ExxonMobil
Signature Polymers

Factsheet

Exceed™Tough+ Exceed™Flow Exceed™Flow+ Exceed™Stiff+ Exxtra™Seal

De-inkable, recyclable* mono-material polyethylene pouch with barrier properties

Recyclable* | De-inkable | Outstanding oxygen barrier | High package integrity & tremendous optics

Data and results presented herein apply specifically to the noted application under this fact sheet.
Your results may differ depending on factors such as operating conditions, equipment and materials used.

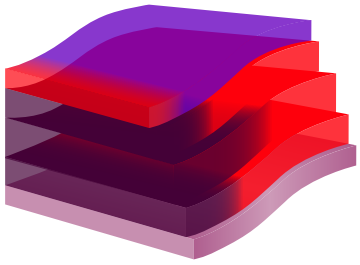
Discover how five companies collaborated using their latest technology to create high-performing, easier-to-recycle packaging that can be de-laminated and de-inked.

MDO-PE film

Using Exceed™ Tough+, Exceed™ Stiff+, and Exceed™ Flow performance PE

Thickness: 25µm

- Exceed™ Tough+ m 0516.ML
- Exceed™ Stiff+ m 0238.MC
- Exceed™ Flow m 0527.MC
- ExxonMobil HDPE

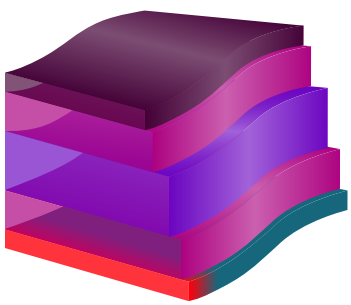


PE sealant film

Using Exceed Tough+, Exceed Flow+, and Exceed Stiff+ performance PE with Exxtra™ Seal plastomers

Thickness: 120µm

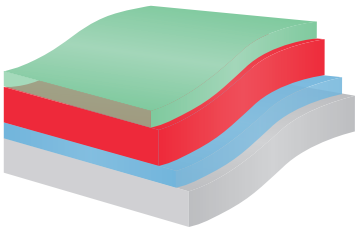
- Exceed™ Tough+ m 0814.ML
- Exceed™ Flow+ m 0938.MC
- Exceed™ Stiff+ m 0926.ML
- Exxtra™ Seal POP 2008.MK
- ExxonMobil™ LDPE



Primers & coatings

Basis weight: 6gsm

- CIRKIT® ClearPrime (WB or SB)
- White/colored ink
- LOCTITE® LIOFOL BC 1582 RE or CIRKIT® OxyBar BC 1582
- LOCTITE® LIOFOL LA 7102 RE/LA 6902 RE



* The terms "recyclable" and "recyclability" as used throughout this case study are intended to refer to the potential for recyclability of full PE solutions designed and manufactured in accordance with recycling guidelines such as PRE RecyClass. Ultimate recyclability of full PE packaging will depend on a number of factors outside the control of W&H/ExxonMobil/Henkel/Siegwerk/Kraus, including, but not limited to, availability of programs and facilities that collect and recycle plastic packaging within a given community. Any and all claims about the recyclability of full PE-packaging are the sole responsibility of the packaging manufacturer.

Henkel WINDMÖLLER & HÖLSCHER KRAUS FOLIE SIEGWERK

Solution

Creating the pouch

In a breakthrough development, easier-to-recycle* mono-material PE pouch has been created that has similar properties to more difficult to recycle laminated pouches. The new pouch utilizes the latest polymers, inks, functional coatings, adhesives and conversion technology and is the outcome of a unique value chain collaboration of ExxonMobil, Henkel, Kraus Folie, Siegwerk and Windmöller & Hölscher. The innovation allows for pouches that can provide a high oxygen barrier, outstanding package integrity, excellent shelf appeal, and can produce an almost colorless recyclate (see picture 1) after the removal of printing ink and the oxygen-barrier coating layer.

