



Notification of a novel technology in accordance with Article 32 of  
Regulation (EU) 2022/1616

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**The “ecoLoop” from Papier-Mettler KG for  
the production of post-consumer  
polyethylene granulate.**



Due to the presence of confidential information, parts  
of the dossier have been redacted

Morbach  
Juli 2024

## Table of Contents

Introduction .....	3
Abstract .....	3
Recycling scheme .....	6
Description of the recycling process .....	7
Labelling and transport of the granules .....	12
Suitability of the granules for the blow film extrusion of service packaging .....	13
A historical review and risk assessment of the PCR carrier bag .....	14
Test plan for external analyses .....	15
Determination of specific migration for the identification of amines and alkanolamines	16
Determination of heavy metals .....	16
Determination the number of colonies .....	16
Determination fluorine content.....	16
Examples of carrier bags .....	17
Internal routine analyses .....	19
Example: Headspace GC/MS analyses.....	19
EDX analyses .....	20
DSC analyses .....	20
ANNEX I: Example of a sample test of the granules (Nov. 2023).....	21
ANNEX II: Example of a sample test on 100% PCR film (Nov. 2023) .....	27
ANNEX III: External comments (2024).....	37
ANNEX IV: Declaration of safety in accordance with Regulation (EC) No 1935/2004 (Nov. 2020) .....	39
ANNEX V: Declaration of safety in accordance with Regulation (EC) No 1935/2004 (March 2009).....	42
ANNEX VI: Letter of No Objection #216 - FDA report.....	47
ANNEX VII: Cleaning efficiency of thermal post-treatment.....	50
ANNEX VIII: EuCertPlast Certificate .....	55
ANNEX IX: DIN EN ISO 9001 Certificate .....	57
ANNEX X: Blue Angel Certificate (“Blauer Engel”) .....	59

List of abbreviations:

a	year
DSC	dynamic differential calorimetry
EDX	energy-dispersive X-ray analysis
EU	European Union
FDA	Food and Drug Administration
HDPE	high density polypropylene
HS	headspace
IR	infrared
IVV	Institut für Verfahrenstechnik und Verpackung
LDPE	low density polyethylene
LLDPE	linear low density polyethylene
LNO	Letter of No Objection
MFI	melt flow index
PA	polyamide
PAK	polycyclic aromatic hydrocarbons
PE	polyethylene
PET	polyethylene terephthalate
PM	Papier-Mettler
PP	polypropylene
R <sub>t</sub>	retention time
SC	sieve change
t	tons
TIC	total ion chromatogram
Reg.	regulation

## Introduction

In 1992, Papier-Mettler opened its first recycling plant at its headquarters in Morbach and has since been using recycled polyethylene film to manufacture items such as carrier bags. Over the years, recycling capacity has been continuously increased. With an installed recycling capacity of approximately  tons per annum, Papier-Mettler is one of the largest recyclers of flexible polyethylene films in Europe.

Regulation (EU) 2022/1616 recognizes, according to Annex 1, Table 1, two recycling technologies suitable for producing recycled plastic intended to come into contact with food: mechanical post-consumer PET recycling and recycling from closed, controlled product loops. All other recycling technologies must be registered as novel technologies.<sup>[1]</sup>

## Abstract

The granules manufactured by Papier-Mettler are used for blown film extrusion and subsequent conversion into service or transport packaging. These materials are referred to as food contact materials (FCM); they are either intended for contact with food or such contact is foreseeable, and it may be direct or indirect.<sup>[2]</sup> Service packaging refers to packaging that is only filled with goods at the final distributor and then handed over to the end consumer,<sup>[3]</sup> such as a carrier bag. Transport packaging may also include outer packaging, such as stretch film. Both service and transport packaging come into “direct” or “indirect” contact with food.<sup>[4]</sup>

The innovative technology known as “ecoLoop” corresponds to the recycling process of conventional mechanical PE recycling: the film material is washed, dried, filtered, degassed at high temperatures and under high pressure, and re-extruded. The finished polyethylene granulate undergoes laboratory and quality controls before being processed into the relevant polyethylene films. These films are used to manufacture carrier bags, for the transport of pre-packaged foodstuffs and for short-term contact with foodstuffs such as fruit and vegetables that are washed or peeled before consumption. This is ensured through laboratory and quality testing as well as risk assessments.

[1] COMMISSION REGULATION (EU) 2022/1616 on recycled plastic materials and articles intended to come into contact with foods, and repealing Regulation (EC) No 282/2008.

[2] [https://food.ec.europa.eu/safety/chemical-safety/food-contact-materials/plastic-recycling\\_en](https://food.ec.europa.eu/safety/chemical-safety/food-contact-materials/plastic-recycling_en)

[3] <https://www.verpackungsregister.org/information-orientierung/themenpakete/serviceverpackungen> (date: 01.07.2014).

[4] REGULATION (EC) No 1935/2004 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on materials and articles intended to come into contact with food and repealing Directives 80/590/EEC and 89/109/EEC.

## Description of the input material

The polyethylene plastic waste originates from the food retail sector or other food businesses and was intended for direct or indirect contact with food. Papier-Mettler manufactures comparable virgin films suitable for food contact, such as shrink hoods or stretch films, which comply with the requirements of Regulation (EU) No 10/2011. The material comes from commercial sources, thereby preventing contamination by end consumers.

It consists of commercial waste from EU countries, including Switzerland and the UK. The plastic films are collected separately by businesses, such as retailers, and then disposed of as plastic waste. Contamination by end users, for example through residual waste or misuse of the film, is therefore neither expected nor foreseeable. Food waste, such as that typically found in the municipal waste, is also not a source of expected contamination. The PE films originate neither from the construction industry nor from the agricultural sector, which also helps to minimize the risk of contamination. The delivered bales of film are approved or rejected by trained staff following a visual inspection, thereby simultaneously evaluating and selecting the suppliers (Figure 1).

