Breaking the Bottlenecks

From Household Waste to High-Quality Industrial Goods

The consumer wants it and the EU demands it: in the coming years, the amount of recycled material in almost all plastic products is to increase significantly. This is easier said than done; especially considering the sought-after materials are often in short supply. Among other things, Tomra believes that residual waste sorting is a solution for increasing recycling rates in a timely manner.

A sought-after industrial commodity: light-colored flakes are in particularly high demand among plastics processors and brand owners. © Tomra

Plastic recycling has certainly had its share of bad publicity, not least due to downcycling – after all, there is a limited demand for items such as park benches, flowerpots and speed bumps. But The recycling industry, working in collaboration with members of plastic value chains, has now made it possible to create virgin-like recycled content with advanced mechanical recycling. Not only does this prove to be an economically feasible and practical alternative to primary materials, it also gives recyclers and material sorting facilities (MRFs) the opportunity to create new revenue streams. Even in the case of highly contaminated plastic waste streams, like municipal solid waste (MSW), it is now possible to source quality feedstock that can be used to create new products.

To date, only a tiny portion of recyclates has found their way into the production of new materials. Most of the recyclates are used for lower-grade applications. So, how can industries such as automotive, food and beverage, and

cosmetics ensure a reliable supply of high-quality recycled feedstock?

Deposit Systems Are Not an All-Purpose Solution

Bridging the gap of material shortages starts with effective collection of recyclables. Deposit Return Systems (DRS), for instance, are a global best practice for the recycling of beverage containers in a closed-loop system. There is not a one-size-fits-all solution: to achieve circularity, complementary solutions are needed to capture other products made of plastic, like post-consumer film packaging. Mitigating contamination and increasing the quantities of recovered recyclates across all waste streams is crucial to the future of plastics.

A harmonized approach is required to enable greater plastics circularity and provide a long-term supply of recycled content for the market to reduce dependency on primary materials. For instance, many countries consider or already introduced Extended Producer Responsibility Schemes (EPR), which give producers significant responsibility for the product's lifecycle – from design to the post-consumer stage of its lifecycle. These policies incentivize producers to consider environmental factors when manufacturing packaging and to contribute to a reduction of the products' environmental impact.

The Role of the Legislation

The Legislation also plays a fundamental role in supporting infrastructure investment, including effective collection, sorting, and recycling of plastic waste. Plastic directives and mandatory recycled content targets can establish the proper framework for prioritizing circularity and breaking the bottleneck of feedstock recovery. The Plastic Packaging and Packaging Waste Directive, introduced by the EU in 1994, is among the legislation that defines recycled content targets, creating end markets for secondary raw materials. The directive makes it mandatory for packaging producers to use at least 50 % recycled content in the production of new plastic packaging by 2025 and more than 55 % by 2030.

In 2021, the European Union also introduced a Single-Use Plastics Directive requiring a minimum of 25 % of recycled content in PET bottles by 2025 and a separate collection target of 77 %. Countries with DRSs are a best practice: Germany achieves a 98 % collection rate for PET and the Netherlands follows closely with 95 %.

Many paths lead to the recyclate: some waste management companies in Europe have already converted. This means they sort and reprocess mixed waste. © Tomra

As much as it seems that we are headed towards a circular economy, we have a long way to go. According to Zero Waste Europe, new bottles only contain 17 % of recycled PET (rPET), on average. Meanwhile, 69 % of other PET products are made with rPET from beverage bottles – diverting materials from the intended closed-loop process. Ideally, plastic materials should be recycled multiple times in the same application to ensure adequate supply for production for as long as economically feasible.

Use of PCR Materials

Directives are a decisive step forward, but there is still a room for improvement. For instance, there is little legislation specifying the use of post-consumer recycled content (PCR) that could fill the gap between demand and supply. In the USA, California leads the most ambitious targets for PCR in beverage bottles. The recently established California Recycled Content Laws set PCR targets at 15 % by 2022, 25 % by 2025, and 50 % by 2030.

