



2024 FlexPack PLACE Conference

April 14-17, 2024 • San Diego, CA • Wyndham San Diego Bayside



REVOLUTIONARY
PACKAGING: RECYCLABILITY
& PERFORMANCE

© 2023 Ube Corporation Europe. All rights reserved.



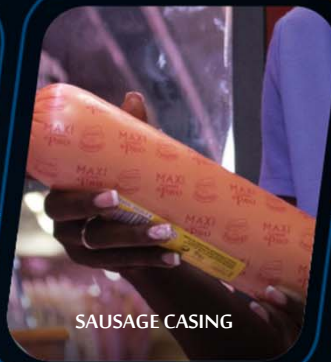
FLEXIBLE PACKAGING FORMATS

WITH PA

REVOLUTIONARY PACKAGING: RECYCLABILITY &
PERFORMANCE



POUCHES



SAUSAGE CASING



THERMOFORMING



SHRINKBAGS



PUNCTURE
RESISTANCE

+



BARRIER

+



THERMOFORMING
DEPTH

+



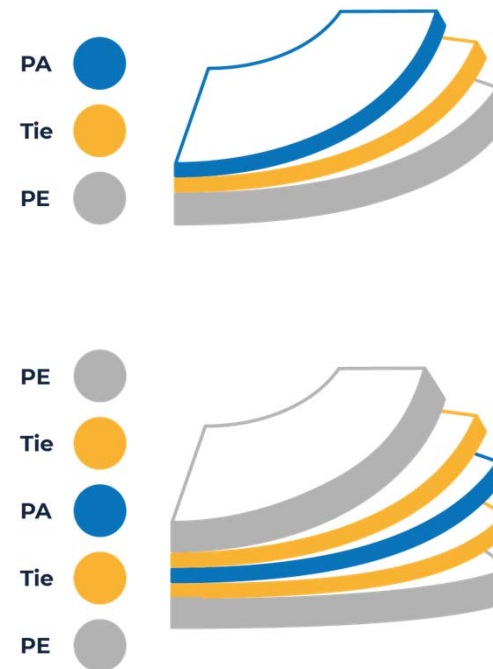
MECHANICAL
PROPERTIES

STANDARD FILMS

IN THE MARKET

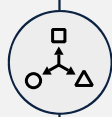
- Most common structures are **coextruded** with PE where PE is the main polymer.
- Between PA and PE layer there is always a **Tie layer**.
- Tie layer is a **PE grafted with MAH** which fixes the structure and compatibilizers polymers.

REVOLUTIONARY PACKAGING: RECYCLABILITY & PERFORMANCE



SORTING

SORTING
FLOW



3D
FRACTION

Dosing
Unit



Screen



<40mm
Residue

Windshifter



Lights
(foil)

Suspension
Magnet



Ferro

Sorter
Nir/VIS/Metals



Beverage
Carton like
material

Sorter
Nir/VIS/Metals



Non ferro
material

Ballistic
Separator



2D
Fraction

LIGHTS

Sorter
Nir/VIS/Metals



PP or PE

2D

NTCP

REVOLUTIONARY PACKAGING: RECYCLABILITY &
PERFORMANCE

PA



Tie



PE



PE



Tie



PA



Tie

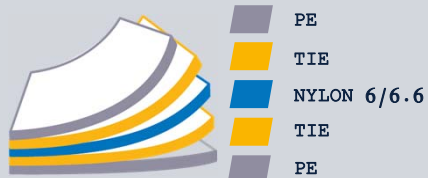


PE



Both films are identified as **PE-2D** by the industrial optical sorter during the analyses, hence are sorted similarly to PE packaging.

CoPA6/6.6 IS SUITABLE FOR RECYCLING WITHIN THE PE-FLEXIBLES STREAM



REVOLUTIONARY PACKAGING: RECYCLABILITY & PERFORMANCE

Association of Plastic Recyclers
2100 M Street NW
Washington, DC 20036
www.plasticrecycling.org

January 17, 2022

Mr. Bruce De Felice
UBE CORPORATION EUROPE S.A.U
Pologne Industrielle 11, Avenue, 40
13000 Cavaillon (France)
Dear Mr. De Felice:

APR, the Association of Plastic Recyclers, is pleased to recognize UBE Corporation's PE based multilayer film with enhanced mechanical and barrier properties confirmed by a PA6.6, 6 inner layer and the presence of PE based tie layers grafted with maleic anhydride (MAH) as meeting the requirements of the PE-based PE-FCR (Food Contact Recycled) Process for PE film and flexible Packaging streams. This APR recognition is based on the technical recyclability of the film innovation, in the polyethylene film recycling stream.

A Review Committee, appointed per the APR Recognition Operating Procedures, reviewed your data submission and concluded the data were correctly obtained by a qualified laboratory and were completely presented to ensure the customer from submitted material received the most challenging test conditions and avoided APR Critical Customer criteria.