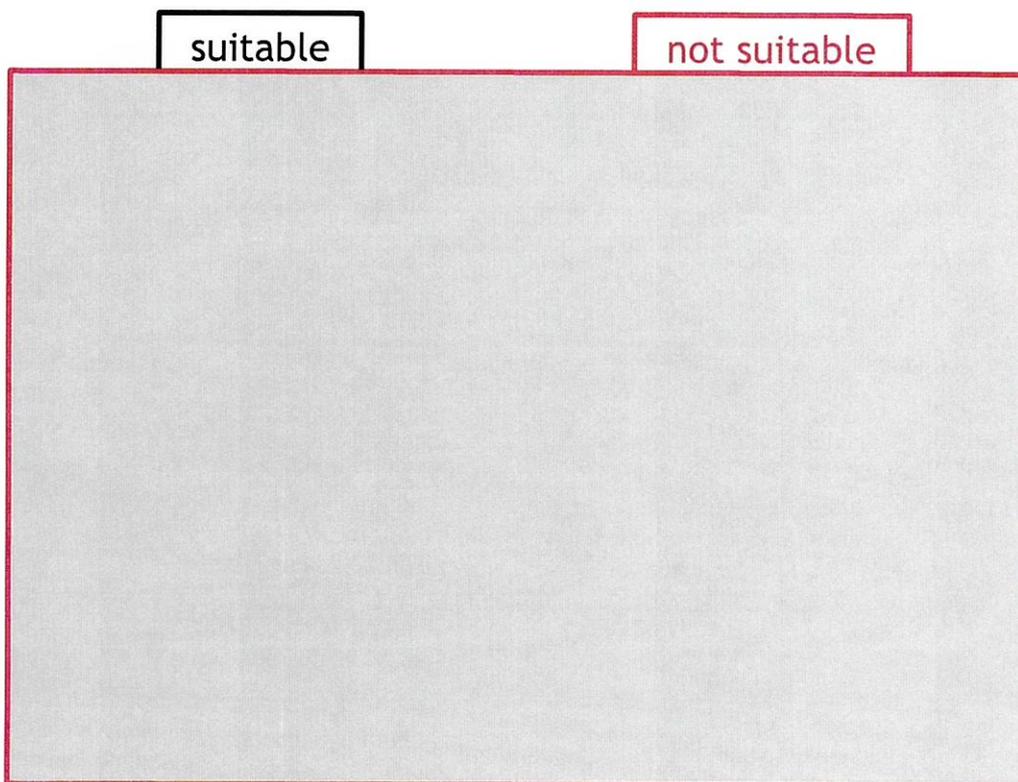


Figure 1. Examples of plastic bales.

The film grades correspond to a  classification, which means that the transparent PE fraction in the input material is at least . This PE fraction consists of LDPE with varying proportions of LLDPE. The remaining, maximum  foreign materials consists of non-transparent PE films, other plastics, metals or paper. Typical film bale specifications are shown in Tables 1 and 2. Foreign plastics are usually PP or HDPE, rarely PET or PA.

Table 1. Typical specifications for film bales.

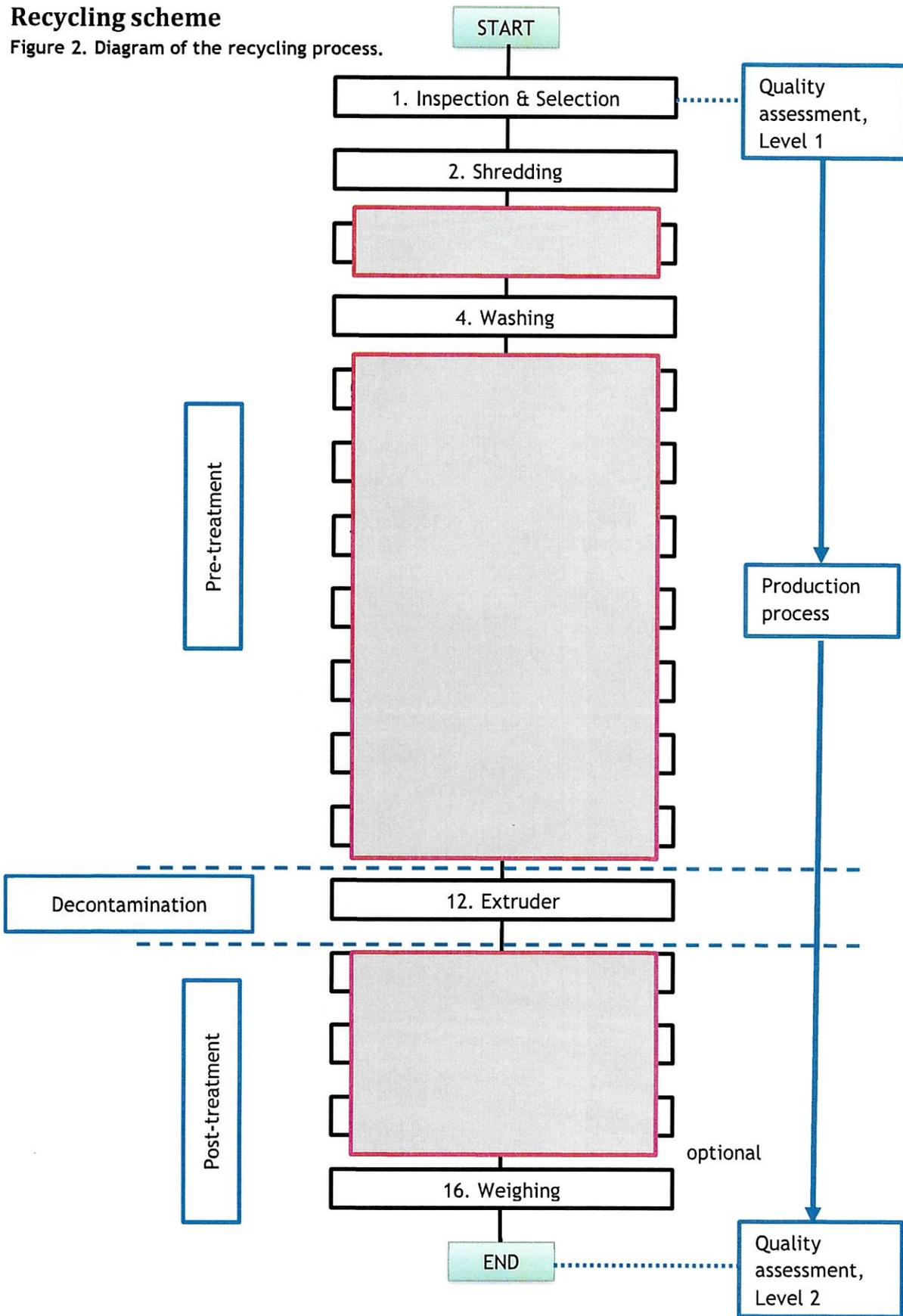
Parameter	Value
Weight	<input type="text"/>
Bale dimensions	
Moisture contentt	
Temperature	
Foreign plastic content	
Cellulose content (paper, wood)	
Metal content	

