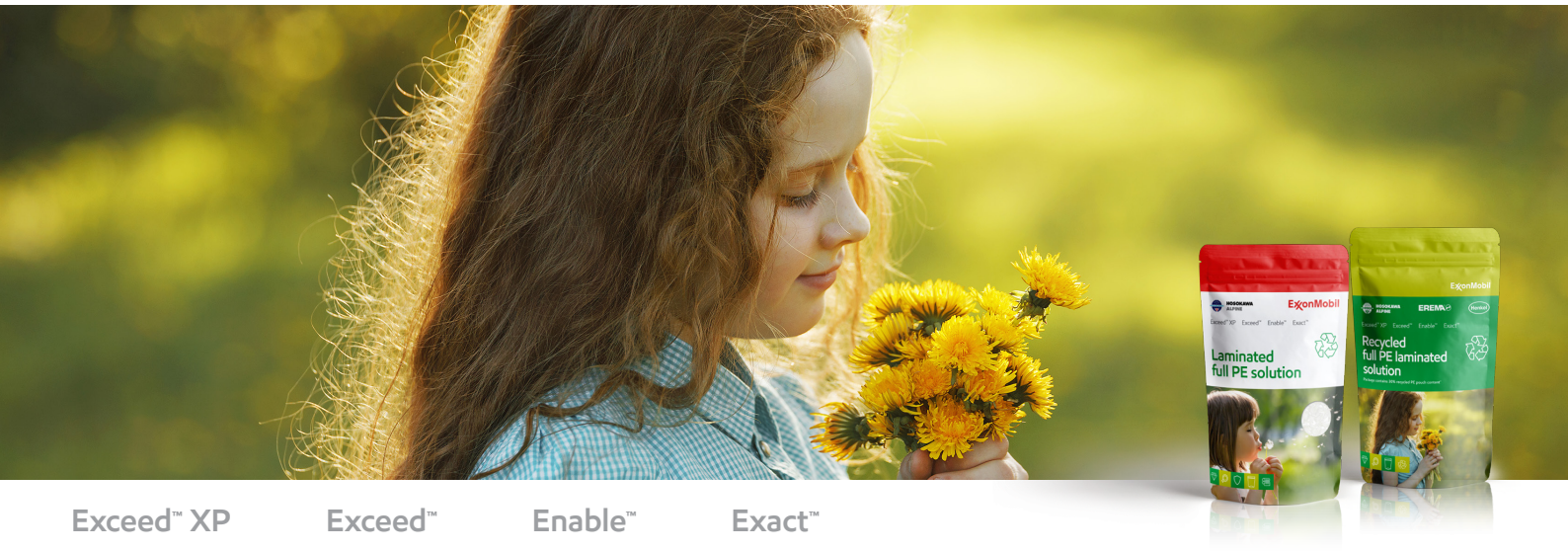
ExxonMobil
Signature Polymers

Case Study



Exceed™ XP Exceed™ Enable™ Exact™

Full PE pouches recycled* to create new pouches

Designed for recyclability

Uses up to 30% recycled PE pouch film

Maintains packaging integrity and optical properites

Challenge

Include recycled PE laminated stand-up pouches (SUPs) in new full PE SUPs

As part of its commitment to helping customers create sustainable solutions, ExxonMobil wanted to develop full polyethylene (PE) stand-up pouches (SUPs) that include recycled PE content from used PE pouches.

In creating a sustainable solution, the challenge was to ensure that the performance of the new SUPs that include recycled material was maintained. By doing so, materials can be kept in the value chain longer, helping to reduce waste.

- Create new full PE pouches from used full PE pouches
- Use up to 30% recycled PE pouch film
- Maintain packaging integrity and optical properties

Solution

Incorporates up to 30% recycled full PE SUP content and maintains packaging integrity and optical properties

A collaboration between **Hosokawa Alpine AG, EREMA Engineering Recycling Maschinen und Anlagen GmbH, Henkel AG & Co KGaA Company** and ExxonMobil has developed a solution that uses recycled full PE laminated SUPs to manufacture new full PE laminated SUPs.

PE pouches can be recycled into new pouches
Replacing conventional multi-material structures, full PE laminated SUPs can be easily recycled where programs and facilities to collect and recycle plastic films exist.

Placed in the PE sealant film layer, the recycled PE laminated SUP content is used in combination with **Exceed™ XP, Exceed™ and Enable™ performance PE polymers** to manufacture new SUPs, helping customers create sustainable solutions.