The PE Film Critical Customer Documents that were used to evaluate the film innovation, are the product of a multi-industry consensus process to identify and address certain key technical considerations related to the recycling of postconsumer PE films. The Documents detail protocols to conduct specific testing per established testing procedures and then provide the simulator with guidance to interpret the results. The protocols are intended to help improve the quality of the recycled PE film stream by adding innovation to make informed decisions about the consequences of packaging innovations. APR thanks UBE for voluntarily submitting the film structure for Recognition. The impact of these protocols is beneficial to waste and recycling efforts. Meeting the Critical Customer Document is a fully significant step in demonstrating overall recyclability of your film innovation.

Our recognition applies only to the PE based multilayer film with enhanced mechanical and barrier properties confirmed by a PA6.6, 6 inner layer and the presence of PE based tie layers grafted with maleic anhydride (MAH). While the Recognition speaks to the compatibility of your innovation film, with PE film recycling, it does not speak to collection of film or include other films in the market that may conflict with the PE film recycling process. The Association of Plastic Recyclers is for sure in its packaging information that the public needs not understand that the Recognition applies to other barrier coatings or to better collection is happening when it is not.

Yours truly,
APR President and CEO

The Voice of Plastic Recycling

RecyClass
LIFE
RECYCLASS TECHNOLOGY APPROVAL
Brussels, 23 April 2022

DISCLOSES

RecyClass recognition applies only to UBE PERFORMANCE PA-SCF technology reported in Annex 1. Therefore, each user must be responsible of assessing of specific packaging using this film. Any specific packaging using this film must be tested individually to demonstrate that the system of new, adhesives, seal, closure and printing conforms to the RecyClass Recyclability Evaluation Protocol for PE film, and that it is tested in the PE flexible stream at the date of first printing starts in Europe. Publication of results of testing of this technology MUST clearly include all the conditions listed in the annexed letter. Periodic reporting of the conditions is submitted. Additionally, any change in the formulation of the technology must be communicated to the Technical Committee which will reassess the approval of the technology.

The RecyClass PE film Technical Committee was requested to carry out an assessment of the technology "PERFORMANCE PA-SCF" by UBE to verify its impact on the quality of recycled PE flexible packaging.

The technology is a LDPE based multilayer film with barrier properties confirmed by a polyamide inner layer. The PA 6.6/6 copolymer (UBE V10/20/20/40) composing the structure at 200µm is characterized by a low melting point and a low density. Its compatibility is ensured by 500µm LDPE based tie layers grafted with maleic anhydride (MAH). The film has been tested separately.

According to the results that were obtained from the laboratory test to kinetics, limited out as per the Recyclability Evaluation Protocol for PE film, the PERFORMANCE PA-SCF technology is considered to be tested compatible with PE flexible recycling.

Based on these results, RecyClass certifies that UBE PERFORMANCE PA-SCF technology have limited negative impact on the current European PE flexible recycling stream and that PE flexible film based on this technology are designed to comply with the following conditions:

at: The density of the PE film is below 0.97 g/cm³.

CERTIFICATE
Recyclability of a Packaging Material Group

BASF SE
Carl-Boehr-Strasse 38
67056 Ludwigshafen am Rhein, Germany

This company receives the certification of recyclability for the following packaging materials:

Designation
Co-Polyamide (PA6.6/6)
made from PA6.6 and PA6.6 monomers with melting points > 200°C
in combination with 0.5 g of adhesive per 1 g of PA; PE-X components; PVOC layers; other non-PE polymeric layers (excluding adhesives, promoters, adhesives, PP, EVA and EVOH), non-polymeric layers (excluding SiOx/AlOx metalizations).

Test result

Assessment criteria	Path 1: Plastic Waste - LDPE	Path 2: Plastic Waste - HDPE
Recyclability of the product	LDPE	HDPE
Recyclability of the product	LDPE	HDPE

According to the CEN standard for plastic material is to be contained in the better application and in the appropriate material presentation and/or as an extension of

Recycling Compatible for PE Film Recycling

This certificate (no. 2101-0201-0201-02) is valid until the 30/01/2023; your sign must be the outcome of a testing process.

The certificate is non-transferable in case of quality or qualitative changes of packaging components.