Table 2. Prohibited contaminants that are subject to complaint (examples).

Contaminants
Latex gloves
Metal
Rubbish
Food scraps, food
PET bottles

## Recycling scheme

Figure 2. Diagram of the recycling process.



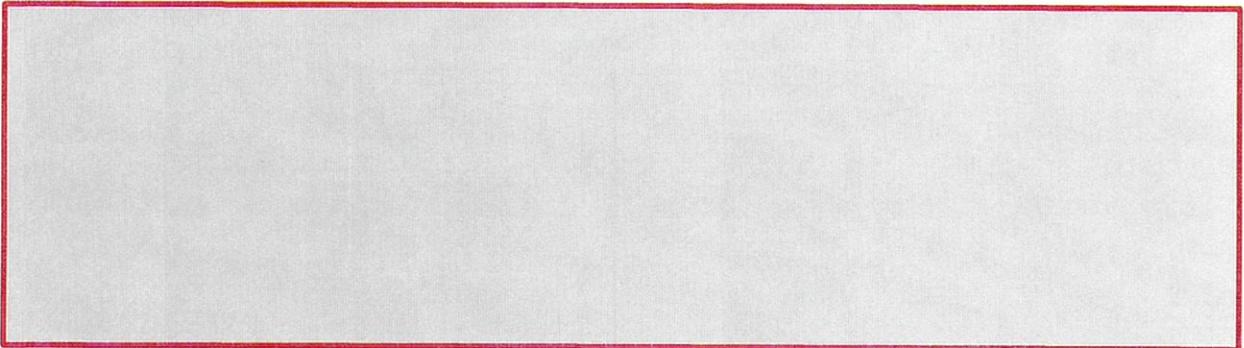
## Description of the recycling process

### Process stage 1: Inspection & selection (pre-treatment)

Trained staff visually inspect each bale for quality and reject any bales containing an excessive amount of unwanted materials. At the start of the recycling cycle, the films are delivered to the recycling plant in bale form and stored in the bale warehouse using a forklift truck. The bales are retrieved from the opposite side of the warehouse. The wires holding the bales together are then removed and the material undergoes a visual inspection. Foreign materials such as metal, wood, foam, etc. are removed, or the bale is rejected due to excessive contamination. Following this process, the raw material is ready to be fed into the plant.

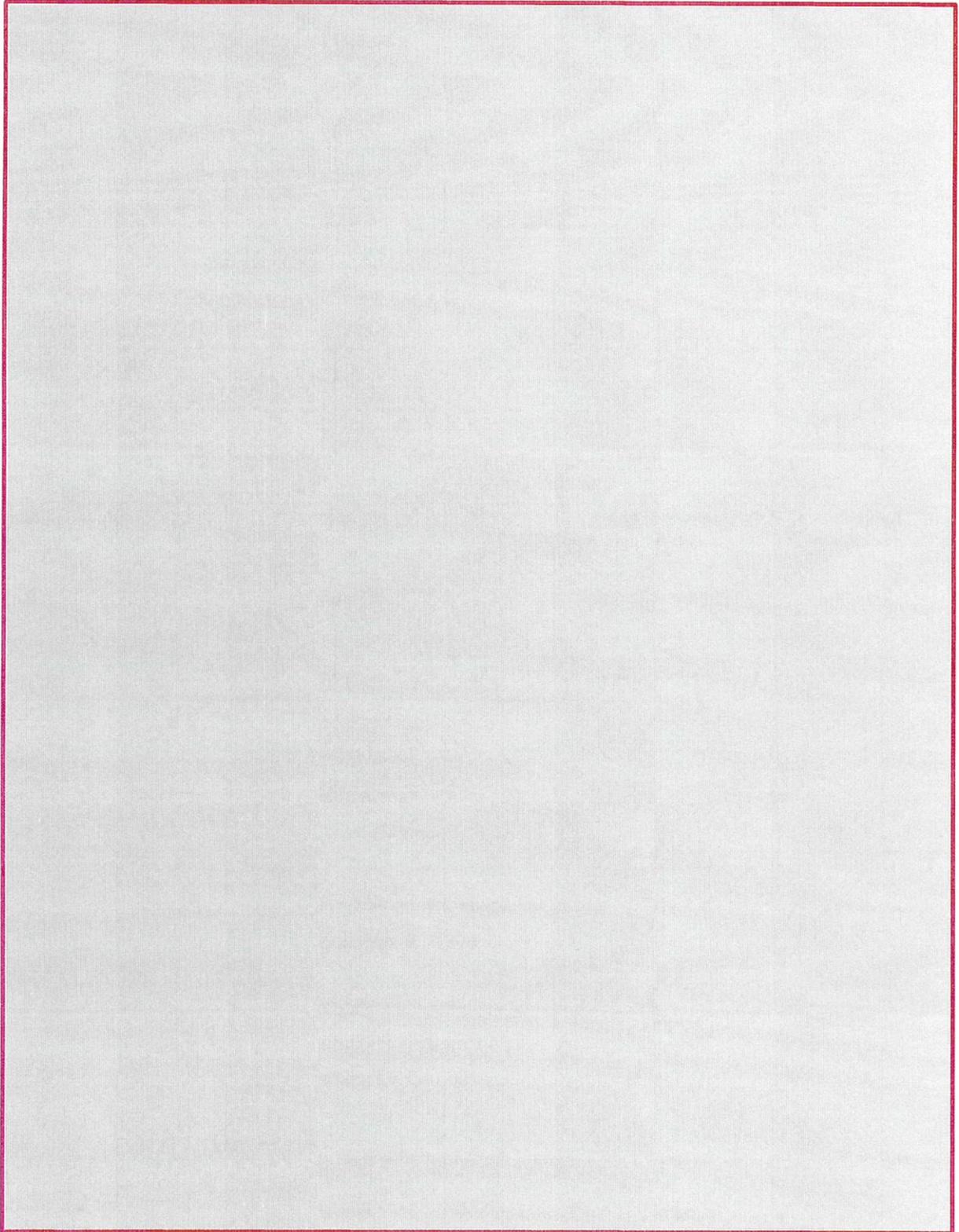
### Process stage 2: Shredding (pre-treatment)

