RECYCLING TECHNOLOGY

Starlinger

RECYCLING TECHNOLOGY FOR WOVEN BAGS

for PP, PE and PET production and post-consumer waste, fast amortisation when replacing virgin material, closing the loop for woven bags

Regranulate from woven bags: *A valuable secondary resource*

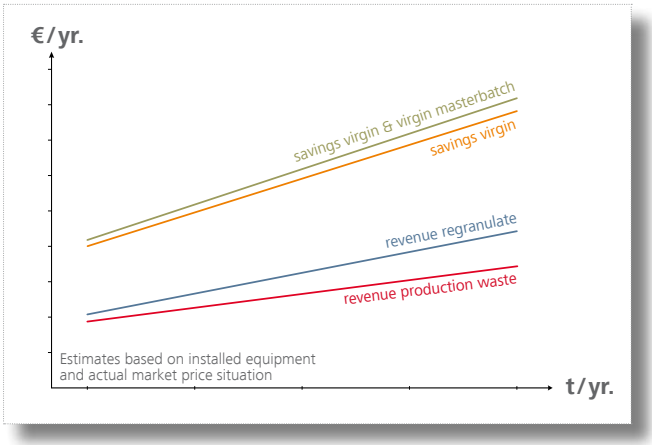
Turning waste into a valuable secondary resource: Recycling and internal re-use contribute to cost savings on raw material as well as to resource conservation.

Financial savings and resource conservation

The input materials for woven bag production – PP, PE, and lately also PET resin – are too valuable to be wasted. This applies both to production waste as well as to woven bags that have already been used. As this waste comes in different shapes, it cannot be reused directly, but has to be recycled into pellets first. Through recycling into regranulate, the value of the material increases, and it can be sold on the market at a much higher price.

With unrivalled experience in the bag production process, Starlinger provides valuable know-how in optimising materials management and, equally important, recycling solutions designed for high production efficiency, energy savings and flexbility.

Recycling offers economic and ecological advantages for bag production companies. A high refeeding rate of regranulate into the tape line offers financial savings in tape production and fast amortisation of the recycling equipment. By adding calcium carbonate to the recycling process, the production waste can be used to produce a masterbatch – the so-called recoBATCH – at a favourable cost and thus increase the bag producer's competitiveness.
Finally, a careful use of raw materials contributes to environmental protection, reduction of the carbon footprint, and resource conservation.



Fluctuating resin prices make the bag producing industry more vulnerable. Whilst selling production waste seems an obvious solution, producing your own regranulate provides – besides the cost advantage – a certain degree of independence from the market price. Bag producers benefit from a high return on investment, which can be increased even more by producing a masterbatch from production waste.

	Reuse	
Type of waste	Tape production	Other (e.g. film, sheet and injection moulding)
Endless tape	up to 100%	up to 100%
Bobbin waste	up to 100%	up to 100%
Woven fabric (raffia)	up to 100%	up to 100%
Printed fabric	not recommended	up to 100%
Laminated fabric, unprinted	for tapes with reduced tenacity, low line speed	up to 100%
Coated fabric, printed	not recommended	up to 100%
Conversion waste	not recommended	up to 100%


VPP virgin mat.
rPP regranulate
Starlinger
E-120 TD
UV stabilizer
$CaCO_3$
colour masterbatch
rPP regranulate

Recycling production scrap:
Maximising profit in-house

Production scrap is generated during various process steps: extruder start-up, winding, weaving, conversion, printing, to name just a few. It can be contaminated during the production step – e.g. printing, or during handling – e.g. by humidity or dust. Thus, material handling plays a key role because the quality of the input material for recycling is crucial for high quality regranulate.

Starlinger has put a lot of effort into increasing the efficiency of the bag production equipment to reduce production scrap. Although zero waste is the goal, it is not entirely possible. And production scrap is not only a loss of primary resin, but also a cost factor when it comes to material handling, storage, selling or disposal.
Through appropriate material handling and recycling, the minimised though unavoidable production scrap is converted into a valuable secondary resource.
The advantage of inhouse recycling compared to toll recycling is full control of materials management. This ensures the quality of the input material, which, in turn, increases the percentage of reuse without negatively influencing the tape quality.
Endless tapes, bobbins and woven fabric may be reused in the tape line up to 100% without downgrading tape quality.

