

Defining the technical process for your plastic revaluation

The technical process for plastic revaluation can vary depending on the type of plastic being revalued, as well as the specific methods used for revaluation.

Let's find out how!

Plastic revaluation refers to the process of recovering value from plastic waste by recycling or repurposing it into new products or materials. The technical process for plastic revaluation can vary depending on the type of plastic being revalued, as well as the specific methods used for revaluation.

Here is the list of the basic steps, more elaborated in the description section below [\[1\]](#):

- **Recycling** (collection and sorting of plastic waste, mechanical or chemical decomposition);
- **Processing** (washing, shredding, pelletizing);
- **Manufacturing of the new products** (melting, injecting ...).

Description

Now, let's look closer at each part of the technical process and what are the nuances of revaluing the most common types of plastic used in the industrial praxis.

1. Recycling

Recycling means creating closed loops of raw materials, aiming to transform plastic scraps into recycled raw materials for the production of final products without any loss of quality [\[2\]](#).

Mechanical Recycling Mechanical Recycling is the process of treating plastic scraps without undergoing significant changes in their chemical structure. This involves sorting, grinding, purification, and revaluation to produce a sustainable raw material, giving rise to a new life cycle and purpose for the plastic [\[2\]](#).

This recycling method is particularly well-suited for plastic monostreams, which typically consist of a single type of polymer that is often collected separately. However, when a product or packaging contains multiple types of polymers, mechanical techniques are essential to ensure effective separation [\[2\]](#). More information about the mechanical recycling process can be found in knowledge unit [3](#) *How to Transform Plastic Waste into Products*.

Chemical Recycling

Certain plastic scraps, such as those found in multiple layer packaging and other complex plastics, cannot be effectively separated using mechanical techniques. In such cases, chemical recycling comes into play to recover the raw materials [\[2\]](#).

In recent times, chemical recycling has experienced significant advancements. This method involves utilizing chemical processes to break down the plastic, purify it, and generate new polymers [\[2\]](#). More information about the chemical recycling process can be found in knowledge unit [3](#) *How to Transform Plastic Waste into Products*.

Different types of plastics manufacturing technologies and processes:

- **Plastic extrusion**

The process of extrusion is required to produce continuous linear, two-dimensional shapes. In the plastic extrusion process, the material is heated and pushed through a shaped cut in a metal plate, forming a continuous shape that is then stretched and cooled to solidify. These linear products can be cut into plastic parts after cooling. Examples of such products include industrial piping, medical device tubing, synthetic filaments, plastic rails, plastic sheeting, and plastic drinking straws ([coextrusion](#)) [5], [6].



Fig. 1 Plastic extrusion machine [5]

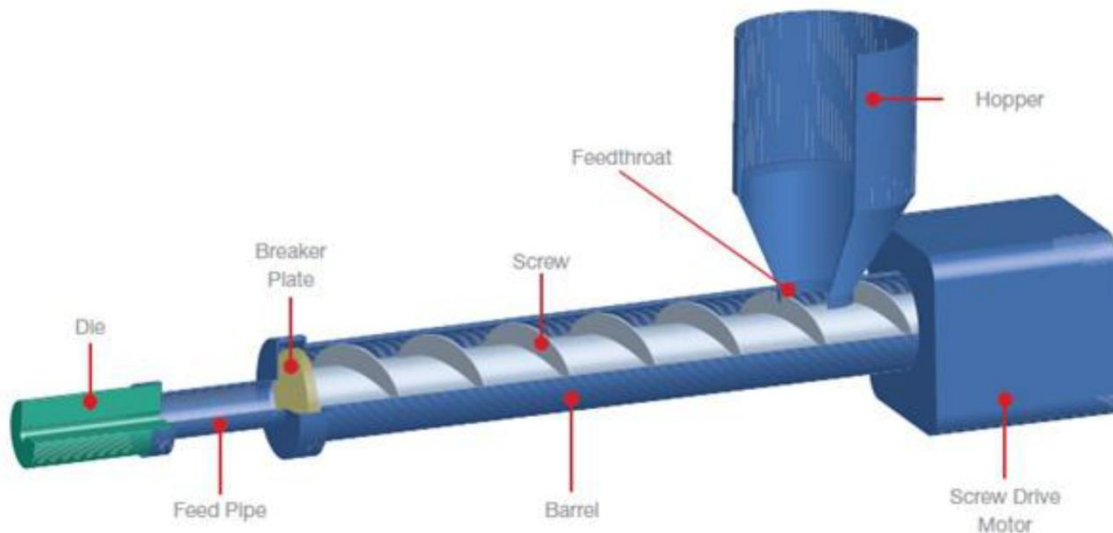


Fig. 2 Plastic extrusion technology [5]