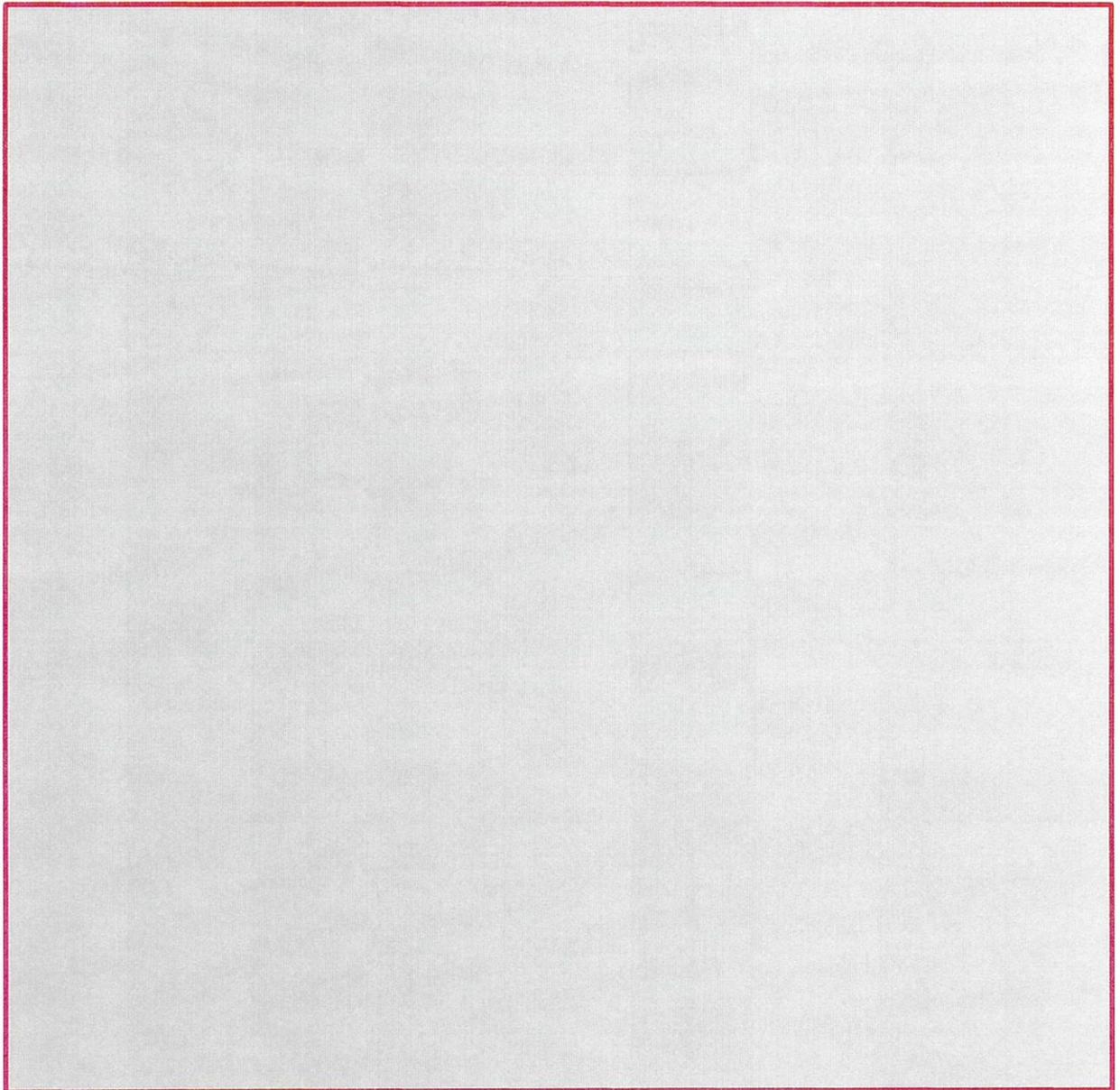
The shredder is used for the coarse shredding of the delivered film bales. The material enters the cutting chamber via a feed hopper. After the cutting process, film scraps measuring approximately 5 x 5 cm leave the shredder through a screen basket.



### Process stage 4: Pre-wash tank (Pre-treatment)

The first washing and sorting process takes place in the pre-wash tank. This tank consists of a chamber filled with water , in which the materials separate according to the principle of buoyancy. The capacity of the pre-wash tank is approx.  Polyethylene (PE) has a lower density than water and floats on the water's surface. Other materials such as metal, stones or polyvinyl chloride (PVC) have a higher specific gravity and sink to the bottom of the conical tank. After approx.  minutes, the material reaches the end of the pre-wash tank and enters the friction separator.