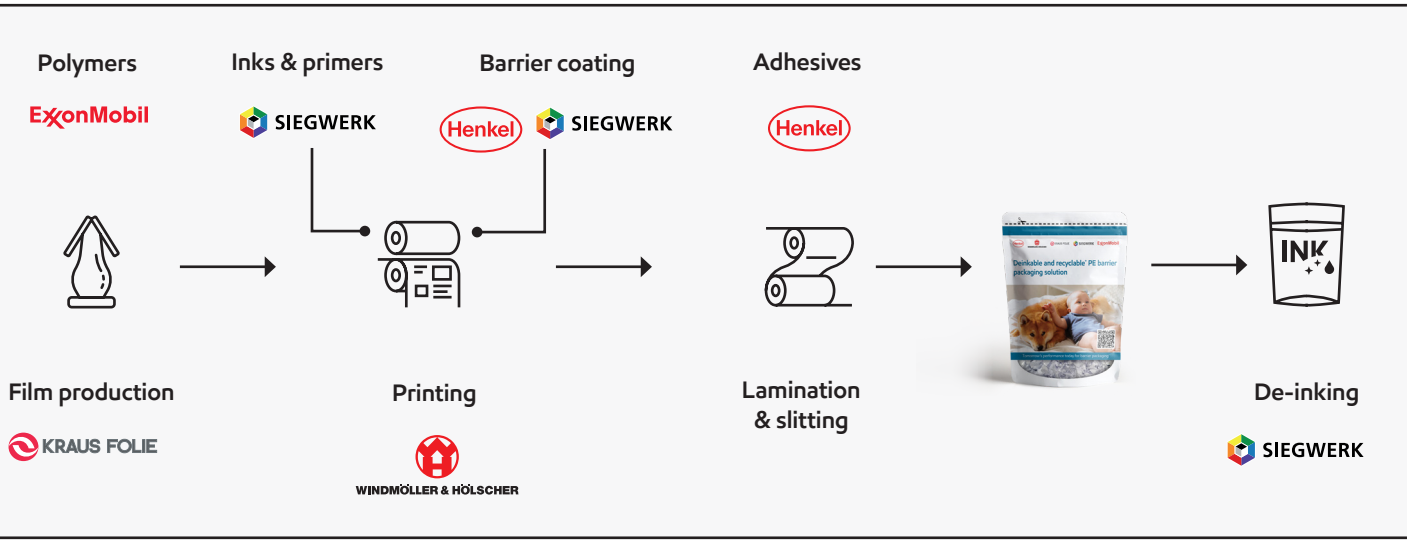
The blown film was produced by Kraus Folie with ExxonMobil resins and produced on a W&H VAREX extrusion line with inline MDO (Machine Direction Orientation) unit.

In order to help achieve outstanding packaging integrity ExxonMobil's latest generation of performance materials were used, including Exceed™ Stiff+, Exceed™ Tough+, and Exceed™ Flow+ performance PEs, Exxtra™ Seal plastomers, and ExxonMobil™ metallocene polyethylene.

De-inking primer, print image and barrier coating were applied in one step using a W&H MIRAFLEX, a flexo printing press with a downstream unit. Two types of deinking primers were used–a solvent-based (SB) and a water-based (WB) primer from Siegwerk´s CIRKIT® ClearPrime product range. Either SB or WB primers can be used depending on the application and provide comparable delamination and de-inking results by applying industrial hot-washing conditions. Both can result in an almost colorless recyclate (see picture 1).

The barrier coating material used is available from Henkel as LOCTITE® LIOFOL BC 1582 and from Siegwerk as CIRKIT® OxyBar BC 1582. The barrier coating can be applied on both flexo and gravure presses at industrial machine speeds on various substrates, offering excellent transparency. Its compatibility with recycling has been confirmed by Cyclos-HTP.

The resulting films were then laminated using Henkel's new solvent-free, two-component polyurethane laminating adhesive, LOCTITE® LIOFOL LA 7102 RE/LA 6902 RE. The system has been designed for monomaterial structures and has been recognized as meeting the RecyClass recycling guideline.



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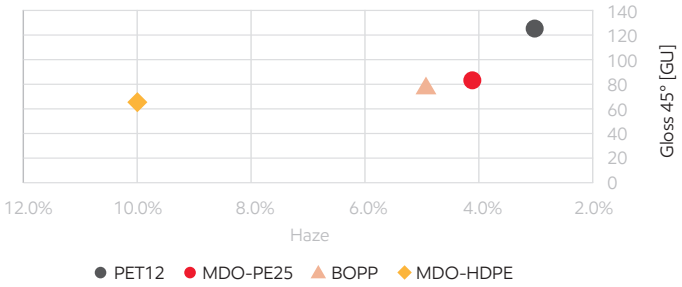
Result

Shelf Appeal

High primer transparency combined with consistent print quality and the inherent gloss of the ExxonMobil PE-based MDO film can help to deliver excellent shelf appeal of the final pouch. Graph 1 shows the MDO substrate has outstanding gloss (83 GU) and low haze (~4%), rivaling the best-in-class PET substrate.

