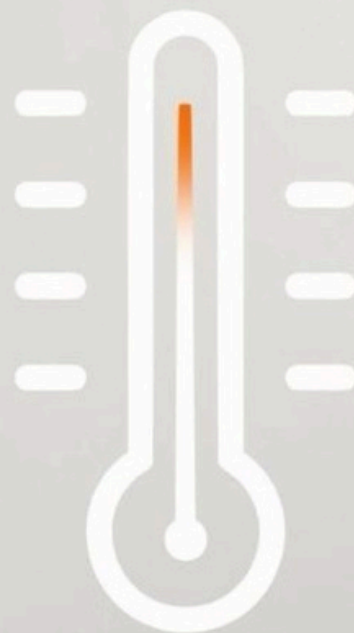


PAA Risks

in Recyclable Multi-layer Mono-material Packaging

A concise, science-based guide for decision makers
in the packaging industry



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Why this topic matters now

From 2030 onwards, packaging placed on the EU market must be demonstrably **recyclable under real processing conditions** according to the EU's Packaging and Packaging Waste Regulation (PPWR). This marks a shift from design intent towards actual behavior in mechanical recycling. As a result, substances that may impair **recyclate quality** or **chemical safety** are gaining regulatory and public attention.^[1] Primary Aromatic Amines (PAAs) belong to the group of substances of concern.

PAAs: origin and risk profile

PAAs can form when certain conventional adhesive chemistries or azo pigments degrade under elevated temperatures. In the mechanical recycling of flexible multi-layer packaging, embedded adhesives are exposed to **extrusion heat** and cannot be removed prior to reprocessing.

Scientific investigations show that aromatic polyurethane (PU) adhesive systems may degrade under these conditions and form PAAs,^[2] whereas acrylic adhesives do not show this degradation behavior.



Figure 1: Aromatic PU adhesives versus water-based acrylic adhesives

[1] Monclús et al. (2025). Mapping the chemical complexity of plastics. Nature. <https://doi.org/10.1038/s41586-025-09184-8>

[2] Prielinger, Lukas & Matausch, Natascha & Juric, Mladen & Ortner, Eva & Markart, Lea & Rainer, Bernhard & Pinter, Elisabeth & Kirchnawy, Christian & Welle, Frank. (2025). SafeCycle - Guidance Document; CORNET Project: Analysis of recycling processes and recyclates and their applicability for various packaging scenarios. <https://doi.org/10.34895/fhcw.0026>

Why PAAs are becoming relevant in packaging discussions

Regulatory frameworks such as the EU Packaging and Packaging Waste Regulation (PPWR) increasingly **link recyclability with chemical safety**. A recent scientific study^[3] has identified aromatic amines as a major group of chemicals of concern in plastics.

In parallel, the European Chemicals Agency (ECHA) is assessing substances present in packaging materials and their impact on recycling processes.^[4] A report is expected by the end of 2026. These developments indicate that **toxic degradation products** such as PAAs may face increasing scrutiny in future regulatory assessments, well before any formal restrictions are introduced.