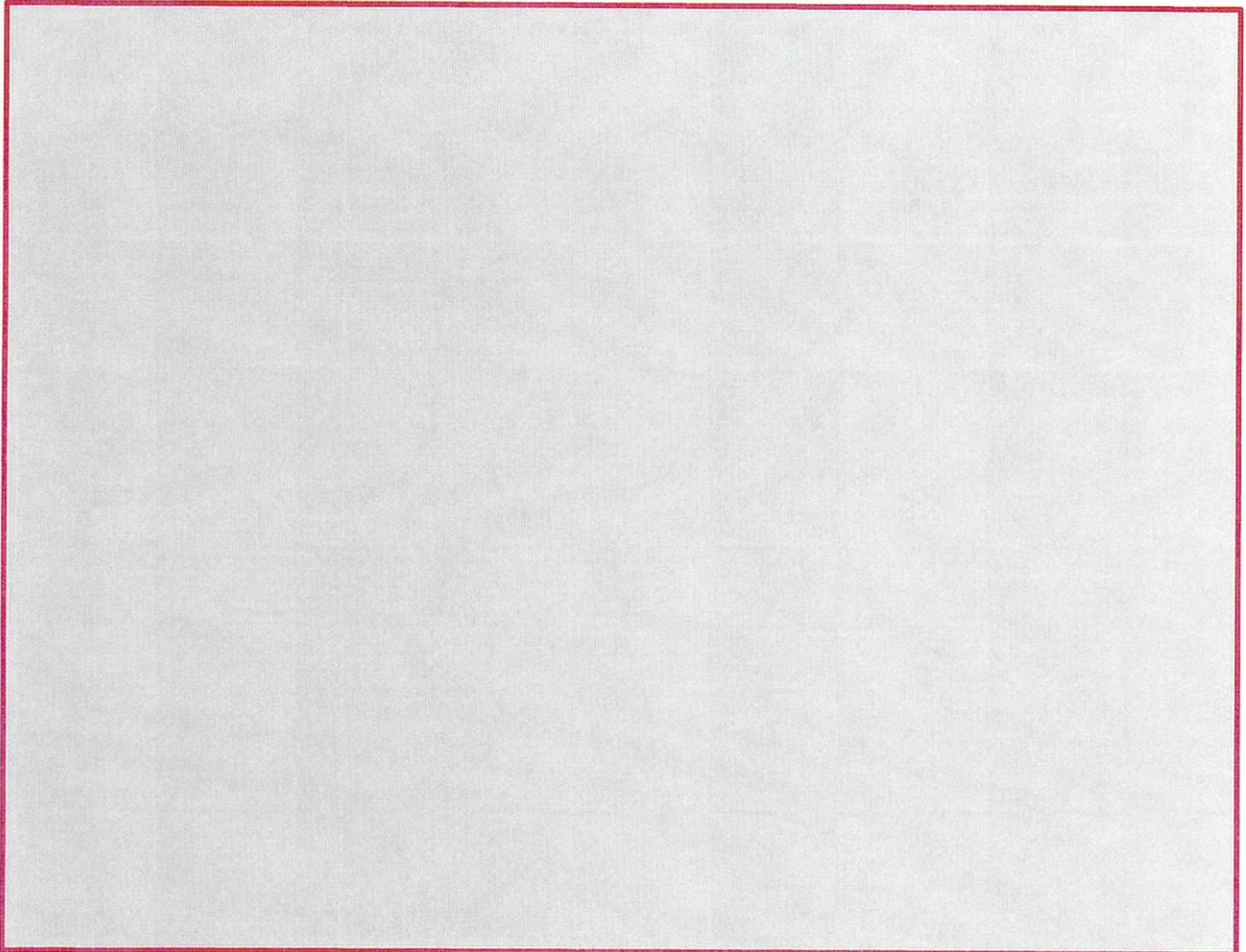
**Process stage 12: Extruder (decontamination)**

The extruder essentially consists of a screw rotating within a heated cylinder. The material pre-compressed by the cutting compactor is transported to the screw head by the screw's rotational movement.

Through heating and the simultaneous friction of the material against the screw flights, the plastic is heated during conveyance, transformed into a molten state and transported to the screw head. Until granulation, the melt is heated to a mass temperature of

To ensure sufficient plastic is fed into the system, the MFI value should be less than  min (190 °C, 2.16 kg); otherwise, the increased viscosity will lead to processing problems. The melt pressure ranges from  (initially) up to a maximum of

A cooling system ensures a constant temperature in the various sections of the extruder. The residence time in the extruder is approx.  min.



Internal studies have shown that the post-treatment is capable of removing volatile components (see ANNEX VII). As early as 2018, the cleaning efficiency of thermal post-treatment was investigated internally based on a 'challenge test' in accordance with EFSA guidelines. For this purpose, 1 tons of PCR regranulate was sampled prior to the final post-treatment and inoculated with the following substances:

Table 3. 'Challenge test' for the post-treatment.

Chemical group	Substance	Boiling point	Molecular mass	Decrease in % after 6 hours
<b>volatile polar</b>	Chloroform	61 °C	119,39 g mol <sup>-1</sup>	>99.9%
<b>volatile non-polar</b>	Chlorbenzene	132 °C	112,56 g mol <sup>-1</sup>	>99.9%
<b>volatile non-polar</b>	toluene	111 °C	92,14 g mol <sup>-1</sup>	>99.9%
<b>non-volatile polar</b>	<i>n</i> -hexane	69 °C	86,18 g mol <sup>-1</sup>	>99.9%
<b>non-volatile polar</b>	methylsalicylate	223 °C	152,15 g mol <sup>-1</sup>	98.4%
<b>non-volatile non-polar</b>	benzophenone	305 °C	182,22 g mol <sup>-1</sup>	>99.9%
<b>non-volatile non-polar</b>	methylstearate	355 °C	298,51 g mol <sup>-1</sup>	63.2%
<b>non-volatile non-polar</b>	phenylcyclohexane	240 °C	160,26 g mol <sup>-1</sup>	>99.9%

The analysis was carried out using headspace GC/MS on the granules. All chemical groups, ranging from volatile polar, volatile non-polar, low-volatility polar to low-volatility non-polar, were covered. Only the purification efficiency in the case of methyl stearate is reduced to 63.2%. This can be attributed, on the one hand, to the highest molecular weight of all the seed substances used (298.51 g·mol<sup>-1</sup>, boiling point = 443 °C) and the resulting low vapour pressure, as well as by the structurally determined affinity of the alkyl chain of the stearic acid derivative towards the saturated structures of the polyethylene.

