How can chemical recycling be applied to the adhesive tapes industry: Limitations and opportunities

Author: Sreeparna Das, Sustainability Communications Consultant, Afera

Adhesive tapes play an essential role in a more sustainable world. They enable lightweighting in transport, support durable bonding in construction, reduce material use in packaging, and extend product lifetimes across electronics and mobility. As industries redesign systems for circularity, tapes often act as enablers of **efficiency, safety, and performance**. To fully realise this value, end-of-life solutions must evolve alongside product innovation.

The tape industry has made meaningful progress in managing its own waste streams. Advances in mechanical recycling are emerging for specific, well-defined fractions such as PET release liners and paper-based tapes, supported by cleaner mono-material constructions and improved sorting technologies. Afera's release liner recycling FAQ outlines the practical pathways available today for these cleaner, more homogeneous waste streams.

Further, debonding-on-demand chemistries, reduced adhesive coat weights, and water-based solutions are helping manufacturers improve **compatibility with existing recycling infrastructure**. These developments demonstrate that mechanical recycling can play a role when material purity and design-for-recycling principles are applied.

Managing mixed tape waste within a regulatory landscape in transition

Yet these advances highlight the contrast with the broader challenge of mixed tape waste. Most adhesive tapes remain **multi-layer, multi-material constructions**, combining paper, PET, or PE backings with sophisticated adhesive formulations and release liners. This intimate bonding makes separation extremely difficult, and traditional mechanical recycling still offers limited solutions for mixed waste streams. For these fractions, chemical recycling technologies such as pyrolysis are increasingly viewed as necessary to unlock circularity at scale.

The regulatory landscape, however, adds a layer of complexity. Chemical recycling remains under active debate in Europe, with questions around accounting rules, environmental performance, and cross-polymer applicability. However, momentum is shifting. Recently, the European Commission confirmed **acceptance of the fuel-use-excluded mass balance approach** for recycled PET under the Single-Use Plastics Directive, a decision widely interpreted as a foundational step toward broader acceptance across polymers. Afera anticipated this direction in its 2024 mass balance position paper, calling for a **harmonised, polymer-agnostic framework** that would allow adhesive tapes and release liners to participate meaningfully in future circular feedstock systems. For a sector built on multi-material performance, this regulatory clarity is essential.

It was against this evolving backdrop that **Marco Karber** presented pyrolysis insights at the **Afera Annual Conference in September 2025**. His contribution drew on work previously carried out at **AES Autonome Energiesysteme GmbH** in Merzenich, Germany, which has since closed its operations. Even so, the technical findings shared remain relevant to ongoing industry discussions about the feasibility of chemical recycling for tape waste.

Pyrolysis for tape materials: Marco Karber presents test results at Afera Annual Conference 2025

Pyrolysis of tape waste: Technical realities, challenges and opportunities

The scale of the challenge is substantial. The tape industry is estimated to generate at least **300 kilotons of waste annually**, and the true figure is likely higher when the full value chain is considered. Testing of representative tape waste streams shows that pyrolysis typically yields:

- 50 to 75 percent pyrolysis oil
- around 5 percent gas
- up to 25 percent ash

The **high ash fraction**, driven by paper and PET content, presents a significant barrier compared to conventional plastic pyrolysis. This creates a downstream challenge. In countries with strict environmental regulations, such as Germany, disposal options for pyrolysis ash are limited. If the ash is non-hazardous, it is currently landfilled, which undermines circularity goals. However, if quality thresholds can be met, the ash could **potentially be upcycled as a carbon black**. Developing valorisation pathways for this ash will be critical for long-term viability.

PVC and other halogenated polymers cannot enter pyrolysis systems due to the formation of corrosive acids. Contaminants such as oxygen, nitrogen, halogens, water, silicon, and unexpected sulphur traces further complicate upgrading of the resulting oil. These findings underscore the need for **pre-sorting, feedstock preparation, and tailored process controls**.

Despite these hurdles, the opportunities are significant. When compared to incineration, pyrolysis offers key benefits. It **keeps carbon in circulation** rather than releasing it immediately through combustion. Modular plant designs reduce the need to transport bulky, low-density waste over long distances.

Converting tape waste into oil via pyrolysis (Courtesy Lohmann GmbH & Co. KG)

Within the tapes industry, companies such as **Lohmann GmbH** and **Coroplast Tape** have conducted and completed **pyrolysis testing** on their own tape production waste, demonstrating that mixed adhesive tape waste can be successfully converted into pyrolysis oil under controlled conditions. These proofs of concept establish a valuable benchmark for the sector.