Author: 2022-01-02

**Stiftung
Zentrale Stelle
VERPACKUNGSREGISTER**

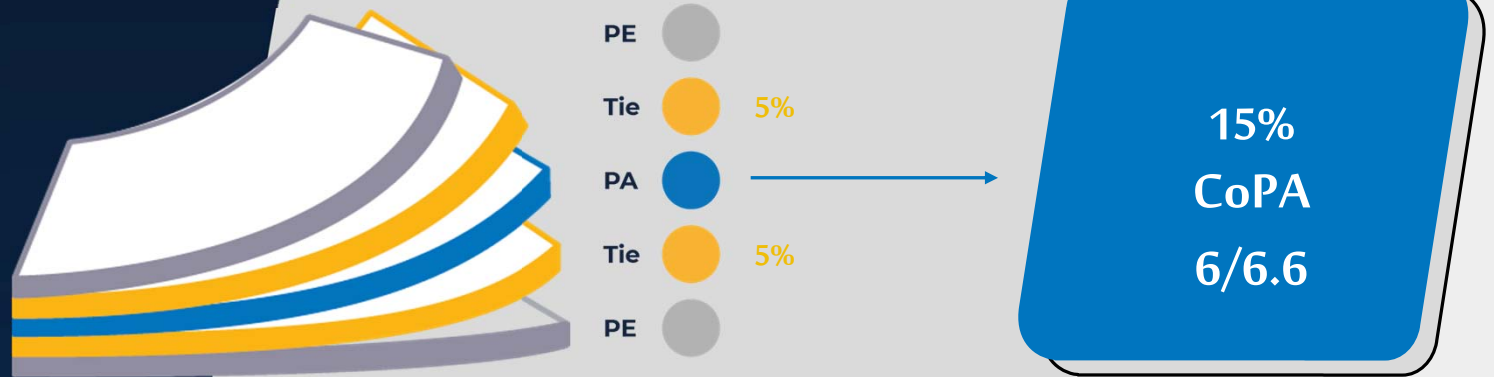
Film and LDPE

Fibre-based labels if the cellulose share cannot be removed by means of cold washing.
PA layers (including nylon 6 or co-polyamide 6-66 in coextruded PE/PA films without EVOH, combined with MAH-grafted PE as an adhesive promoter at a ratio of at least 0.5 g of adhesive per 1 g of PA); PE-X components; PVOC layers; other non-PE polymeric layers (excluding adhesives, promoters, adhesives, PP, EVA and EVOH), non-polymeric layers (excluding SiOx/AlOx metalizations).



RECYCLING STUDIES AT UBE R&D CENTER

REVOLUTIONARY PACKAGING: RECYCLABILITY &
PERFORMANCE

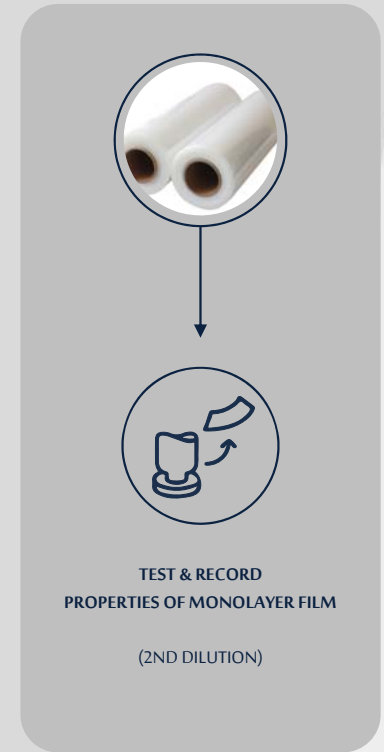
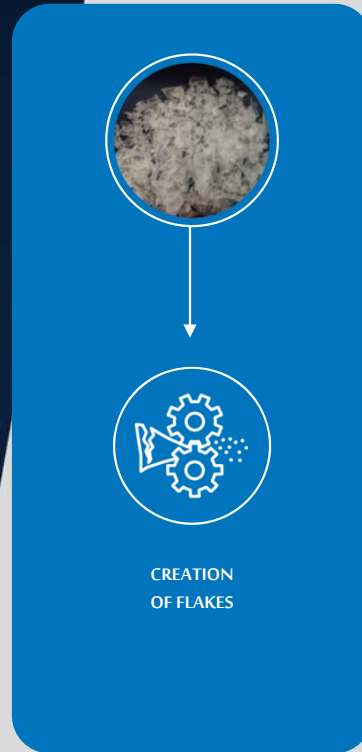