#### Process stage 16: Weighing (post-treatment)

The weighing tower consists of a tapered cylindrical collection tank, a set of scales and a diverter.

## Labelling and transport of the granules

The recycled material is transported to the appropriate silos using silo trucks. No labelling takes place during transport, as the batch order numbers are available in digital form. This is carried out in accordance with DIN EN ISO 9001:2015 (see Annex IX) for the scope of development, manufacture and distribution of flexible packaging made from plastics and plastic composites, as well as the processing of recycled granulate from plastic films.

In addition, the recycling process and the associated management systems meet the required standard for certification under the EuCertPlast Audit Scheme 4.2. in accordance with EN 15343:2007 (see Annex VIII), thereby ensuring traceability for the PE-PCR regranulate and the PE-PCR film at all times. As RecyClass certification is set to replace that of EuCertPlast in the foreseeable future, Papier-Mettler was audited against RecyClass criteria as early as June 2024. Only the formal certification is still pending.

The mass fraction of PCR material in the PCR granulate is always 100%. This cannot be altered, as there is no infrastructure for compounding, i.e. for mixing in virgin material, additives, or similar. The recovered material is provided with a digital label. This contains information on which recycling plant processed the material and at what time. A physical label is neither necessary nor practicable, as the recovered granulate is always transported to the relevant silos using the company's own silo vehicles. Traceability and labelling are also ensured here by means of the certification mentioned above.

A records archive is maintained to store information on the quality of individual batches in accordance with Section 4.1 of the summary of conformity monitoring referred to in paragraph 3(c). The records stored in this archive are retained for a period of five years. Experience has shown that variations within a batch can be easily identified using indicative parameters. A batch is thus linked to a specific calendar week in which at least [redacted] granulate samples are analyzed per week. In addition to visual assessment, the measurement of [redacted] [redacted] thermal properties [redacted] and the determination of heavy metals [redacted] serve as indicators.

## Suitability of the granules for the blow film extrusion of service packaging

Even though the patent application for this novel technology ends with the extrusion of the PCR granulate, the resulting PCR material remains restricted to its intended use, namely blow film extrusion for the production of service packaging, such as a carrier bag, with a thickness of up to approximately   $\mu\text{m}$ . The film can serve as transport, wrapping, retail, shipping or service packaging, which is used exclusively for the transport of packaged foodstuffs and involves brief contact with fruit and vegetables that are washed or peeled prior to consumption. This is also a key factor for risk assessment.

From a chemical perspective, too, an additional purification step takes place during blown film extrusion. Thus, chemical analysis reveals an additional reduction in, for example, olefin oligomers, although a direct comparison of the values is only possible to a limited extent due to differences in sample preparation.

It is generally accepted that an extrusion process, at the given temperatures and pressures (see process stage 12), always amounts to microbiological decontamination. This is confirmed by the determination of the surface colony count on the granulate, as well as on the film extruded from it (see ANNEX I & II)

This has been demonstrated in the past by numerous studies. For this purpose, the PCR granulate was extruded into a film and subsequently subjected to extensive testing. This included, amongst other things, migration measurements in accordance with Regulation (EU) No 10/2011 on plastic materials and articles intended to come into contact with food. The classification of food simulants by food category was carried out in accordance with Annex III, Tables 1 and 2, based on foreseeable contact with 'Fruit, vegetables and products derived therefrom; 04.01 Fruit, fresh or chilled: A. unpeeled and uncut', resulting in a correction factor of X/10 for food simulant E (poly(2,6-diphenyl-p-phenylene oxide = Tenax)). Repeated use was also investigated by measuring the total migration of the films on multiple occasions, with no increase observed in the second or third measurements. The total fluorine content is below the legal limits set out in Regulation (EU) 2025/40. The NIAS-GCMS screening shows mainly polyolefinic saturated hydrocarbons and olefin oligomers. Microbiological tests in accordance with  that the PCR material is not only sufficiently inert but also microbiologically safe for the production of films for the aforementioned application. Heavy metal analyses were carried out  to comply with Packaging Directive 84/62/EC and Regulation (EU) 2025/40. In addition, the migration of both primary aromatic amines and alkanolamines was investigated.

The sensory assessment of odour in accordance with DIN 10955:2004-06 reveals the expected typical, characteristic odour of recycled polyethylene material. The transfer of odours and flavours in tap water is used as the basis for assessment, with tap water serving as the indirect test medium.

## A historical review and risk assessment of the PCR carrier bag

For more than 20 years, suitability and compliance with Regulation (EC) No 1935/2004 on materials and articles intended to come into contact with food have been confirmed by an independent, accredited institute, the Industrial Research and Development Association



The latest test results can be found in the annexes (ANNEX I & II) and have already been outlined in the previous section. A current statement regarding the suitability of the PE-PCR carrier bags (ANNEX III) from  well as the most recent declaration of safety in accordance with Regulation (EC) No 1935/2004 from 2020 (ANNEX IV) and the oldest, still complete, declarations of safety from 2009 (ANNEX V) are attached. The documentation covering this period is fully verifiable.