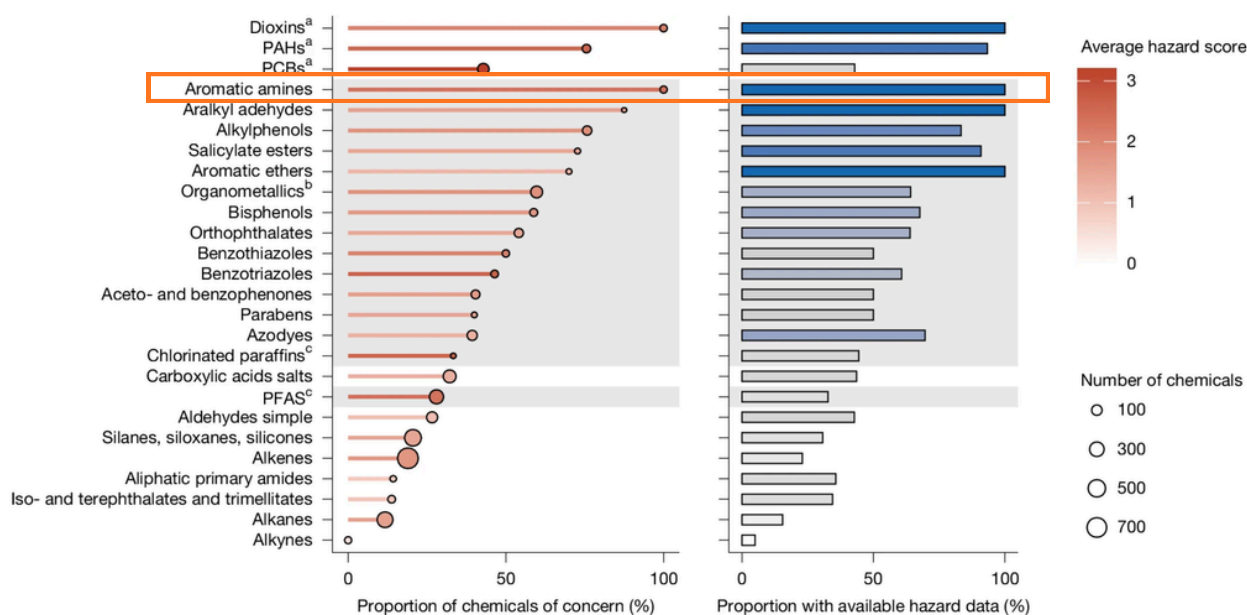


Figure 2: Proportion of chemicals of concern across major groups of plastic chemicals. Source: Monclús et al. (2025), Figure 4^[3]

[3] Monclús et al. (2025). Mapping the chemical complexity of plastics. Nature. <https://doi.org/10.1038/s41586-025-09184-8>

[4] European Chemicals Agency (ECHA). (n.d.). Activities under the Packaging and Packaging Waste Regulation (PPWR). <https://echa.europa.eu/echas-activities-under-ppwr>

»» Relevance for key roles involved in future packaging designs

Companies and packaging professionals along the whole value chain will need to rethink how to approach future designs. **Packaging development** teams have to consider how material choices perform not only in use, but also during recycling. **Sustainability managers** depend on credible recyclability claims that withstand future scrutiny. **Product stewards** as well as regulatory and advocacy roles require robust, defensible material strategies to manage emerging substance-related discussions. Across all functions, early understanding reduces later redesign and cost. In addition, it can be assumed that public pressure on brand owners will increase if the public begins to discuss the presence of **highly toxic substances in recycled plastic**, even if it is used for less sensitive applications. Contact to consumers of packaged products can never be excluded and reputational risks are quite high.



Common adhesives can form PAA as toxic degradation product under heat stress in recycling.

»» Adhesive selection as a strategic lever

In **multi-layer mono-material packaging** structures, adhesives pass completely through the recycling process and are exposed to high temperatures. **Aromatic PU systems** may form PAAs under these conditions, potentially affecting recycle safety and acceptance. **Water-based acrylic dispersion adhesives** offer an alternative approach, showing thermal stability under recycling conditions and avoiding the formation of toxic degradation products. Adhesive selection therefore directly influences recyclability, regulatory robustness and long-term portfolio resilience.



From compliance today to resilience tomorrow

The central question for the industry is no longer limited to current compliance. It is whether today's packaging decisions remain defensible as recycling requirements, chemical assessments and public expectations evolve. A structured, science-based review of adhesive technologies can help strengthen regulatory confidence, protect sustainability credibility, and avoid late-stage redesign or disruption.



Contact us for a personal consultation

Use a direct exchange with our experts to identify hidden risks in your packaging portfolio.



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Sources and further reading

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