RECYCLING STUDIES AT UBE R&D CENTER



PE/PA film

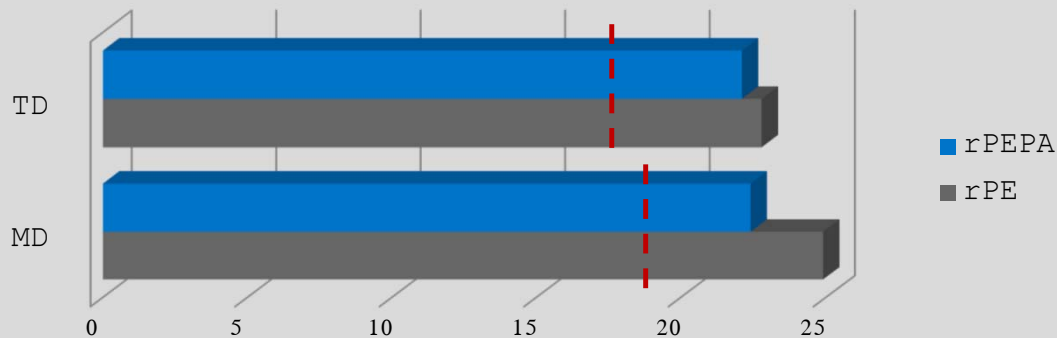


REVOLUTIONARY PACKAGING: RECYCLABILITY &
PERFORMANCE

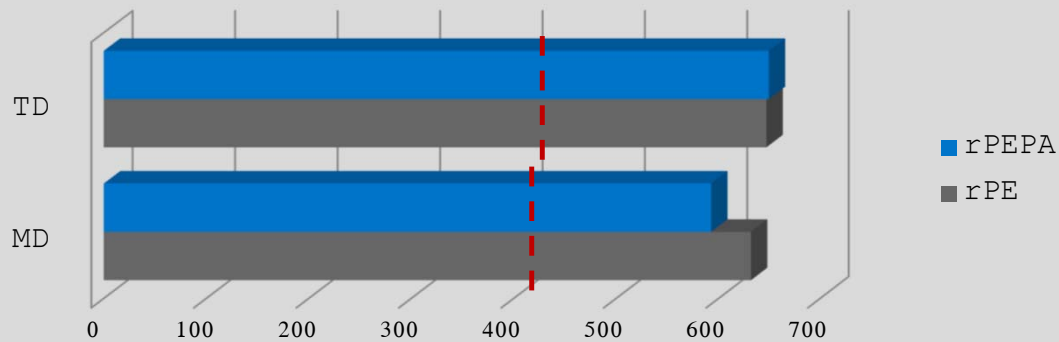
RECYCLING STUDIES

RESULTS

Stress at break (MPa)



Elongation at break (%)



--- Δ 25% to rPE (Control Film)

* Results obtained from 25 μ m monolayer film.

© 2023 Ube Corporation Europe. All rights reserved.

REVOLUTIONARY PACKAGING: RECYCLABILITY & PERFORMANCE

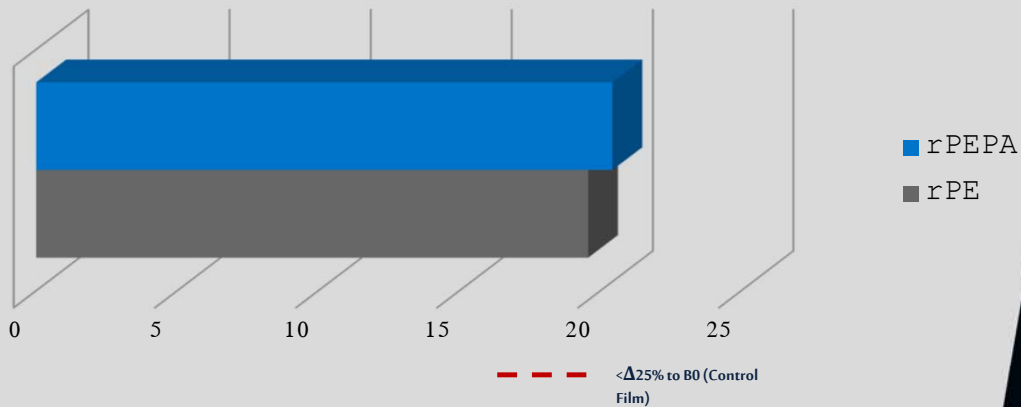
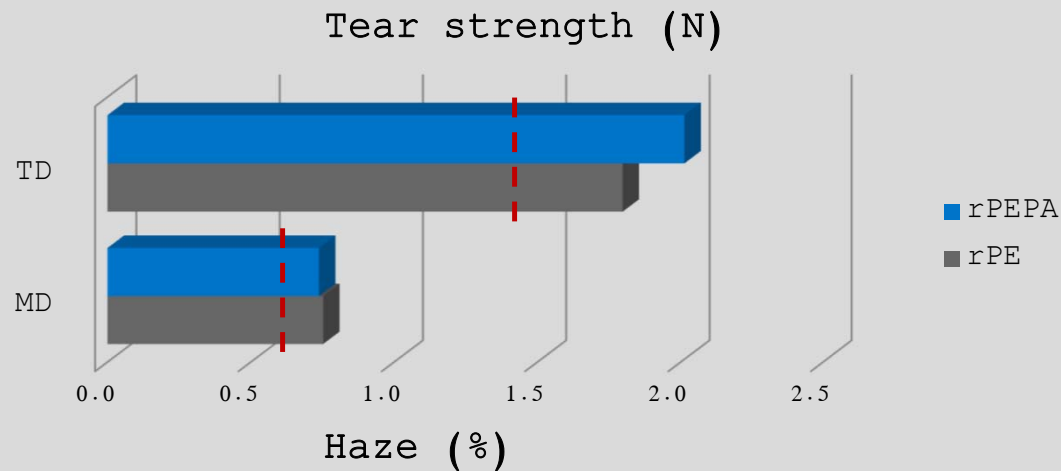


VERY STABLE EXTRUSION
AT PE TEMPERATURE
RANGE & PRESSURE
BELOW DELTA VALUES
REQUESTED



NO DRYING NEEDED,
PRESSURE
BELOW DELTA VALUES
REQUESTED & BUBBLE
VERY STABLE DURING
ALL PROCESS

RECYCLING STUDIES RESULTS



© 2023 Ube Corporation Europe. All rights reserved.

* Results obtained from 25 μm monolayer film.