Recycling samples from woven bag production

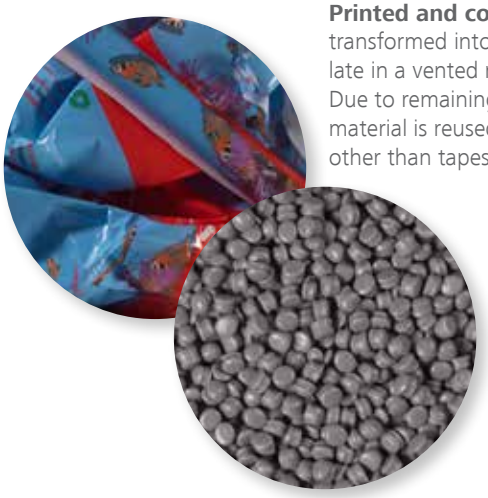
RECYCLING TECHNOLOGY

Start-up lumps are hard to grind, but can be easily processed on the recoSTAR universal line due to the sturdy ACTIVE shredder design.

Pre-portioned **endless tapes** do not require any pre-cutting. Alternatively, the compSTAR tape compactor presses them into easy-to-handle blocks prior to recycling.

Clean **bobbins** are an ideal feedstock for upcycling applications such as $CaCO_3$-filled recoBATCH.

Woven fabric: Moving fabric rolls around in the factory can contaminate the material with dirt and dust. Such solid contaminants are removed by the melt filter of the recycling line.



Printed and coated fabrics are transformed into gas-free regranulate in a vented recoSTAR extruder. Due to remaining pigments, this material is reused for products other than tapes/woven bags.

Woven bags: The bag production steps sewing, welding and gluing may pose a challenge and determine the right recycling setup.

Recycling post-consumer big bags: *challenge accepted!*

At the end of their life, there are various options for **woven plastic bags**. Clearly, they are far too valuable to end up on dumpsites; at the very least, their calorific value should be utilised in an incineration plant. Moreover, most post-consumer woven bags qualify for a more favourable option: **mechanical recycling.** The bags are processed into regranulate on a recycling machine, and the material is then turned into injection moulding products such as pots, bins, trays or boxes.

Depending on the quality of the post-consumer woven bags as well as on the recycling equipment that is used, woven bags may even enter a **fully closed loop** and become woven bags once more.
Big bags, also called FIBCs, are particularly well suited for recycling because of their large size and weight. The challenge in recycling big bags is that they come in many different forms: with or without PE liner, coated or uncoated, and with loops and seams consisting of either PP, PA or PET.

Depending on their content, application and the preferences of certain markets, various **types of big bags** are distinguished. Generally, post-consumer big bags are grouped according to their source, colour, contamination and humidity. These big bags are available in pressed bales; after cutting and washing, they are processed into pellets on an extrusion recycling line.

RECYCLING TECHNOLOGY

Grade A: These post-consumer big bags are sourced from one individual stream and are consistent in colour (mainly white) and low in contamination and humidity.

Grade B: These big bags originate from a broader range of sources. They contain higher amounts of contamination and colour.

Grade C big bags come from many different applications and are a mix of many colours. Their origin isn't always known and they are typically highly contaminated.

Reach for the stars:

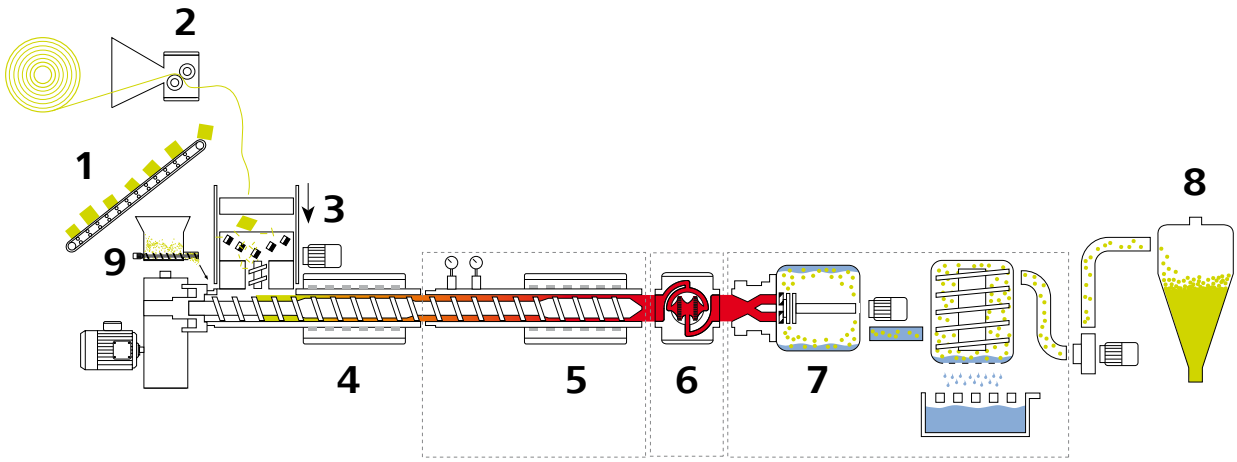
100% post-consumer big bag recycling

Production scrap as well as post-consumer waste come in different conditions. The filtration system is selected according to the level of contamination, the pelletising equipment according to the type of polymer.

recoSTAR universal

The recoSTAR universal recycling line is the most efficient solution for in-house scrap. It handles all the hard-to-grind waste streams from woven bag production in the ACTIVE shredder.

The ACTIVE shredder ensures perfect material preparation for high output through exact cutting geometry and rotor design. ACTIVE stands for **A**ccessibility & quick colour change, **C**ontrolled cutting & dosing, **T**ight knife clearance & high performance, **I**ntelligent & innovative, **V**ersatile & wide material range, **E**asy start & stop operation. The curved hydraulic pusher and the three-drive design with load-controlled dosing screw ensure consistent feeding of the ground material into the extruder. Easy access and maintenance grant high uptime. The recycling can be equipped with additive dosing units and technical features for $CaCO_3$ filled rPP masterbatch production **(recoBATCH).**



1. Conveyor belt
2. Nip roll feeder
3. ACTIVE shredder
4. Extruder
5. Degassing extruder
6. Melt filter with power backflushing
7. Water ring pelletiser
8. Filling station
9. Additive dosing unit (option)

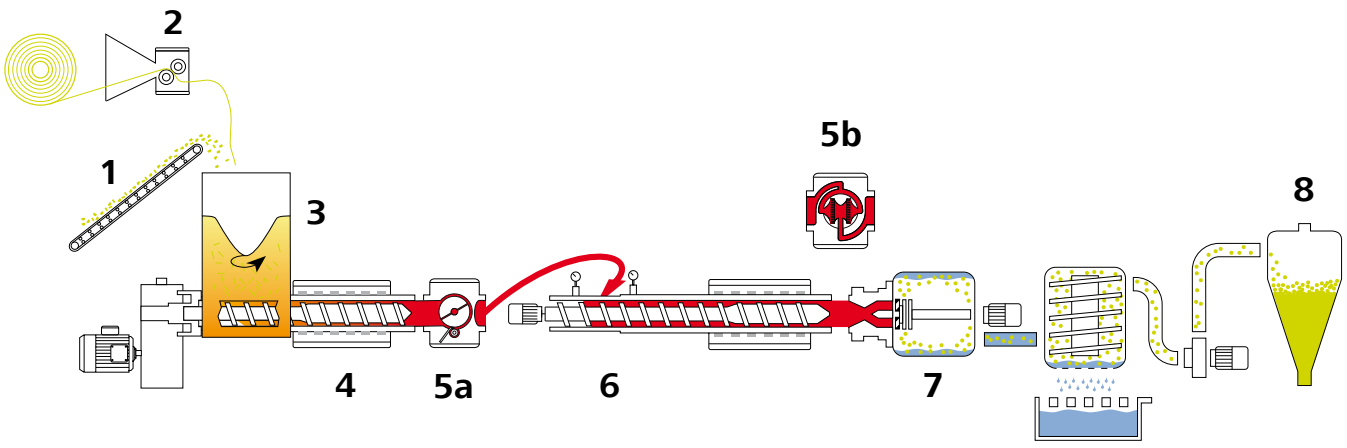
RECYCLING TECHNOLOGY

recoSTAR dynamic

The recoSTAR dynamic recycling line is the right choice for post-consumer woven bags. It handles residual moisture after the washing line in the SMART feeder.