- **Injection molding**

Injection molding results in three-dimensional shapes that do not maintain a consistent parallel line. This manufacturing technique is primarily based on the molten die-casting method. It involves filling a mold with heated liquid, which then cools down to form a solid piece that is ejected from the mold. Injection molding has a higher design cost because of the complex mold. But it results in finished pieces without additional assembly or processing.

This process can produce complex cross-sections like multi-lumen tubing for medical devices or food processing. Extruded materials have smooth surfaces, eliminating the need for post-production cleaning. It's beneficial when various lengths of the same profile shape are needed. By creating a stock product through continuous production and cutting to length as needed, setup and design costs are reduced for similar items.

Examples of products made using this method include chess pieces, plastic combs, plastic plates or cups, and three-dimensional shapes with openings like plastic baskets or crates [4].



Fig. 3 Injection Moulding technology and plastic waste by Umelohmotne [15]

- **Blow molding**

Blow molding is a technique utilized to produce hollow plastic components like bottles and containers. This process entails melting the plastic material and inflating it into a mold, where it adopts the mold's shape. After cooling, the plastic part is taken out from the mold. Blow molding is a cost-effective method, especially suitable for manufacturing large quantities of hollow plastic parts [8].

- **Rotational Molding:**

Rotational molding is a technique applied to produce large, hollow plastic parts like tanks and playground equipment. The process includes heating a mold and rotating it around two perpendicular axes. Afterward, the plastic material is introduced into the mold, where it melts and adheres to the mold's surface. Once the mold cools down, the plastic part is taken out from the mold [8].

- **Thermoforming:**

Thermoforming is a method used for manufacturing thin, shallow plastic parts like packaging trays and lids. The process involves heating a sheet of plastic until it becomes pliable, and then shaping it over a mold using vacuum pressure or mechanical force. The plastic part is then cooled and removed from the mold [8].

- **3D printing**

3D printing, also called additive manufacturing, involves constructing a three-dimensional object layer by layer using a computer-designed model.

Unlike subtractive manufacturing processes, where the final design is carved out of a larger material block, 3D printing adds material to build up the 3D part, reducing material wastage. It is well-suited for producing intricate and customized items, making it ideal for rapid prototyping purposes [9].



Fig. 4 3D printer [17]

See concrete examples of technical processing of five the most common type of plastics, also visualized in Figure 5.

Technical process for revaluing HDPE (High-Density Polyethylene) [10]:

- Collection and sorting: HDPE waste is collected and sorted by type and color.
- Washing and shredding: The HDPE waste is washed to remove any contaminants and then shredded into small pieces.
- Pelletizing: The shredded HDPE is melted and extruded into small pellets.
- Manufacturing: The HDPE pellets are used as raw material to produce new HDPE products such as plastic bags, plastic lumber, plastic furniture.

Technical process for revaluing LDPE (Low-Density Polyethylene) [11]:

- Collection and sorting: LDPE waste is collected and sorted by type and color.
- Washing and shredding: The LDPE waste is washed to remove any contaminants and then shredded into small pieces.
- Pelletizing: The shredded LDPE is melted and extruded into small pellets.
- Manufacturing: The LDPE pellets are used as raw material to produce new LDPE products such as plastic bags, plastic films, composite lumber, garbage bags and liners, trash and compost bins, paneling, shipping envelopes and furniture.

Technical process for revaluing PET (Polyethylene Terephthalate) [12]:

- Collection and sorting: PET waste is collected and sorted by type and color.
- Washing and shredding: The PET waste is washed to remove any contaminants and then shredded into small flakes.
- Recycling: The PET flakes are melted and extruded into fibers or new bottles.
- Manufacturing: The PET fibers can be used to produce new products such as clothing and carpets, while the new bottles can be used to package liquids again.