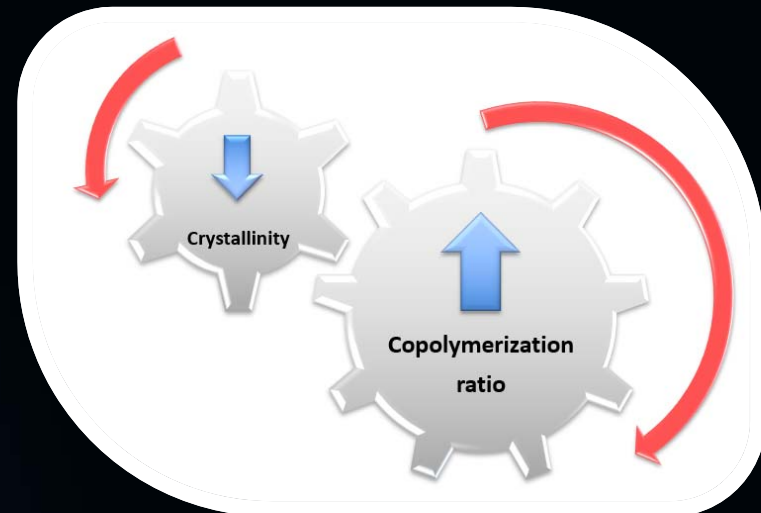
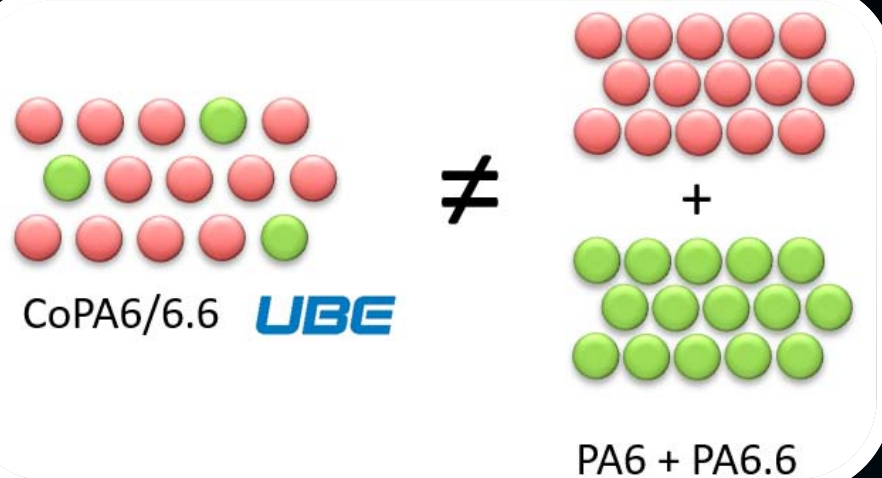
REVOLUTIONARY PACKAGING: RECYCLABILITY &
PERFORMANCE

ALL MECHANICAL
PROPERTIES OVER
THE LIMIT DELTA
VALUE REQUESTED

THE GUIDELINE
CONSIDERS THIS NEW
CoPA AS RECYCLABLE
& WAS CONFIRMED BY
THE TECHNICAL DATA

Nylon CoPA6/6.6

REVOLUTIONARY PACKAGING: RECYCLABILITY &
PERFORMANCE



- We specialize in polyamide copolymers.
- We offer polyamide copolymers with various copolymerization ratios.
- In 2023, introduced CoPA **5036B**;
*** a PA6/6.6 with copolymerization ratio of 30%.

IS CoPA RECYCLABLE?

REVOLUTIONARY PACKAGING: RECYCLABILITY & PERFORMANCE



PE-based multilayer film with enhanced mechanical and barrier properties conferred by a PA6/6.6 inner layer and the presence of PE-based tie layers grafted with maleic anhydride (MAH) meets APR Critical Guidance Criteria.



RecyClass

The technology is a LDPE-based multilayer film with barrier properties conferred by a polyamide inner layer. The PA 6/6.6 copolymer (UBE NYLON 5034B) composing the structure at 15%wt is characterized by a low melting point (<192°C) and a low stiffness. Its compatibility is ensured by 10%wt LLDPE-based tie layers grafted with maleic anhydride (MAH). The film has been tested unprinted.



Institut cyclos-HTP GmbH
Institut für Recycling und
Produktverantwortung

Co-Polyamide (PA6/6.6) made from PA6 and PA6.6 monomers with melting points < 200°C as layer in coextruded polyethylene films, based on LDPE and/or LLDPE;

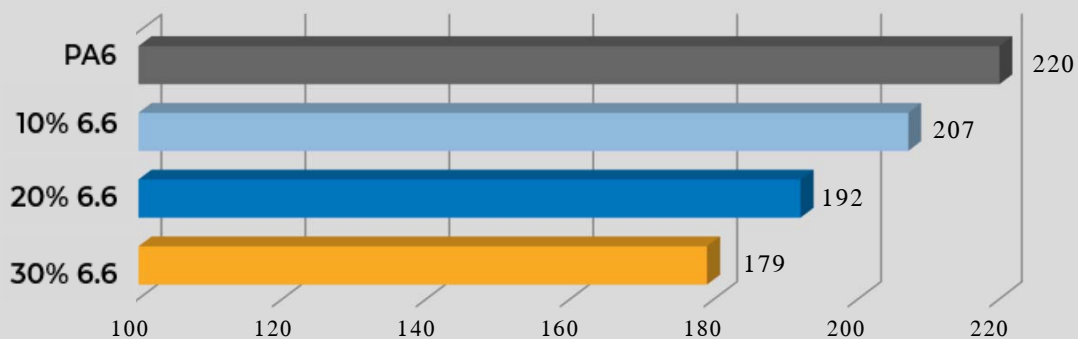
In combination with ≥0.5g per g PA of maleic anhydride-grafted PE as tie layer specified for PA/PE tested with ≤5% by weight of PA6 in a PCR LDPE recyclable.