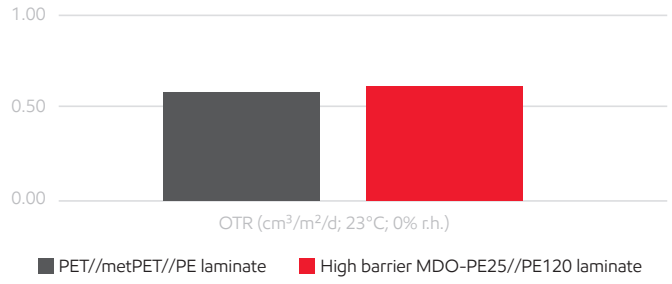
Graph 1—MDO substrate optical properties



Barrier properties

This pouch incorporates barrier coating material LOCTITE® LIOFOL BC 1582 RE/CIRKIT® OxyBar BC 1582, which can be applied on both flexo and gravure presses at industrial machine speeds on various substrates. The coating allows production of a very high PE content (~96) pouch while still providing low Oxygen Transmission Rate (OTR) of 0.58 cc/sqm/d; comparable to multi-material structures, as can be seen in Graph 2.

Graph 2—Oxygen barrier**

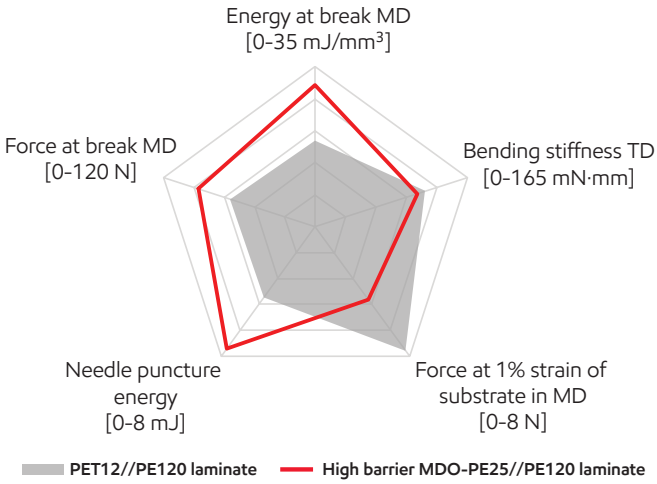


**All barrier values are to be considered as indicative as they may strongly depend on various parameters and test conditions.

Mechanical properties

This pouch incorporates the latest metallocene polyethylene resin, Exceed™ Stiff+, to help deliver outstanding package integrity–resulting in improvements of 70% in needle puncture energy and 37% in force at break versus comparable multi-material alternatives, while keeping comparable bending stiffness to maintain stand-up ability. These results are quantified in Graph 3.

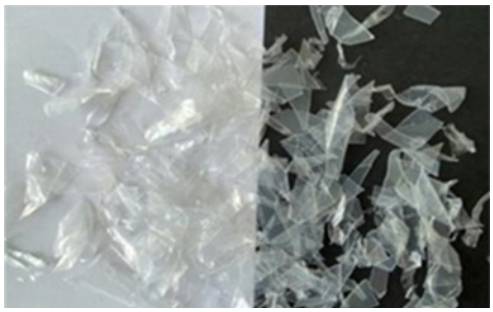
Graph 3—Mechanical properties



Delaminating and deinking properties

After delamination and removal of the printing ink and coating from the laminate structure, a nearly colorless recyclate (see picture 1) can be produced. The below visual provides an overview of the deinking process.