The SMART feeder ensures ideal material preparation prior to extrusion by simultaneously performing the following functions: **S**hrink & cut, **M**ix & homogenise, **A**ctive feed & control, **R**otate & friction, **T**emperature & dry. The dynamic automation package regulates the ideal operation point. The automatic speed adjustment of the rotating disc and positioning of the load-controlled intake slider increase the output, and higher levels of humidity can be processed.

The continuous melt filter immediately removes any solid contaminants and, depending on the post-consumer FIBC grade to be processed, a second melt filter for fine filtration can be used. The C-VAC degassing unit increases the melt surface by 300% and ensures perfect pellet quality.



1. Conveyor belt
2. Nip roll feeder
3. SMART feeder
4. Extruder
5a. Continuous melt filter
5b. Melt filter with power backflushing (option)
6. C-VAC degassing extruder
7. Water ring pelletiser
8. Filling station

Easy tape handling: *compSTAR*

Inline compacting of endless tapes

Tapes from the starEX tape extrusion line are sucked continuously into the tape compactor compSTAR. It is not necessary to open it for emptying; consequently, production is not interrupted. The unit can serve up to two starEX tape extrusion lines. The tape material is compacted by a hydraulic pressing cylinder, then passes through a heating channel where the surface melts, forming a continuous strand. The strand is then cut into blocks which are easy to handle. The blocks can be recycled in-house or sold on the market where they achieve a higher price than untreated waste.

The end product of the Starlinger compSTAR are compacted blocks of endless tapes with 90 % volume reduction, minimised risk of contamination and easier handling of the otherwise loose endless tapes.

RECYCLING TECHNOLOGY

Recycling plus upcycling: *recoBATCH*

Upcycling of production scrap by adding calcium carbonate ($CaC0_3$) powder during the recycling process on the Starlinger recoSTAR universal recycling line. Various properties are improved during extrusion, while raw material costs for tape production and calcium carbonate masterbatch are reduced.

Advantages of recoBATCH production
- Inhouse production of masterbatch in "one step" during the recycling process
- No lumping of $CaCO_3$ batch as possible agglomerate formations are filtered out by the melt filter
- Better pellet quality
- Perfect dosing position and mixing properties

Advantages for the end product (film)
- Potential for material savings (down-gauging)
- Higher stiffness and puncture resistance, increased tear strength
- Improved barrier properties
- Improved printing properties → less ink required

Advantages for tape production
- Controlled quality
- Perfect physical properties of final tape
- Lower raw material costs
- Knowledge about input materials reduces wear risks

Upcycling: Produce your own masterbatch with the recoBATCH system
Calcium carbonate is increasingly used as a filler to reduce raw material costs and improve various properties during film extrusion. $CaCO_3$ powder is cheaper than $CaCO_3$ pellets, but its use is limited as it is difficult to compound in standard production extruders. By adding up to 50 % powder in the recycling extrusion process, a ready-to-use calcium carbonate masterbatch – called recoBATCH – can be produced. Test results for tapes produced with 40 % of recoBATCH added to the virgin resin showed the same tape quality as those produced with a conventional masterbatch.

Starlinger recycling technology
Furtherstrasse 47a
2564 Weissenbach, Austria
T: + 43 2674 800 3101
F: + 43 2674 86328
E: recycling@starlinger.com
recycling.starlinger.com

Starlinger Head Office
Sonnenuhrgasse 4
1060 Vienna, Austria
T: + 43 1 59955-0, F: -180

Starlinger & Co Gesellschaft m.b.H.
A member of Starlinger Group