However, scaling up such recycling initiatives will require **coordinated collaboration**. The primary challenge lies in the **mismatch of waste volumes** when partnering with external recyclers. To achieve economically viable and sustainable collection and processing, multiple manufacturers must align efforts to aggregate sufficient volumes of tape waste.

These discussions are actively progressing within the Waste Management Workstream of Afera's Flagship Sustainability Project (AFSP). Members are encouraged to join upcoming meetings and contribute to shaping the industry's roadmap for sustainable waste management and recycling.

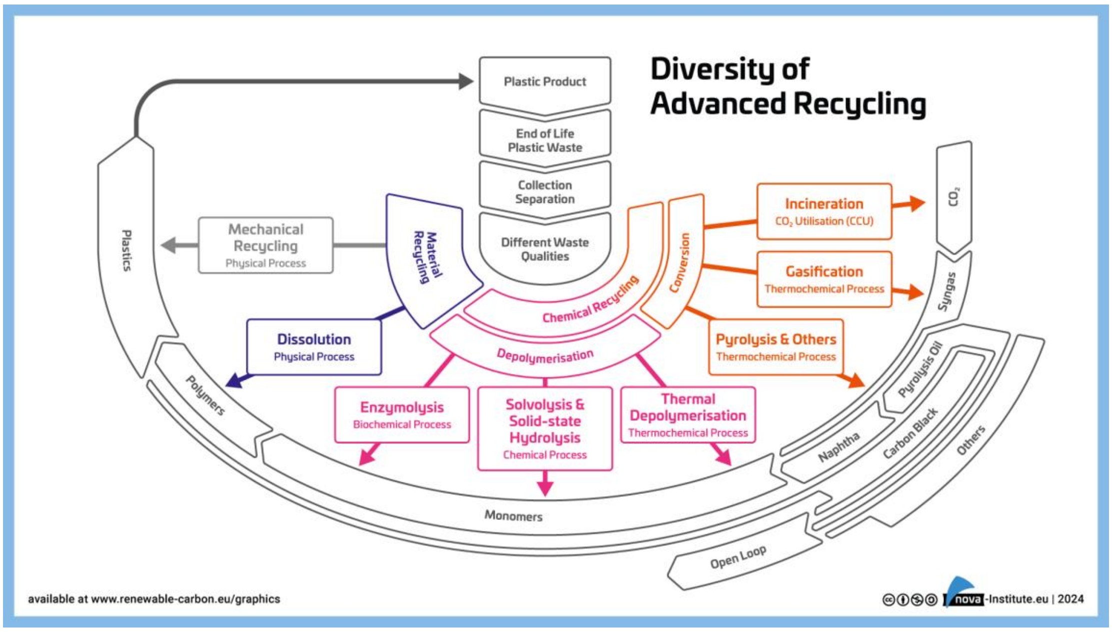
Beyond pyrolysis: Other pathways within chemical recycling

While pyrolysis has attracted the most attention in tape industry discussions, it represents only one branch of the advanced recycling spectrum. The framework developed by nova-Institut GmbH illustrates a wider set of pathways, each with distinct opportunities and constraints for multi-material waste streams such as adhesive tapes.

- **Solvolysis and depolymerisation**: These processes target condensation polymers like PET, breaking them down into monomers or oligomers that can be re-polymerised into virgin-quality materials.

- **Thermochemical technologies**: These processes transform complex or heterogeneous waste into simpler chemical intermediates. These approaches are particularly relevant for multi-material constructions, offering flexibility in feedstock acceptance and the potential to generate versatile outputs that can be reintegrated into chemical value chains.

- **Enzymatic recycling**: Still at an early stage, enzymatic depolymerisation of PET and other polyesters could eventually offer a low-temperature, selective route to recover monomers.



Diversity of chemical recycling pathways (Courtesy nova-Institut GmbH)

Taken together, these pathways underscore that chemical recycling is not a single technology but a portfolio of approaches. For the adhesive tapes industry, the challenge lies in mapping specific waste fractions to the most suitable process, while ensuring regulatory acceptance and economic viability.

The path forward

Looking ahead, the combination of **technological progress, regulatory clarity, and industry advocacy** is gradually shaping a more coherent pathway for chemical recycling in the tape value chain. Mechanical recycling will continue to expand where material purity allows, while chemical recycling offers a route for the complex, multi-material fractions that cannot be mechanically processed. As mass balance frameworks mature and more manufacturers validate chemical recycling routes, the industry is moving closer to a future in which the **sustainability value tapes deliver during use is matched by credible circularity at end of life**. Achieving this future will require coordinated action across manufacturers, recyclers, policymakers, and end-users, but the direction of travel is clear.