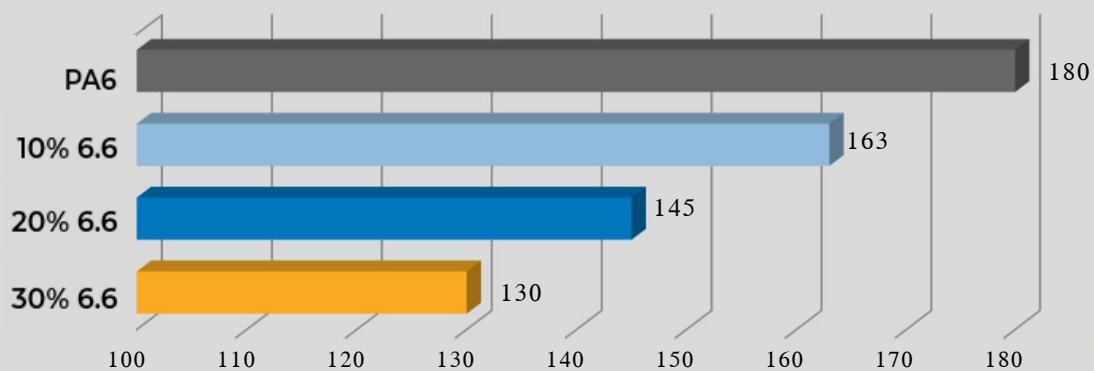
Co-polyamide 6/6.6 in coextruded PE/PA films without EVOH, combined with MAH-grafted PE as an adhesive promoter at a ratio of at least 0.5g of adhesive per 1g of PA.

THERMAL PROPERTIES

Melting Temperature (°C)



Crystallization Temperature (°C)



© 2023 Ube Corporation Europe. All rights reserved.

REVOLUTIONARY PACKAGING: RECYCLABILITY & PERFORMANCE

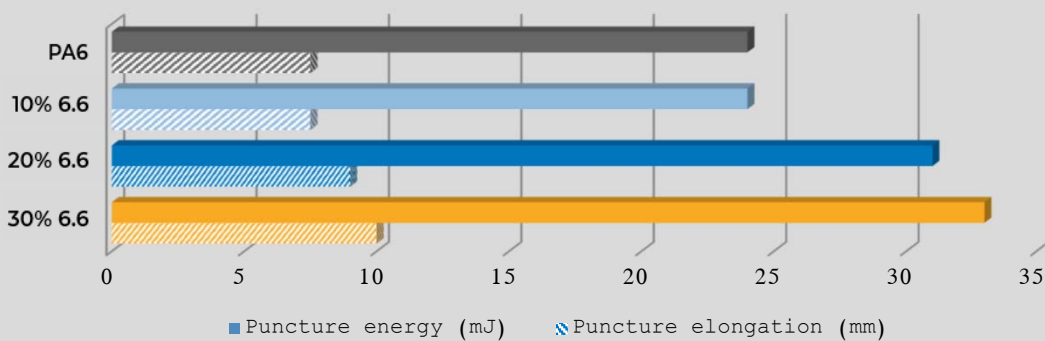


PA6

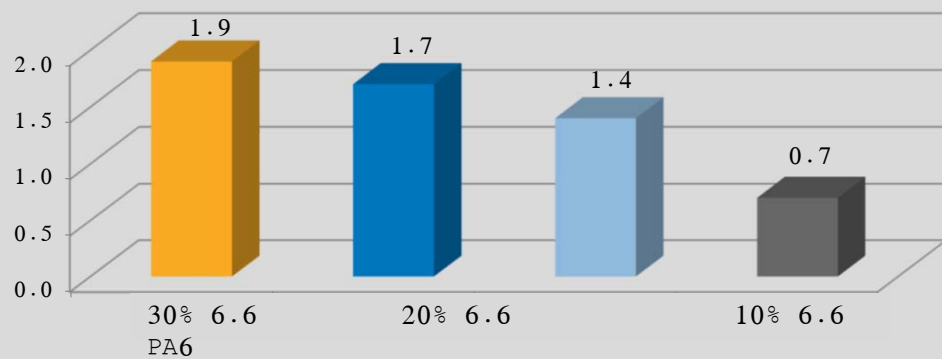
PA6/6.6

PUNCTURE & TEAR RESISTANCE

Puncture Resistance



Tear Resistance (N)