Furthermore, the carrier bags with a PCR content >80% have been awarded the Blue Angel (see Annex 10), the environmental label in accordance with DIN EN ISO 14024 administered by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (ANNEX VIII). The award criteria under UZ30a impose strict requirements on product safety. This includes further chemical analyses, such as the absence of phthalates in accordance with EN ISO 18856 or EN 14602, the determination of chlorine and bromine content in accordance with DIN EN 62321-3-1:2014-10, the determination of heavy metal migration in accordance with DIN EN ISO 71-3 (Category 2), and the determination of PAH content in accordance with AfPS GS2019:01 PAH.<sup>[4]</sup>

Furthermore, Papier-Mettler has held a Letter of No Objection (LNO) #216 from the US Food and Drug Administration (FDA) since March 2019.

The suitability of recycled plastics, such as polyethylene, has been confirmed on several occasions by the FDA; LNO #2 states the following:

*“[W]e are aware that most foods are already wrapped in approved food-contact packaging before being placed into these type of grocery bags. Because of this, we expect that there would be little likelihood that recyclable or degradable polymers used in grocery bags would significantly come into contact with food and/or become components of food... [W]e would consider the use of polymers to make grocery bags as a food additive situation that does not require regulation.”<sup>[5]</sup>*

[4] <https://www.blauer-engel.de/de/zertifizierung/vergabekriterien#UZ30a-2019> (date: 08.07.2014).

[5] <https://www.cfsanappsexternal.fda.gov/scripts/fdcc/index.cfm?set=RecycledPlastics&id=2> (date: 09.07.2014).

## Test plan for external analyses

The external analyses are carried out on a quarterly basis. The food simulants were classified by food category in accordance with Annex III, Tables 1 and 2. In the case of carrier bags, the contact involves “fruit, vegetables and products derived therefrom; 04.01 Fruit, fresh or chilled: A. unpeeled and uncut”, resulting in a correction factor of X/10 for food simulant E (poly(2,6-diphenyl-p-phenylene oxide) = Tenax). A comprehensive analysis of a PE-PCR granulate sample is provided as an example in ANNEX I. The following is a proposal for the routine testing of granules/films:

Migration tests are carried out in accordance with standards EN 1186:2022-07, in conjunction with DIN EN 1186-2:2022-10, DIN EN 1186-3:2022-10, and EN 13130-1:2004-08. The test conditions are selected on the basis of Annexes III and V of Regulation (EU) No 10/2011:

### Determination of total migration

Duration and temperature:

Food simulant:

Migration loading:

### Determination of specific migration for NIAS GC/MS screening

Duration and temperature:

Food simulant:

Migration concentration:

## Determination of specific migration for the identification of amines and alkanolamines

Duration and temperature:

Food simulant:

Migration concentration:

The migration solution is used to determine primary aromatic amines and alkanolamines.

## Determination of heavy metals

The sum of the maximum concentrations of lead, cadmium, mercury and hexavalent chromium is determined in accordance with EU Packaging Directive 94/62/EC and Regulation VO (EU) 2025/40 (PPWR).

## Determination the number of colonies

The microbiological tests were carried out in accordance with DIN ISO 8784-1:2016-05 and ISO 8784-3:2022-04.   
solution contain

## Determination fluorine content

The organic and total fluorine contents are determined using combustion ion chromatography (CIC) in accordance with Regulation VO (EU) 2025/40 (PPWR).

## Examples of carrier bags

Table 4. Example specifications for a reusable carrier bag (“DuraBag®”).

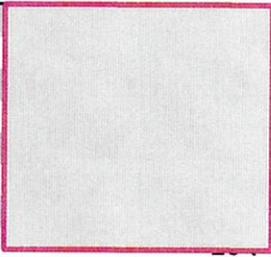
Parameter	Value
Width	
Height	
Fold	
Construction	
Outer layer	
Inner layer	
Weight	
Volume	



Figure 3. “DuraBag” permanent carrier bag.

Table 5. Example specifications for a standard carrier bag

Parameter	Value
Width	
Height	
Fold	
Construction	
Outer layer	
Inner layer	
Weight	

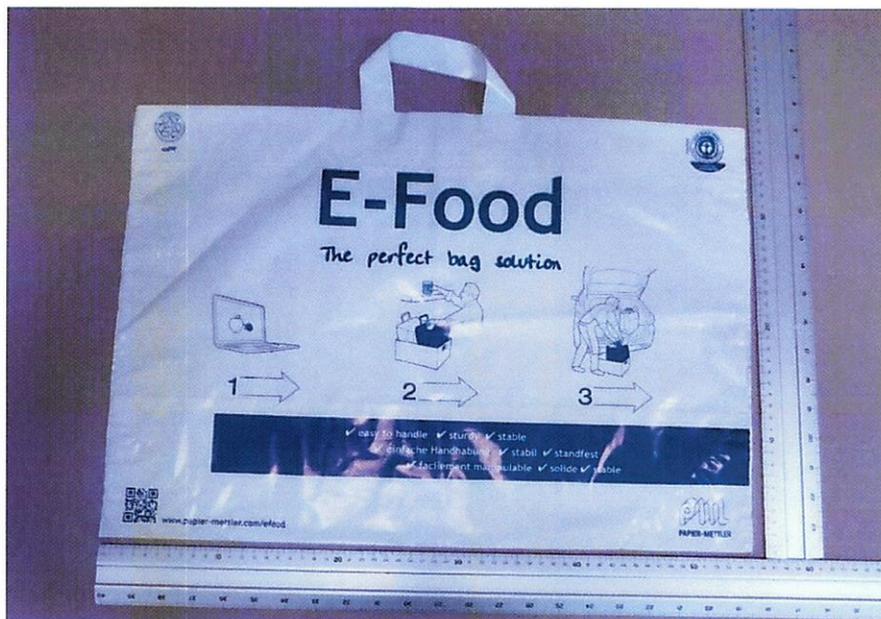


Figure 4. A Standard carrier bag.

