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Glass packaging - Opportunities for an even better Recycling

Recommendations for the design of glass packaging to increase recyclability –
Developed by working group 2 "Evaluation of recycling technology" of the
Forum Rezyklat

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Table of contents

1	Introduction	3
2	Recommendations for packaging design	4
3	Recycling glass from residual waste	5

1 Introduction

Glass packaging is considered one of the most sustainable packaging solutions on the market. They not only impress with their stability and versatility, but also with their excellent recyclability: glass can be melted down and reused almost an infinite number of times without the material losing any of its quality. In addition, every collected and recycled piece of glass actively contributes to saving energy, as recycling used glass requires significantly fewer resources than producing new glass. In Germany, a large proportion of packaging glass is currently recycled – around 85 % of collected glass packaging finds its way back into the material cycle. Despite this high recycling rate, there are still considerable losses in glass recycling. According to the Umweltbundesamt (Federal Environment Agency), an average of 5.7 % of the glass placed on the market ends up in residual waste, which means that it is permanently removed from the recycling process. Losses also occur in the sorting process: very small fragments of less than 10 mm cannot be collected by the sorting plants, or not sufficiently. In addition, there are quantities of glass in the sorting residue that could not be correctly sorted out due to coatings, adhering labels or other impurities, for example. The optimization potential has therefore not yet been exhausted.

Work package 2 "*Evaluation of recycling technology*" of the Forum Rezyklat dealt intensively with the challenges and opportunities in glass recycling. The aim was to analyse existing technologies, identify weak points and draw conclusions in the form of recommendations for action for recycling-friendly packaging design. To this end, a glass recycling plant (Reiling, Marienfeld) was visited, the glass recycling process was analysed and design-for-recycling criteria were discussed.

It should be particularly emphasized that the technologies used in glass processing already at a very high level and at a similar stage in all plants. From the point of view of the Forum Rezyklat, therefore, there is currently no immediate need for technological optimization. **Rather, it is clear that the focus of future improvements should be on design for recycling in order to further increase the recyclability of glass packaging and minimize material losses in the process.** The criteria developed are presented below.

2 Recommendations for packaging design

The following recommendations are in line with the criteria of the minimum standard of the Zentrale Stelle Verpackungsregister (Central Agency Packaging Register):

- **Avoiding lead glass:** Lead glass contains heavy metals and therefore a significant challenge in the recycling process. The melting temperature differs from conventional packaging glass, which impairs the quality of the recycled glass and leads to undesirable colour changes and inclusions.
- **Reduction of opaque and very dark glass:** The optical sorting devices recognize glass based on the light transmission of the cullet. Opaque glass packaging and very dark glass hardly lets any light through (transmission below 10 %), which means that they are not identified as such by the sensors of the sorting systems, but are recognized as contaminants. In these cases, they are incorrectly sorted out as CSP (ceramic, stone, porcelain). The approach of introducing a higher light intensity in the sorting system was investigated and rejected again, as more opaque/dark glass is recognized as good material, but more thin porcelain is also incorrectly classified as glass. This in turn leads to undesirable material inclusions and jeopardizes the recycling quality enormously. Opaque coatings/imprints and very dark colours should therefore be avoided.
- **Optimization of labels and adhesives:** Labels play an important role in the recycling of glass, as they have to be removed during processing. Paper labels are usually unproblematic, as the adhesive and therefore the label can be easily removed by moisture during storage. Plastic adhesive labels, on the other hand, can present challenges as moisture cannot penetrate through the label, but only through the side edges to the adhesive. This can lead to labels sticking to broken glass and both being sorted out as contaminants. It is therefore recommended that labels – regardless of the material – can be easily removed from the glass in combination with a suitable adhesive in order to avoid glass losses and increase the recyclable content.

In addition to the points mentioned, further findings were identified that exceed the current requirements of the minimum standard (version 2024):

- **Optimization of labels and adhesives:** As an alternative to the moisture-removable labels mentioned above, "abrasive" removable labels can be used. These can be "scraped" off the glass mechanical action (rubbing the cullet together) during the shredding process. In this way, the pure glass fragments also end up in the recycling process. A suitable test method for this is the Cetie test ([DT41.00 Simulation test of label separation in the glass recycling process](#)).

- **No bottom-covering sleeves:** Sleeves that completely encase glass packaging (including bottom containment) pose a fundamental challenge in the recycling process. It is important that the fragments can fall out of the sleeve during the shredding process – this is hardly possible with sleeves with a base enclosure. For this reason, sleeves that cover the base should be avoided. Furthermore, a continuous perforation on the side of the sleeve is to make it easier for the glass fragments to fall out. This tears open when the packaging is shredded, the fragments accumulate separately and are then recycled.
- **Standardization of glass colour to white, green and brown:** Restricting glass to the basic colours white, green and brown makes sorting and recycling much easier. These colours can be reliably separated in the recycling plants and recycled without any loss of quality. Glass of other colours, which is usually disposed of in green glass, can disrupt the recycling process as it impairs the colour quality. Standardizing on these three colours therefore ensures an efficient cycle and a higher recycling rate. It also makes it easier for consumers to identify the container in which the packaging should be disposed of.
- **Prefer metal closures:** For glass recycling to work, it is crucial that closures and their threads are designed in such a way that the glass can fall out easily during crushing. Plastic closures do not pose a challenge here, as they can be easily sorted out – but they are not recycled. Metal closures made of tinplate or aluminum, on the other hand, are particularly advantageous as they can not only be sorted into a separate fraction, but are also recycled afterwards.

3 Recycling glass from residual waste

In addition to improved design for recycling, technologies for recovering glass from residual waste also show great potential for further increasing the recycling rate of glass. The expansion of such pre-sorting technologies could make an important contribution to increasing the glass recycling rate. One obstacle to the implementation of these approaches currently the lack of recognition of recycled packaging materials from residual waste for the recycling quota of the dual systems in accordance with the VerpackG (Packaging Act).