COTREP

Comité Technique pour le Recyclage des Emballages Plastiques

Resin

Flexible PE

# GENERAL NOTICE 74

## Impact of metallisation on the regeneration of flexible PE household packaging


## SUMMARY

The aim of this general notice is to assess the impact on mechanical regeneration of flexible PE household packaging that has undergone full surface metallisation to provide the film with barrier properties.

This notice only concerns inner layer metallisation used to provide barrier functionality.

In addition to this notice, sorting tests will also be performed on metallised flexible PE to assess whether it can be directed to regeneration plants and particularly the impact of metallisation or a metallic decorative element on the outer layer.

**Sorting centre**
Ability of packaging waste to be channelled to the regeneration plant

**Regeneration**
Ability of packaging waste to be converted into ready-to-use flakes or granulate

**Use of recycled material**
Ability of flakes or granulate to be converted into new products

Study scope

The outcomes of pilot-scale regeneration tests show a slight rise in pressure at the extrusion/granulation head at proportions of 15%. Most of the mechanical properties of the rPE film obtained are consistent with the standard film; however, there may be a slight impact on certain mechanical properties such as suitability for sealing.

COTREP sought to ensure that on an industrial scale there is no risk of build-up of metallic particles from metallisation impacting the regeneration process over time, as this could damage the equipment. The outcomes of tests on the premises of an industrial operator show that metallisation of PE film does not disrupt the extrusion/granulation process at proportions of approximately 15%. The resulting rPE film is compliant and meets the quality criteria set by the industrial operator.

**Given the current state of regeneration equipment and techniques available in France, metallisation on flexible PE offers partial compatibility with mechanical flexible PE regeneration.**

COTREP may review this document with regard to technological and market developments if needed.


## 1. CONTEXT

Metallisation consists of vacuum deposition of an ultra-thin layer of aluminium in the range of a few angströms to a few nanometres on a PE film. The resulting film has a characteristic surface appearance known as "metallised".

Metallisation gives PE film excellent oxygen and moisture barrier properties, providing superior protection and preservation for products such as crisps, savoury snacks, pet food, biscuits, chocolate, etc. This metallised PE film is used in combination with a sealant film to produce pouches or bags.

The marketing potential of PE films requiring metallisation as a barrier layer represents more than 20,000 tonnes in 2030.

**This notice seeks to assess the impact of metallisation on flexible PE packaging on mechanical regeneration and the quality of the recycled material. In this notice, metallization is defined as the deposition of aluminium via a vacuum vaporisation process to produce an ultra-thin layer of a few angströms to a few nanometres, in order to provide barrier properties. This notice only concerns inner layer metallisation.**

# 2. IMPACT ON PILOT SCALE REGENERATION

## 2.1. Principle and analytical criteria

In its mechanical regeneration study, COTREP assessed the impact of metallised flexible PE on the regeneration process and on the quality of recycled PE (rPE) produced from flexible household packaging.

These tests were performed on a pilot scale based on protocols defined by COTREP for recycling flexible PE packaging. The protocols are representative of industrial practices applied by regeneration plants processing streams in France.[1]

Various physical-chemical criteria were measured during the test phases and compared to those of a standard sample composed of 100% rPE.

## 2.2. Test samples

Tests were performed on a complete packaging item representative of structures available on the market. The film chosen is composed of a PE film to which metallisation has been applied and laminated with a PE sealant film. The adhesive used for lamination is a polyurethane in standard use in flexible PE packaging.

A 100% rPE film was produced exclusively as the standard film for the study from granulate sourced from a regeneration process using packaging waste generated by the French selective collection system (flexible PE standard).

Tests were performed on multilayer metallised PE with proportions of 5%, 10% and 15% by mass to account, respectively, for marketing potential in 2025, an intermediate proportion and marketing potential in 2030.