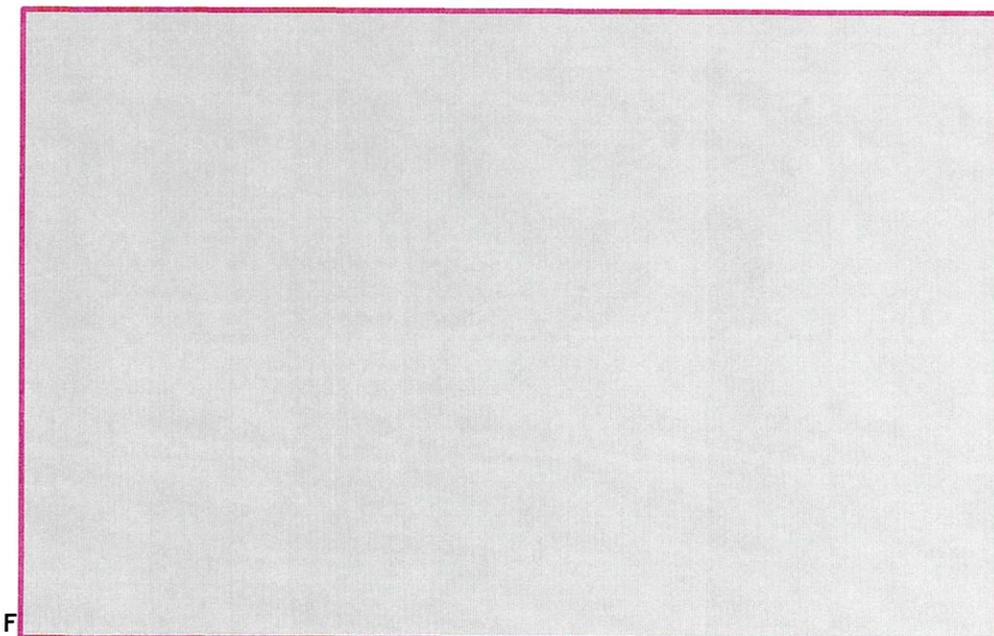
## Internal routine analyses

The entire recycling and manufacturing process for the granulate and the films produced from it is monitored at various stages through a series of internal laboratory tests, including visual inspection of the uniformity of the raw material, granulate and film [redacted] flow rate (MFR) (ISO 1131-1); determination of density (ISO 1183-1); differential scanning calorimetry (DSC) (ISO 11357); determination of ash content (ISO 3451-1); analysis of metal content using energy-dispersive X-ray spectroscopy (ISO 22309) and [redacted]

Although laboratory tests cannot replace more specialized analyses, such as migration studies in food simulants, they have proven over the decades to be reliable indicators of product safety.

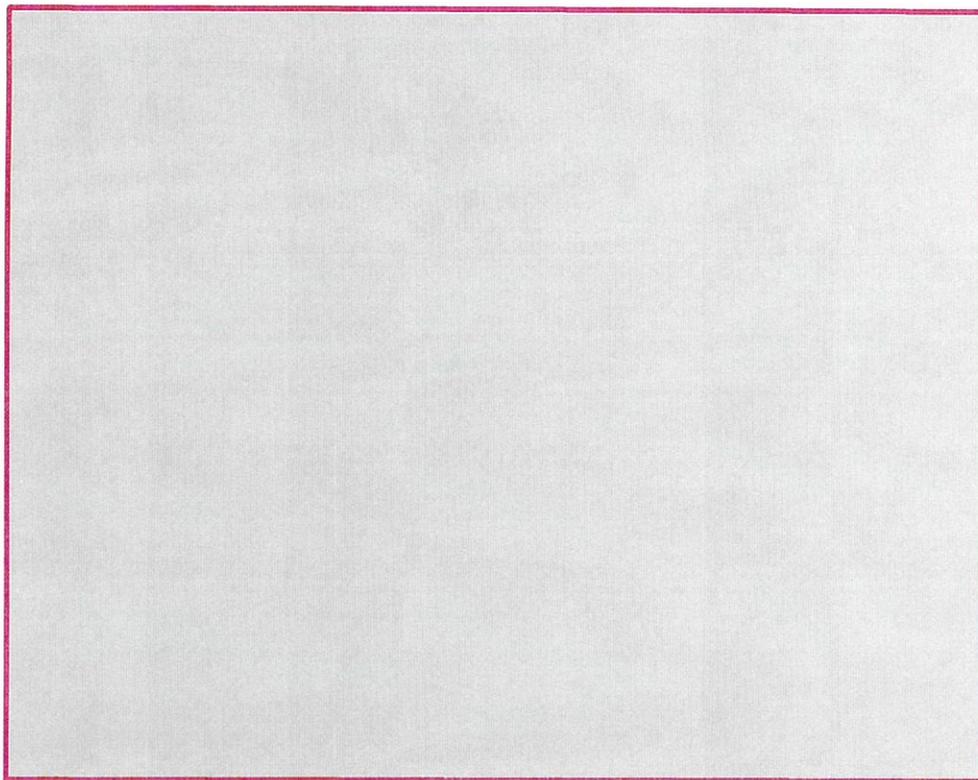
**Example:** [redacted] analyses

The [redacted] signals (see Figure 5) for PE and its short-chain degradation products. In no case is a single pure compound observed. Rather, it is a mixture which, under the given conditions, can be described as 'PE oxidation'.



suitable

F



als. The sample

not  
suitable

The test is carried out in accordance with the parameters used in ANNEX VII.

### **EDX analyses**

The quantitative analysis of heavy metals is carried out directly on the ash following the incineration of the PCR granulate samples. This allows, amongst other things, the levels of lead, cadmium, mercury and hexavalent chromium to be determined in accordance with EU Packaging Directive 94/62/EC and Regulation VO (EU) 2025/40 (PPWR). Any exceedance of the limits will result in the granulate being rejected.

### **DSC analyses**

DSC analysis detects endothermic and exothermic transitions, such as the melting point and the associated crystalline content of a sample. If, in addition to the typical melting points of 109 °C for LDPE and 125 °C for LLDPE, other critical foreign plastics, such as PLA (melting point = 155 °C), are detected, the granulate is rejected.