Increasing the use of recycled content requires the entire industry to take action, design recyclable packaging, and improve the supply of quality recyclates with both new and existing instruments. A Holistic Resource Systems approach to waste management combines deposit return systems (DRS), separate collections for selected material streams, and mixed waste sorting to recover plastics for advanced mechanical recycling.

Potential of Residual Waste Sorting

Beyond dedicated collection streams, the addition of mixed waste sorting is also proving to deliver high-quality plastic for recycling. A case study with AVR, a residual waste sorting plant in the Netherlands, demonstrated that mixed waste sorting with high-performing technologies can capture 12 times »

Info

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more plastics for recycling, cutting down on CO_2 emissions. Other sorting facilities, such as the Norwegian companies Ivar IKS or Roaf, also demonstrate the enormous potential that mixed waste sorting offers if municipalities and businesses invest in advanced technologies and new processes.

Today, recyclers and sorting plant operators are faced with the task of cleaning contaminated waste to a level suitable for further processing or local trading. At the same time, brand owners and converters that buy PCR are demanding high-purity mono fractions, sorted by polymer type and colors. By adopting new sensor-based sorting technology, plant operators can effectively sort and purify high-value plastics from waste streams to supply single-grade fractions to the market.

To create more valuable products, a combination of pre-sorting and flake sorting solutions is needed. First, near-infrared sorters separate targeted plastics from contaminants such as unwanted polymers and foreign materials. The purified plastics are then shredded, washed, and dried. The resulting plastic flakes are then processed in a secondary step with a high-precision flake sorting system that can sort flakes as small as 2 mm. These ultra-flexible systems enable operators to define whether they'd like to sort materials by polymer type and/or color, creating products specifically tailored to even the most demanding requirements. The outstanding technology featured in these systems can sort a vast range of colors, including the highly demanded natural, clear, and light blue flakes, as well as all bright colors, while ensuring maximum polymer purity. In this way, operators are given the means to minimize contamination levels and supply the industry with very high-quality materials they can process into virgin-like recyclates.

View into the IVAR plant: since 2019, 22 autosort machines are sorting plastics and paper here.

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Conclusion and Outlook

While most recyclers prefer plastics coming from single material streams with lower contamination levels, operators can source more materials to meet demand by 'cleaning' plastics of impurities. Post-consumer packaging waste, for instance, can be an excellent source of recyclable polymers and is available in large quantities. Although more contaminated compared to post-industrial plastic waste, sophisticated sorting systems can automatically recover and purify the materials by utilizing advanced mechanical recycling processes. This too would increase the availability of PCR material on the market.

Collaboration is key in plastic recycling. Improving recyclability and increasing the quantity of recycled content demands that industry go upstream because high-quality recycling begins in the design phase. Brand owners are incentivized to implement design-for-recycling to help facilitate the sorting process. The more complex and colorful the design of a product is, the more difficult it is to sort and recycle. Thus, to maximize resource recovery, product design, sorting technology, and the overall process must complement each other. With all methods, from the product's design to its end-of-life-management going hand in hand, it is evident that change does not come from a single actor in the value chain – to innovate and transform the industry, everyone must play their part. ■

Residual Waste Sorting: Norway as a Role Model

Tomra and a Norwegian waste sorting plant have demonstrated that mixed waste sorting prior to disposal is a superior solution to separate collection. Since it stopped the separate collection for plastics in its region and unleashed the power of mixed waste sorting, the facility increased recovery rates from 28 % to 82 % and achieved recycling rates of 56.4 %, thus meeting the EU's 2025 recycling targets ahead of time.
From an environmental perspective, sorting, recovering, and recycling plastics from mixed waste streams – instead of relying solely on material-dedicated collection systems – leads to a two-fold reduction in CO_2 emissions. First, less plastics, that comes with a high caloric value but based on fossil carbon, are incinerated. Second, the provision of high-quality recycled plastics reduces the need for primary production. Thus, IVAR contributes to delivering environment-friendly feed and works in line with the principles of a circular economy, resulting in a decrease of 33,000 t of CO_2 emissions a year, which is equivalent to taking 20,000 fossil fuel cars off the road.