyrolysis

Pyrolysis is currently the most widely used advanced recycling technology in Europe. It is a thermochemical process that heats materials in the absence of oxygen, producing four main outputs: PyCoke, PyOil, gases, and a small amount of wastewater. The gases generated are typically combusted to fuel the process itself, while PyOil is the primary product of interest because it can be refined into chemicals and materials similar to those derived from crude oil.

Futamura recently evaluated how NatureFlex performs in a pyrolysis system using three different input blends:

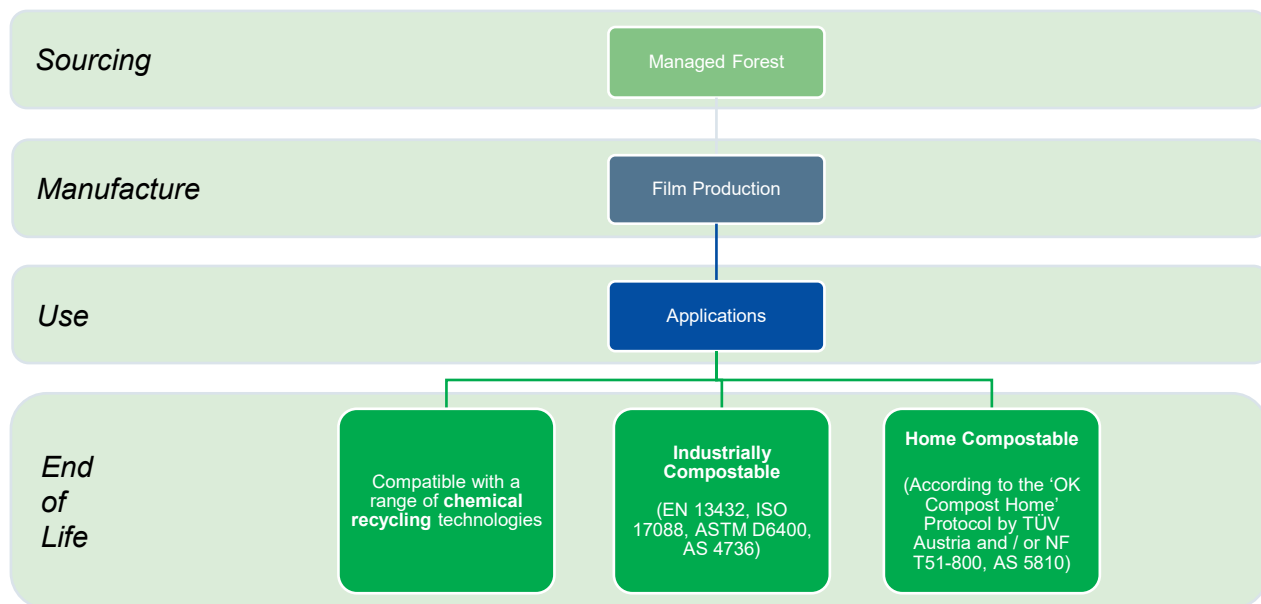
- 100% NatureFlex™
- 50:50 NatureFlex™ : mixed polyolefins
- 25:75 NatureFlex™ : mixed polyolefins

Results showed that **all carbon from NatureFlex™ was successfully retained in the pyrolysis oil**. In the 25:75 blend, the oil yield approaches 50%, a level generally considered economically viable.



Bioplastics represent less than 1% of flexible packaging, with NatureFlex only a fraction of that, and so, their presence poses a negligible impact on pyrolysis operations. The study demonstrates **NatureFlex™ can be included in feedstocks at levels up to 50% without negatively affecting the process**. We are currently also exploring NatureFlex in **gasification**.

Summary – End-of-Life Options for NatureFlex™



is a registered trademark of European Bioplastics e.V. in the EU



is a registered trademark of the Australasian Bioplastics Association



Through continued innovation and collaboration, we aspire to make NatureFlex™ a leading example of renewable packaging that supports both composting and recycling infrastructures

Disclaimer: Futamura Chemical Company, or any of its affiliated companies (hereinafter 'Futamura') declines any liability with respect to the use made by any third party of the information considered herein. The information contained herein represents Futamura's best knowledge thereon without constituting any express or implied guarantee or warranty of any kind (including, but not limited to, the accuracy, the completeness or relevance of the data set out herein). Futamura is the sole owner or authorised user of the intellectual property rights relating to the information communicated.

The information relating to the use of the products is given for information purposes only. No guarantee or warranty is provided that the product is adapted to the client's specific use. The client should perform his own tests to determine the suitability for a particular purpose. The final choice of use of a product remains the sole responsibility of the client.

Sales Offices

Europe (UK) T: +44 (0)16973 41212
Americas (USA) T: +1 770 818 3102
Asia-Pacific (Japan) T: +81 52 562 1841

W: www.futamuragroup.com

E: info@futamuragroup.com