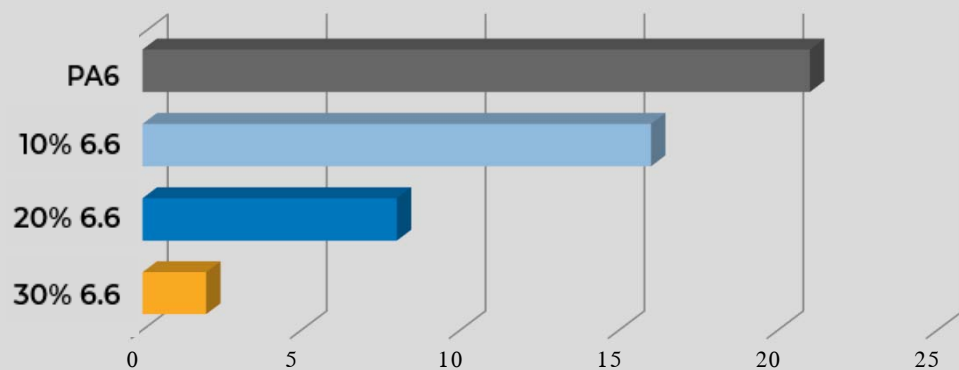


PA6/6.6

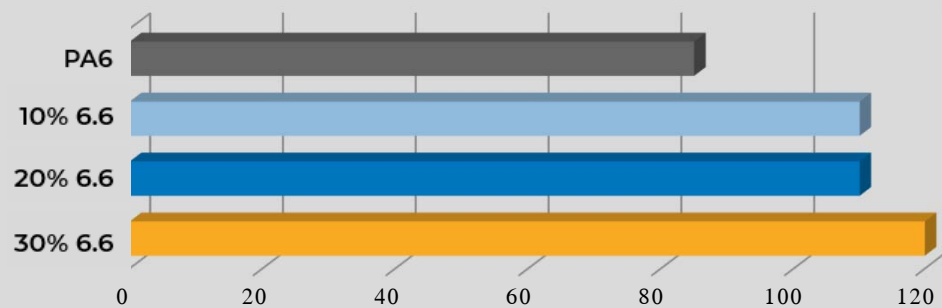
PA6

OPTICAL PROPERTIES

Haze (%)



Gloss (%)



© 2023 Ube Corporation Europe. All rights reserved.

* Results obtained from 50 μ m monolayer airblown film.

REVOLUTIONARY PACKAGING: RECYCLABILITY & PERFORMANCE



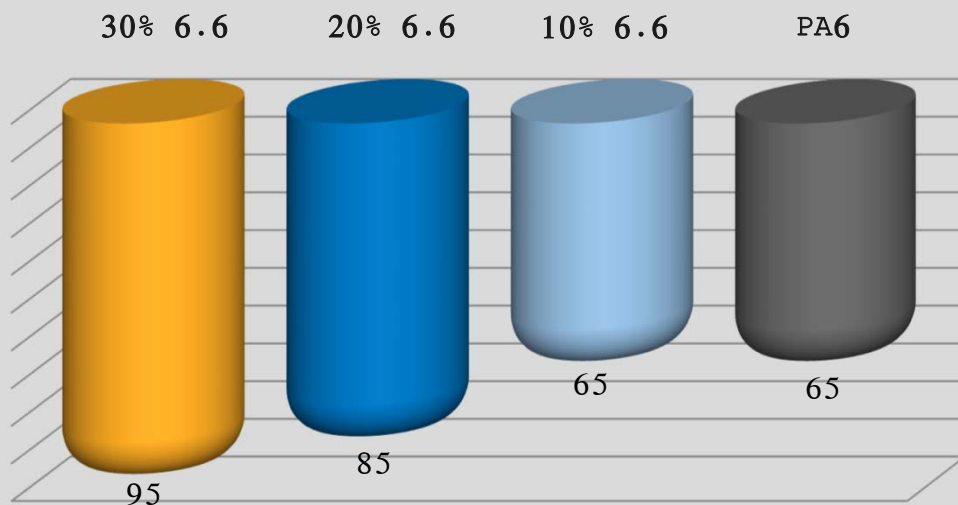
PA6/6.6

PA6



THERMOFORMABILITY

MAX. DEPTH



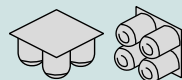
CONDITIONS

FILM

Process : Airblown
Structure : Monolayer
Thickness : 50µm
Tested dried as mold

MOLD

Ø : 91 mm
Depth : Adjusted until break



HEATING

Temp. : Adjusted to the optimal level for each grade
Time : 3s

REVOLUTIONARY PACKAGING: RECYCLABILITY & PERFORMANCE



PA6/6.6

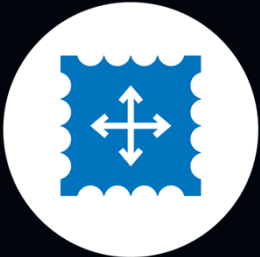
PA6

STRETCHABILITY

MAX. THERMAL SHRINKAGE

NYLON	Pre-heating temp (°C)	Max. stretching ratio	Annealing temp. (°C)	Max. Thermal shrinkage
PA6	90 °C	2.5 x 2.5 to 3.0 x 3.0	> 130 °C	25 – 30%
20% 6.6	90 °C	3.0 x 3.0	> 130 °C	35 – 40%
30% 6.6	90 °C	3.0 x 3.0 to 3.5 x 3.5	> 130 °C	45 – 50%

REVOLUTIONARY PACKAGING: RECYCLABILITY & PERFORMANCE



PA6/6.6

.....

