

# Deinking

Are Design for Recycling Guidelines keeping up with technological advances?



# Introduction

Recent years have seen a surge in demand for transparent and white recyclates, largely fueled by Brand Owner commitments, as outlined in the Ellen MacArthur Foundation report [1] and anticipated European Union regulations mandating recycled content in all plastic packaging, as per the Packaging and Packaging Waste Regulation.[2] This trend has intensified discussions on how to ensure a steady supply of uncoloured recyclates. In response, some Design for Recycling Guidelines have recently updated their recommendations for white polyolefin (PO) and polystyrene (PS) packaging, advocating against non-physically separable decorations, like direct-print or in-mould labels on rigid containers.[3]

In light of these developments, Siegwerk and Greiner Packaging have initiated a project to thoroughly investigate the recycling potential of such materials. Central to this project was the examination of hot caustic washing processes, traditionally employed in PET bottle recycling and increasingly adopted by PO and PS recyclers. These more intensive washing processes, are not only integral to achieving higher quality recyclates via more effective label removal and cleaning of the flakes to reduce odour of the product, but are also showing promise for ink removal, as summarized in the EuPIA position paper on deinking of plastic packaging waste.[4]



Printed cups in blue, black and red utilized in the study

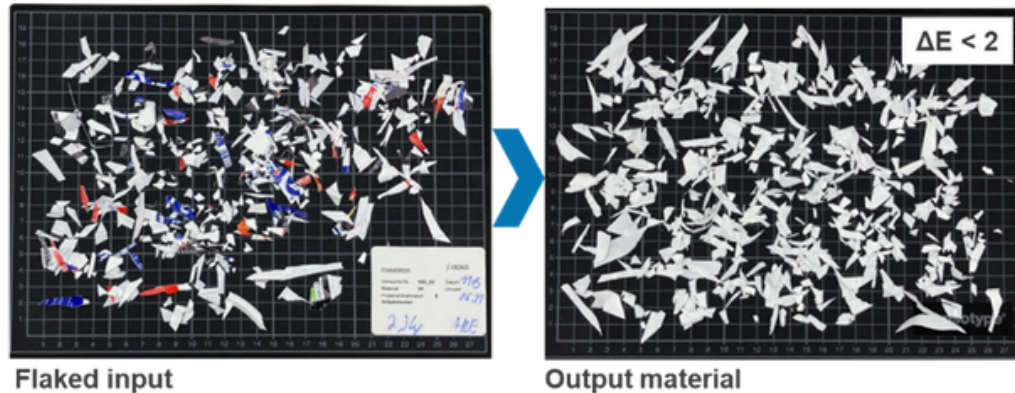
# The Project

The collaboration began with laboratory tests on both PP and PS cups, at Siegwerk's facilities, adhering to DIN SPEC 91496.[5] The tests resulted in complete ink removal, with  $\Delta E$  values ranging from 0.5-1.5, well below the acceptable limit of 3. These encouraging results led to the next phase of validating these findings under industrial conditions. For this, Krones, recognized as one of the market leaders in globally supplying hot washing equipment to PO recycling companies, provided their pilot plant, a representative version of the set-ups used in the industry, for conducting large-scale washing tests.



Krones intensive washing pilot plant in Flensburg

In this stage, 500 kg of mixed-colour PP cups were processed. To the delight of the consortium, the continuous hot washing process was highly effective in removing inks without any deviation from standard washing conditions, while using standard offset printing inks.



Mixed-colour printed PP cup flakes as input and the resulting clean, deinked flakes

Additionally, water treatment tests, also following DIN SPEC 91496 procedure, showed that inks could be readily flocculated out of the lye, enabling the washing solution to be used in a closed cycle.

