

CHI-C8-PEF-1

Recycling Application Compatibility Test for PE-based Flexible Packaging

Version 3.0

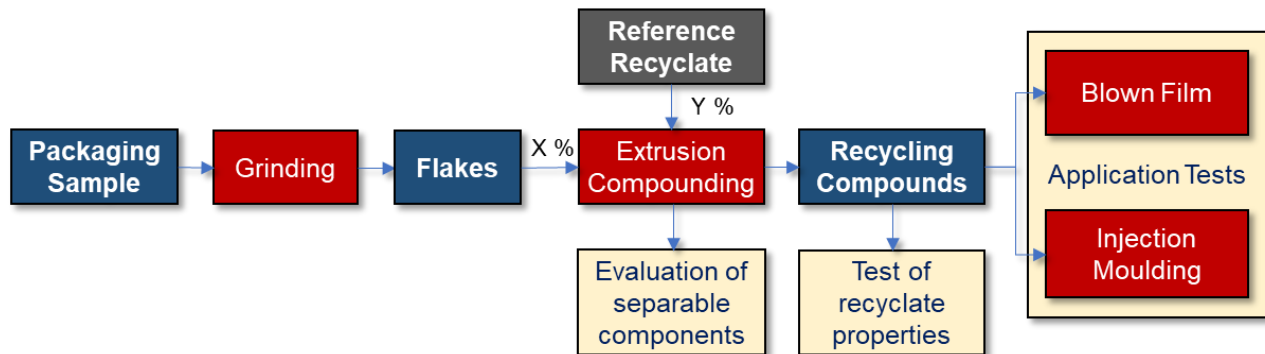
This CHI test method was developed by cyclos-HTP for LDPE-based flexible packaging and includes the following steps (Principle of the test method is shown in the flow chart on page 2):

1. **Materials** to be provided:
 - Flexible PE-based packaging/material structure containing a component with an unknown recycling compatibility, "PCK-S0"
 - Optional, reference packaging made of the same base PE grades (PE-LD or PE-LLD), "PCK-R0"
 - Commercial recycle commonly used for the same target application in the recycling path, "REF"
2. **Grinding** of the respective samples to flakes on a granulator with 5-10 mm sieve
3. **Extrusion/compounding** of materials combinations on a lab-scale extruder with mono or double screw to form various recycling compounds; melt temperature 200-220°C:
 - (A) "**CHI5**": 5% PCK-S0 + 95% REF
 - (B) "**CHI30**": 30% PCK-S0 + 70% REF

Optional:

 - (C) "**PP30**": 30% PCK-R0 + 70% REF
4. **Melt Screen** (filter with 100 µm pore size) can be used to separate heterogeneous components and to examine them qualitatively. The quantitative assessment of inhomogeneity is performed by documenting the melt pressure increase within 30 minutes after start of extrusion. Where indicated, the filtrate can be qualitatively examined to assign it to a component in the starting material.
 - **Characterisation** of recycling compounds: Thermally (DSC), viscosity (MFR); density
5. **Test specimens for Injection moulding** are prepared from recycling blends (+ reference REF) according to DIN EN ISO 3167
 - **Characterisation** of test specimens: Morphologically (microscopy) and mechanically by tensile testing (DIN EN ISO 527) and Notched bar impact testing (DIN EN ISO 179).
6. **Blown Films** are produced containing 50% of the recycling compounds out of steps 3/4 and 50% virgin PE-LD/LLD according to the CHI test method [CHI-C8-BFPE](#).
 - **Testing of the blown film samples** according to the CHI test method [CHI-C8-BFPE](#).with regard to their mechanical (DIN EN ISO 527-3) and optical properties, as well as sealing properties (DIN 55529) and sealing seam tightness (CHI method).
7. **Evaluation** of all test results is carried out according to the following criteria, whereby the evaluation refers to the tested applications. The results of samples CHI5 and CHI30 are compared with REF. Optional the samples CHI30 and PE30 are also compared.
An evaluation for the applications in injection moulding and blown films is made in the following order:
 - a) A significant, negative deviation of the relevant test results between **CHI5** and **REF** leads to a classification of the assessed packaging structure or substance as "not compatible for recycling" (CAT3 according to the CHI assessment and requirement catalogue).
 - b) If the relevant results between **CHI5** and **REF** are in a comparable range or CHI5 is even better, the assessed substance or packaging structure can be stated as "recycling compatible"
 - c) If the relevant results between **CHI30** and **REF** are in a comparable range or CHI30 is even better, the assessed packaging structure or substance can be stated as "recycling compatible" and - under suitable conditions - as "valuable material". A definitive assessment of a single substance according to this criterion is only possible if the suspect material is present in the original packaging sample in a high concentration.
 - d) In case of comparable results of CHI5 and REF and negative results of CHI30 in comparison to REF, an optional comparison of samples **CHI30** and **PE30** is used to prove whether the deviation originates from the PE base material in the sample or if the critical component under investigation has a limited recyclability.

Principle of the test method:



Overview of test samples and evaluation parameters:

	Trial #	REF	CHI5	CHI30	PE30
<i>Recyclate blends</i>	PCK-S0 (sample with critical material)	0%	5%	30%	0%
	REF (reference PCR recyclate)	100%	95%	70%	70%
	PCK-R0 (reference packaging sample)	0%	0%	0%	30%
<i>Recyclate blends characterisation</i>	DSC Tm peak [°C]				
	Fraction with high melting points (e.g. evaluation of PP contents)				
	Density [g/cm³]				
	MFR (190°C/2.16kg) [g/10min]				
<i>Injection moulding application mechanical testing</i>	Tensile Modulus (E _t) [Mpa]				
	Tensile Strength (σ _m) [Mpa]				
	Tensile Stress at Break (σ _b) [Mpa]				
	Elongation at Break (ε _b) [%]				
	Charpy Impact strength (acU) [kJ/m²]				
<i>Blown film application mechanical testing</i>	Tensile strength (MD/CD)				
	Elongation at Break (MD/CD)				
	Dart impact failure				
<i>Blown film application sealing properties</i>	Sealing properties on lab sealing press (sealing temperature T _s vs. time t _s)				
	Tensile testing of sealing strength				
	CHI seam tightness test (see CHI-C8-BFPE)				

Version history:

Version No.	Date	Reason/Content of revision
1.0	Oct 2019	First version of test method
2.0	Mar 2020	Updated test program and parameters
3.0	Sep 2021	Updated evaluation criteria; improved scheme