Technical process for revaluing PP (Polypropylene) [13]:

- Collection and sorting: PP waste is collected and sorted by type and color.

- Washing and shredding: The PP waste is washed to remove any contaminants and then shredded into small pieces.
- Pelletizing: The shredded PP is melted and extruded into small pellets.
- Manufacturing: The PP pellets are used as raw material to produce new PP products such as automotive parts, industrial fibers, and packaging materials.

Technical process for revaluing Polystyrene (PS):

- Collection and sorting: PS waste is collected and sorted by type and color.
- Washing and shredding: The PS waste is washed to remove any contaminants and then shredded into small pieces.
- Pelletizing: The shredded PS is melted and extruded into small pellets.
- Manufacturing: The PS pellets are used as raw material to produce new PS products such as disposable cups, packaging materials, or insulation materials.
- General Purpose Polystyrene (GPPS) and High Impact Polystyrene (HIPS) are probably the most commonly used PS resins for injection molding [14].

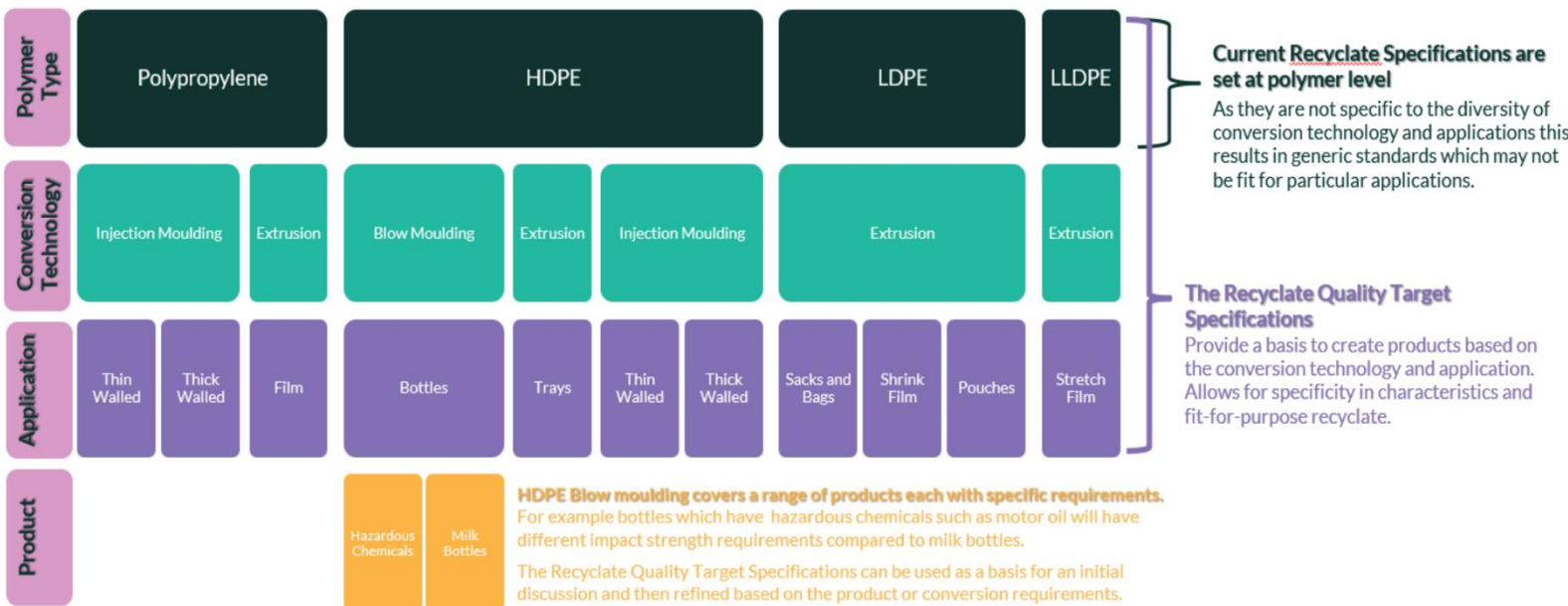


Fig. 5 Building on Existing Specifications by Creating Recyclate Quality Target Specifications at an Application and Conversion Technology level [20]

In any case, we recommend consulting your needs and procedures with experts and experienced companies in the field of plastic revaluation.