PA6

RECYCLED PE/PA APPLICATIONS

REVOLUTIONARY PACKAGING: RECYCLABILITY &
PERFORMANCE

- **rPEPA resin**

- Origin : Post industrial multi-layer film
- Structure : PE / Tie / PA / Tie / PE
- PA thickness : 25% of total film thickness
- PA type : Mix of PA6 and CoPA6/6.6
- Color : Mix
- Recycling process : Mechanical recycling

- **New film : Co-extrusion, including rPEPA by**

- Total thickness : 75 μm
- rPEPA layers thick. : 65 μm (87% of total film thickness)
- Targeted app. : Substitution of PE film for the automotive industry

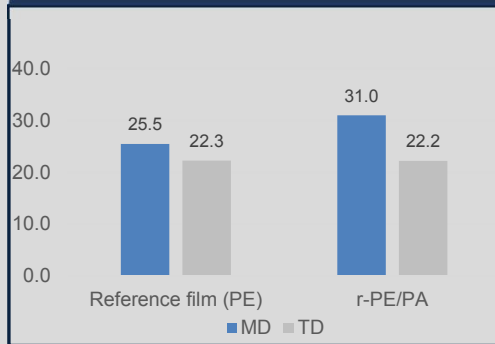


RECYCLED PE/PA APPLICATIONS

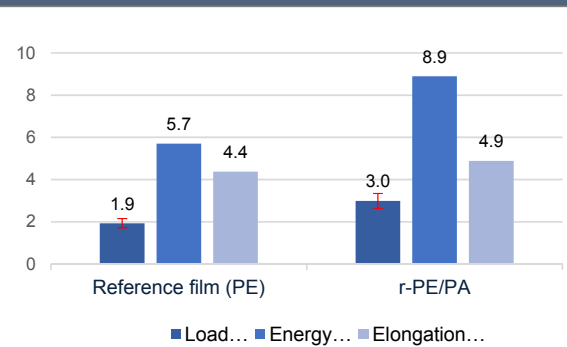


REVOLUTIONARY PACKAGING: RECYCLABILITY & PERFORMANCE

Strength at break (MPa)



Puncture



- LDPE (Welding Layer)
- rPEPA (Core Layer)

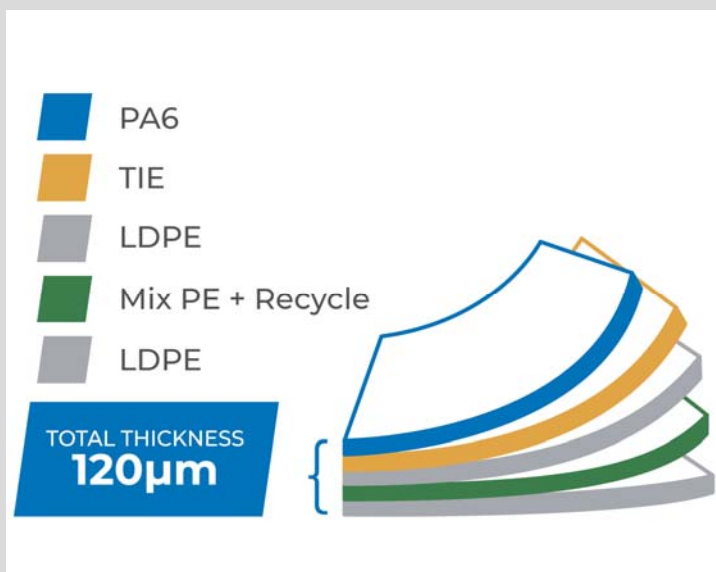
Flextech produced a film with 87% rPEPA. Extrusion ran very stable

rPEPA/PE Improved mechanical properties compared to original PE film

RECYCLED PE/PA APPLICATIONS

REVOLUTIONARY PACKAGING: RECYCLABILITY & PERFORMANCE

- Substituting PE layer with rPEPA
- Using rPEPA with 24% PA content



No issues reported during extrusion of this MLF utilizing rPEPA!

	PA6 (outer)	TIE	LDPE	Mix PE + rPEPA	LDPE (inner)
Thickness	20 µm	8 µm	16µm	60µm	16µm



- **Higher Performance**

- Puncture Resistance
- Tear Resistance
- Optical Properties
- Thermoformability
- Stretching
- Lower curling effect
- Better Processability
- Lower Melting Point



- **Recyclable Packaging**

- Proven recyclability
- Total thickness reduction
- Food waste reduction



- **New Applications**

- Very High Depth Thermoforming
- Sealable PA → PA Monomaterial Packaging
- Asymmetrical Structures → Lamination replacement



2024 FlexPack PLACE Conference

April 14-17, 2024 • San Diego, CA • Wyndham San Diego Bayside



REVOLUTIONARY PACKAGING
WITH

UBE NYLON