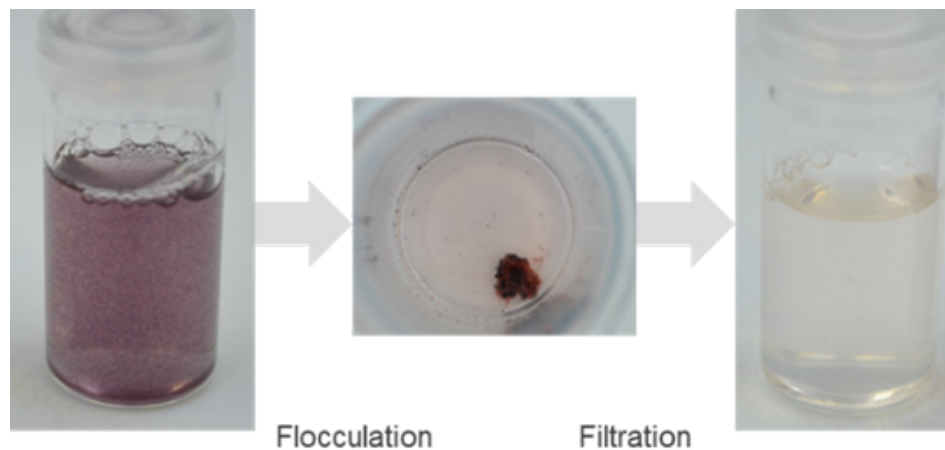


Illustration of the flocculation test conducted following DIN SPEC 91496, demonstrating the efficient separation of inks from the washing solution.

“Caustic hot washing is becoming essential in plastic recycling. Efficient removal of filling good residues, adhesives and inks requires more intense washing systems, particularly when targeting consumer packaging,” explained Michael Auburger, product specialist recycling solutions at Kronos.

“Design for Recycling Guidelines are important tools to enable a Circular Economy. However, it is even more important to continuously review them and develop them further if necessary”, continued Anita Gruber, Greiner’s global project manager circular economy. “As converters, we aim to design our packaging in the best possible way. We also believe that the entire value chain must work together to drive positive developments.”

“Indeed, achieving packaging circularity in Europe isn’t just about changing upstream design,” added Andrey Charkovskiy, senior business partner recycling and polymers at Siegwerk. “The whole value chain has to work together and Design for Recycling Guidelines must be continually reassessed to recognize the latest in recycling technology. Cross-value chain industry initiatives like creation of the standardized deinking test protocol DIN SPEC 91496, are essential and need to be acknowledged on the European level,” he concluded.

# Conclusion

By confirming the effective deinking of PP and PS direct-printed cups under hot caustic washing conditions – a method increasingly adopted in the recycling industry for producing consumer packaging recyclates – this project highlights the necessity for Design for Recycling Guidelines to adapt to newly established and effective industrial practices.

This case study represents a broader need for similar initiatives, also in the area of flexible packaging where the prevalence of non-deinkable systems remains a significant challenge. Aligning recycling policies with the latest industrial capabilities and expanding deinkability assessments according to DIN SPEC 91496 to all forms of packaging is essential. Such alignment ensures that advancements in recycling technologies are utilized best, thereby driving the entire industry towards a sustainable circular economy.

## REFERENCES

[1] "The Global Commitment 2022" from the Ellen MacArthur Foundation: <https://www.ellenmacarthurfoundation.org/global-commitment-2022/overview>

[2] Proposal for a revision of EU legislation on Packaging and Packaging Waste: [https://environment.ec.europa.eu/publications/proposal-packaging-and-packaging-waste\\_en](https://environment.ec.europa.eu/publications/proposal-packaging-and-packaging-waste_en)

[3] D4R Guidelines of RecyClass: <https://recyclass.eu/recyclability/design-for-recycling-guidelines/>

[4] EuPIA position paper on deinking: <https://www.eupia.org/key-topics/circular-economy/>

[5] DIN SPEC 91496, Recycling of printed polymer packaging – Evaluation of deinking using a test procedure: <https://www.beuth.de/en/technical-rule/din-spec-91496/375461367>

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