Picture 1—Almost colorless recyclate



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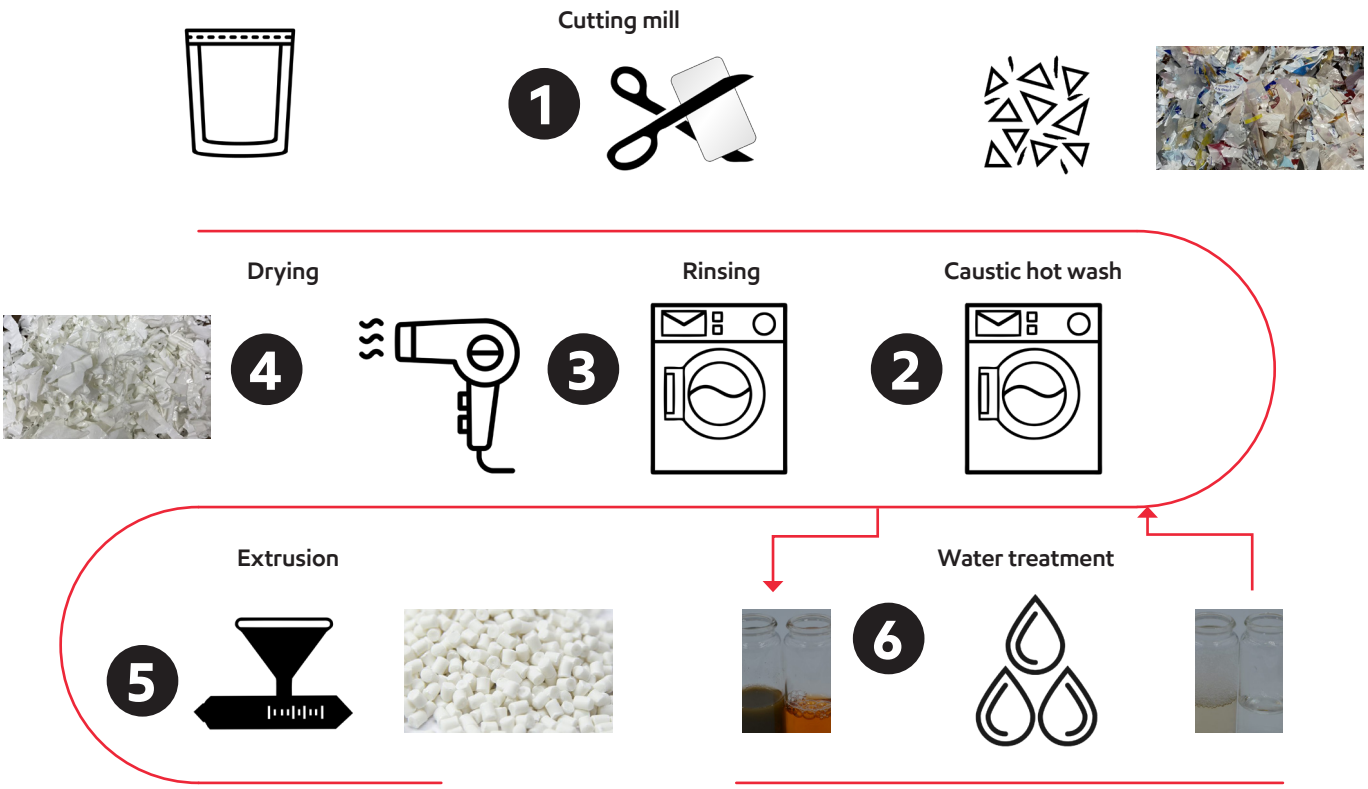
De-inking of printed plastic packaging



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Test item	Test method
Oxygen transmission rate (OTR)	Henkel test method
Water-vapor transmission rate (WVTR)	Henkel test method
Tensile properties on film at room temperature	ExxonMobil test method
Puncture-needle test	ExxonMobil test method
Bending stiffness	ExxonMobil test method
Haze	Based on ASTM D-1003-13
Gloss 45°	ExxonMobil test method

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ExxonMobil Signature Polymers

Bring your impossible

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, it is the names that change. Everything else remains the same. We will be making these modifications over the next six months 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 have changed in this document:

Legacy Commercial Name	New Commercial Name
Exceed™ XP 8656ML	Exceed™ Tough+ m 0516.ML
Enable™ 4002MC	Exceed™ Stiff+ m 0238.MC
Enable 2705MC	Exceed™ Flow m 0527.MC
Exceed XP 8784ML	Exceed Tough+ m 0814.ML
Enable 4009MC	Exceed™ Flow+ m 0938.MC
Exceed S 9243ML	Exceed Stiff+ m 0926.ML
Exact™ 3237	Exxtra™ Seal POP 2008.MK

Some of our existing Exceed, Achieve, Paxon and premium PP/HD grades have moved to Exceed brand; most existing Enable grades have moved to Exceed Flow[+]; most of our existing Exceed XP grades have moved to Exceed Tough[+]; most of our existing Exceed S grades have moved to Exceed Stiff[+]. More details here **https://www.exxonmobilchemical.com/en/brands/signature-polymers/exceed_high_performance_polymers** or contact your ExxonMobil representative to know more.

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