## 2.3. Results

**IMPACT OF METALLISATION ON FLEXIBLE PE REGENERATION PROCESSES**

| RECYCLING PROCESSES | IMPACT | *DESCRIPTION* |
|---|---|---|
| SHREDDING | ✓ | *No impact on shredding* |
| WASHING AND SPINNING | ✓ | *No impact on washing and spinning* |
| FLOTATION AND DRYING | ✓ | *No impact on flotation or drying* |

[1] *For further information, see protocols Flexible PE-1 and Flexible PE-2 on the COTREP website: www.cotrep.fr*

| RECYCLING PROCESSES | IMPACT | *DESCRIPTION* |
|---|---|---|
| EXTRUSION/ GRANULATION | ⚠ | *Pressure increase at the extruder head without the need for a filter change.*<br>⇨ *Risk of build-up of metallic particles over time* |
| BLOW EXTRUSION | ⚠ | *No impact during film manufacture.*<br>*Most of the mechanical properties of the films are consistent with the standard film:*<br>⇨ *There may be a slight impact on certain mechanical properties such as suitability for sealing in proportions of 15% metallised films* |

⚠ Caution ✓ No impact

## 2.4. Conclusion of pilot tests

The pilot tests performed by COTREP on metallised PE films showed a slight increase in pressure at the extruder head during granulation. The metallised films have no impact on any of the other regeneration processes or during blow extrusion. The mechanical properties of rPE films containing up to 15% of metallised films are consistent with the standard film; however, there may be a slight impact on certain mechanical properties such as suitability for sealing.

Given this slight pressure increase during granulation, COTREP has identified a risk of build-up of metallic particles in the extruder during extrusion over time, with potential process problems such as clogging or damage to filters or blades, etc.

COTREP wished to check the impact of metallised films during extrusion-granulation in industrial conditions and ensure there would be no problems of build-up of metallic particles over time.

# 3. IMPACT ON INDUSTRIAL SCALE REGENERATION

## 3.1. Principle and analytical criteria

This industrial test seeks to assess the processability of metallised flexible PE during extrusion-granulation.

The test was conducted on an industrial scale for the recycling of flexible PE at a regeneration plant processing French flexible PE household packaging streams.

The granulate produced containing a proportion of 15% of metallised PE films was characterised according to the usual quality control procedure on the industrial operator's site, including the MFI, moisture content, density, suitability of the granulate for producing a film, etc. The test is successful if no deviation from the usual production is observed.

## 3.2. Test samples

Tests were performed on packaging that had already undergone pilot-scale testing. The films chosen are composed of a PE film to which the metallised barrier has been applied and laminated with a PE sealant film. The adhesive used for lamination is a polyurethane in standard use in flexible PE packaging.

The industrial test standard is production made from films generated by selective collection of flexible PE household packaging representative of the usual production of the industrial operator on whose premises the test was conducted.

Tests were performed with a proportion of approximately 15% metallised PE film by mass to take account of the marketing potential in 2030.

### 3.3. Results

| RECYCLING PROCESSES | IMPACT | *DESCRIPTION* |
|---|---|---|
| EXTRUSION/ GRANULATION | ✓ | *No impact on the extrusion/granulation process in industrial conditions during a test of more than 8 hours with a proportion of 15%*<br>*No impact on filtration*<br>*No pressure rise while the test was conducted*<br>*No impact on the quality of the granulate produced in relation to the operator's usual production* |

⚠ Caution ✓ No impact

## TECHNICAL CONCLUSIONS

Through tests performed by COTREP, it was possible to assess the impact of inner layer metallisation as a barrier in flexible PE on mechanical regeneration of flexible PE packaging.

Results obtained show that the presence of metallisation up to a proportion of 15% does not disrupt the different stages of the regeneration process. A slight increase in pressure was observed in pilot-scale test conditions. Most of the mechanical properties of the films obtained during pilot-scale testing up to a proportion of 15% are consistent with the standard film; however, there may be a slight impact on certain mechanical properties such as suitability for sealing. The good processability of metallised films was verified on an industrial scale at a regeneration plant processing French flexible PE household packaging streams.

It should be noted that the appearance of the films produced was not assessed in this test. A further study may be performed to supplement this notice.

**Given the current state of equipment and techniques used in France**, inner layer metallisation used as a barrier in flexible PE offers **partial compatibility** in the flexible PE stream. This opinion may be reviewed with regard to technological and market developments if needed.