Pouches contain up to 30% recycled PE pouch film
Once the SUP packages have been used and collected, **INTAREMA® TVEplus® technology from EREMA Engineering Recycling** combines filtration, homogenization and degassing in a single, effective step. The result is high-quality recycled PE material that can be used in new laminated SUP packaging for non-food applications.

*Recyclable in communities that have programs in place to collect and recycle plastic film.

HOSOKAWA ALPINE EREMA Henkel

PE MDO film—optics/stiffness through high orientation processing

Fabricating full PE SUP films on **Hosokawa Alpine MDO film lines with TRIO technology** delivers enormous value. High orientation allows the film properties to be optimized to meet specific SUP requirements for optical (gloss and haze) and stiffness properties.

By stretching the films, which contain performance PE polymers (Table 1), on MDO lines with TRIO technology the mechanical and optical properties can be tailored to meet the needs of the application.

High oriented film performance can be achieved with orientation ratios of less than five, compared to six, which is often needed to deliver good optics with other leading polymers. Achieving good optics at lower stretch rates can help reduce film breakage and enhance efficiencies. It can also help reduce energy use.

Exceed™ XP, Exceed™ and Enable™ performance PE polymers deliver PE MDO films with excellent performance by providing: (Figure 1).

- Optics—similar haze properties to BOPET/BOPA and sufficient gloss
- Stiffness properties—comparable to BOPET/BOPA
- Elongation resistance during printing—flexo and rotogravure

PE Sealant film

The PE MDO film was laminated to a PE sealant film (Figure 2). The PE sealant film can contain 100% virgin performance PE polymers (Cycle 1—Table 2) or it can include recycled PE in the core (Cycle 2—Table 2)

Solvent-free adhesive lamination

Loctite® Liofol solvent-free adhesives from **Henkel's** newly introduced RE product range are "designed for recycling." These adhesives contribute to the success of full PE SUP films by offering a set of features allowing homogenous laminates to be recycled mechanically with excellent results. This is achieved at efficient machine speed with optimal ink compatibility for high-quality printing, high initial tack and room temperature curing.

Results

Maintains packaging integrity and optical properties

New full PE laminated SUP packages that use up to 30% recycled PE in the full laminated film structure offer comparable package integrity and optical performance to conventional SUPs. The recycled PE is placed in the sealant layer.

These recycled pouches are well-suited for non-food applications, such as detergents, dishwasher tabs and so on. Using Exceed XP performance PE polymers, the properties are maintained even though up to 30% recycled PE is used in the laminated structure (Figure 3), helping customers deliver sustainable solutions.

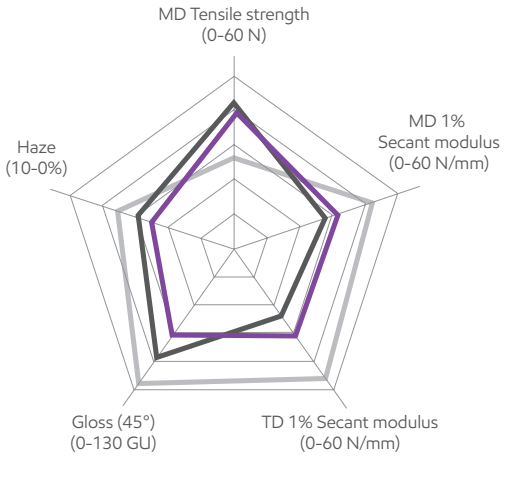
Exceed XP, Exceed and Enable, and Exact plastomers in full PE laminated SUPs provide comparable performance to film structures containing BOPET/BOPA/BOPP (Figure 3) by delivering:

- **Toughness/stiffness balance**—damage resistant, ability to stand upright
- **Sealing performance**—packaging integrity, which can results in less waste
- **Optical properties**—glossy shelf appeal, brand visibility

Table 1: PE Machine direction orientation (MDO) film formulation

PE MDO film 25 µm 1/1/2/1/1—MDO ratio 4.8	
Printed skin	Enable 4002 + Exceed XP 8656
Sub-skin	ExxonMobil HDPE
Core	Exceed XP 8656
Sub-skin	ExxonMobil HDPE
Outer skin	Enable 4002 + ExxonMobil HDPE

Figure 1: PE Machine direction orientation (MDO) film vs. other films; 12 µm BOPET and 15 µm BOPA films



All data from tests performed by or on behalf of ExxonMobil.