Case studies & Examples

The goal of the Umelohmotne project is to popularise recycling. Owners can make designer pieces themselves, such as soap dishes, phone cases, brush cups, clocks, bow ties for men, but also medals for runners or stylish glasses made of recycled plastic.

The company targets the general public, corporations and enterprises with a strong accent on sustainability and CSR activities. Their products are made from PP and HDPE, previously also PET but not anymore.

Product design is created internally by the founders. Technology has been proprietary and developed by the local technology company. Combined plastic shredder and Injection mold press helps Umelohmotne to process and transform plastic waste into usable design products. The first was a very unfortunate experiment with ground PET material, which you can find in PET bottles of the same name. There was a lot of smoke and as a result a nice but perfectly cracked plastic pancake.

Today they make more complex things: iPhone cases, sunglasses, wall clocks, bowls, soap dishes and more. They are mainly inspired by the Precious Plastic community, but also by friends who sometimes advise them on what they would like to see from them.

The production process begins with the cleaning and sorting of plastic waste. They have to get rid of paper labels, glue and possibly leftover yogurt or clay. They sort plastics by type and color. In this way, they can already scrap them into useless pieces and put them aside for later. They made the plastic shredder in the garage from an old engine from a mixer.

If they want to make, say, a phone case, they heat their injection molding machine to 200°C and pour ground plastic into it. After 15 minutes, they place the mold under this giant syringe and inject the molten plastic into it. The mold can be opened immediately, because the contents solidify in an instant. They will process the phone case made in this way by hand and add it to the others. If by chance they don't succeed, they can grind it again and turn it into a dish.

They owe the color patterns to the matter of coincidence, the sorting of plastics and the ratio of one or another color combination. Most often, they mix some color shade into the most abundant white. Potted, brown-black pieces that can create a quail egg effect are popular. On the other hand, vain pieces of gold color from Nescafé and Woolite lids look luxurious.

They offer their products on a B2C model and through direct sales, online sales (e-shop), Exhibitions and local markets, and their social media channels [15], [16].



Resources

Links:

- [1] https://www.bpf.co.uk/sustainability/plastics_recycling.aspx#s2
- [2] <https://morssinkhofplastics.nl/en/recycling/>
- [3] <https://www.bpf.co.uk/plastipedia/sustainability/how-is-plastic-recycled-a-step-by-step-guide-to-recycling.aspx>
- [4] <https://www.pbsplastics.com/what-is-the-difference-between-plastics-extrusion-and-injection-molding>
- [5] <https://www.pbsplastics.com/about/what-is-extrusion/>
- [6] <https://www.pbsplastics.com/extrusion-styles/coextrusion/>
- [7] <https://www.twi-global.com/technical-knowledge/faqs/3d-printing-vs-injection-moulding>
- [8] <https://www.deskera.com/blog/plastics-manufacturing/#plastic-manufacturing-process>
- [9] <https://www.twi-global.com/technical-knowledge/faqs/what-is-3d-printing>
- [10] <https://www.businesswaste.co.uk/your-waste/plastic-recycling/hdpe-recycling/>
- [11] <https://www.edlpackaging.com/blog/how-is-ldpe-film-recycled-after-its-used-for-secondary-packaging/>
- [12] <https://www.recycletheone.com/recycle-now/how-does-pet-plastic-recycling-work/>
- [13] <https://www.cadybag.com/polypropylene-recycling-process-introduction/>
- [14] <https://www.creativemechanisms.com/blog/polystyrene-ps-plastic>

[15]

<https://www.instagram.com/umelohmotne/?fbclid=IwAR3IJYU1NoP4ncXQOuN1yZ2i4cg8sGGpc26C7woP1ZMaR8sUzPWZH4X3H-M>

[16] https://www.facebook.com/umelohmotne/about?locale=sk_SK

[17] <https://learn3dfashion.com/2023/01/19/3d-printing-the-dawn-of-a-new-tech-age/>

Papers (press articles, guides, reports):

[18] <https://www.wamag.cz/file/858/magnetic-separators-for-recycling.pdf>

[19] https://www.retec-recycling.de/app/webroot/uploads/retec-loesninger/flyde-saenke-system/flyer_retec-float-sink-separator.pdf

[20] <https://endplasticwaste.org/en/our-stories/improve-plastic-packaging-circularity>