Figure 2: Machine direction orientation (MDO) blown process to replace BOPET/BOPET/BOPP film to highly oriented PE film with outstanding gloss, haze and stiffness properties

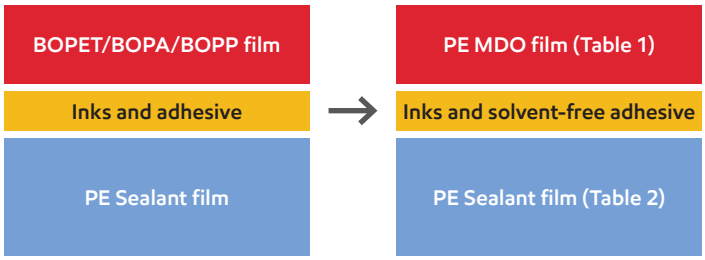
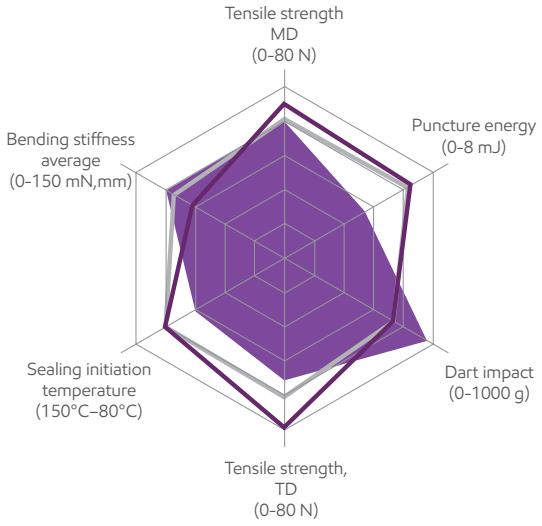


Table 2: PE Sealant film using performance PE polymers and recycled PE

	Cycle 1: 100% virgin PE 120 µm —1/1/2/1/1	Cycle 2: Contains PE recycled content 120 µm—1/1/3/1/1
Co-extrusion layer ratio	1/1/2/1/1 120 µm	1/1/3/1/1 120 µm
Sealant	Exceed 2012 or Exact plastomer	Exceed 2012 or Exact plastomer
Sub-skin	Enable 4009	Enable 4009 + white MB
Core	Exceed XP 8784 + ExxonMobil HDPE	80% PE recycled content + Exceed XP 8784
Sub-skin	Enable 4009	Enable 4009 + white MB
Lamination	Exceed XP 8784	Exceed XP 8784

Figure 3: Comparison of full PE laminated stand-up pouches, SUP with 100% virgin PE and SUP with 30% recycled PE, with conventionally laminated SUP (12 µm BOPET laminated with 120 µm PE)



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PE Product portfolio—create laminated SUPs

Grade name	Density (g/cm³)	Melt index (g/10 min)	MDO layer	Sealant layer
Exceed XP 8656 series	0.916	0.50	•	
Exceed XP 8784 series	0.914	0.80	•	•
Exceed 2012 series	0.912	2.00		•
Enable 4009 MC	0.940	0.90		•
Enable 4002 MC	0.940	0.20	•	
ExxonMobil HDPE HTA 108	0.961	0.70	•	•
ExxonMobil HDPE 7845.30	0.958	0.45	•	•

Contact us for more information: **exxonmobilchemical.com/SUP**

ExxonMobil Signature Polymers

Bring your impossible

E0919-124E49

What's new: ExxonMobil Signature Polymers

All our polymers are now positioned under a single portfolio brand: Signature Polymers. The aim is to simplify our product architecture and naming to improve portfolio navigation for you. We would like to stress that our commitment to high-quality products remains the same. The composition of the products are unchanged, it is only the names that updated. We will be making these modifications over the next few months, through mid 2025, so you will see both old and new grade names highlighted during that time.

Here's a quick overview of brands and grade names that will be changed in this document:

Legacy Commercial Name	New Commercial Name
Enable™ 4002	Exceed™ Stiff+ m 0238
Exceed™ XP 8656	Exceed™ Tough+ m 0516
Exceed™ 2012	Exxtra™ Seal m 2012
Enable 4009	Exceed™ Flow+ m 0938
Exceed XP 8784	Exceed Tough+ m 0814
Enable 4002 MC	Exceed Stiff+ m 0238.MC
ExxonMobil™ HDPE HTA 108	ExxonMobil™ HD 6107FL
ExxonMobil HDPE 7845.30	ExxonMobil HD 5805

Want to see what's changed in our portfolio? Go to **exxonmobilchemical.com/sptransform**