



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

<p>Recyclable*</p>	<p>De-inkable</p>	<p>Outstanding oxygen barrier</p>	<p>High package integrity & tremendous optics</p>
--------------------	-------------------	-----------------------------------	---

Concerned about not being able to print your packaging in 2030 over recyclability concerns? Discover how 5 companies collaborated using their latest technology to create high performing, recyclable packaging that can be de-laminated and de-inked.



MDO-PE film

Thickness: 25µm

- Exceed XP 8656ML
- Enable 4002MC
- Enable 2705MC
- ExxonMobil HDPE

PE sealant film

Thickness: 120µm

- Exceed XP 8784ML
- Enable 4009MC
- Exceed S 9243ML
- Exact 3237
- 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 / 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 of the partners' (W&H / ExxonMobil / Henkel / Siegwerk / Kraus) control 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.

Solution:

Creating the pouch:

In a breakthrough development, a fully recyclable* 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, Siegwirk and Windmüller & 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 unit.

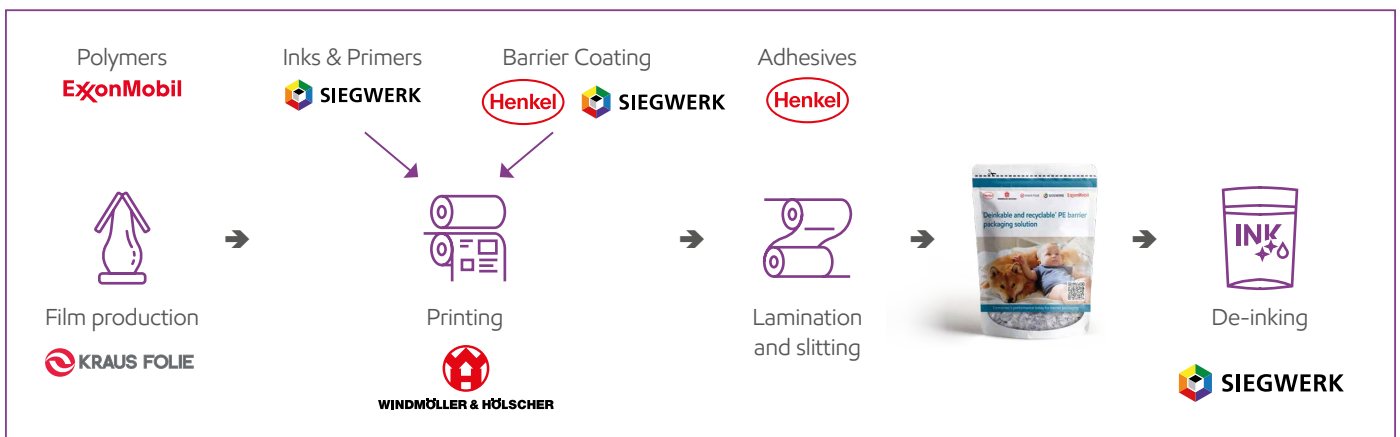
In order to help achieve outstanding packaging integrity ExxonMobil's latest generation of performance polyethylene such as Exceed™ S, Exceed™ XP, Exact™, Enable™ and HDPE materials were used.

Deinking primer, print image and barrier coating were applied in one step using a W&H MIRAFLEX™, a flexo printing press with a downstream unit.

2 types of deinking primers were used – a solvent-based (SB) and a water-based (WB) primer from Siegwirk'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 Siegwirk 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, 2-component polyurethane laminating adhesive, LOCTITE® LIOFOL LA 7102 RE / 6902 RE. The system has been designed for mono-material structures and has been recognized as meeting the RecyClass recycling guideline.



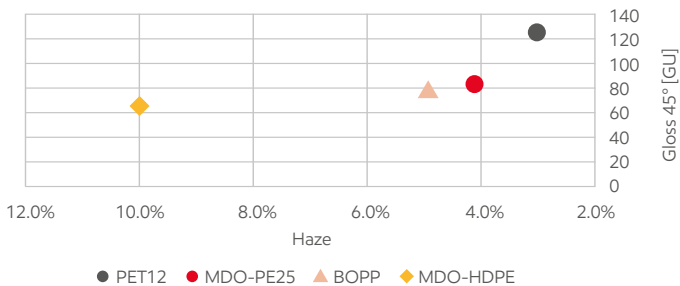
*The terms "recyclable" and "recyclability" as used throughout this case study are intended to refer to the potential for recyclability of full PE solutions designed and manufactured in accordance with recycling guidelines such as PRE RecyClass. Ultimate recyclability of full PE packaging will depend on a number of factors outside of the partners' (W&H / ExxonMobil / Henkel / Siegwirk / Kraus) control 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.

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) & low haze (~4%), rivaling the best-in-class PET substrate.

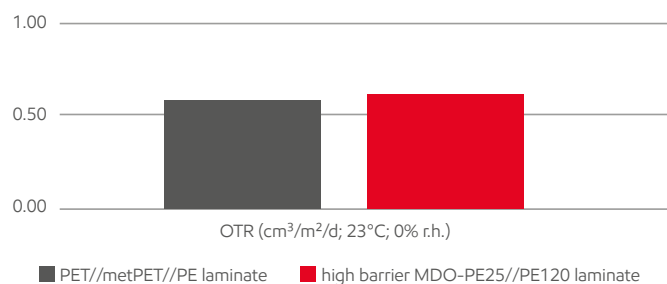
Graph 1 - MDO Substrate Optical properties



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*



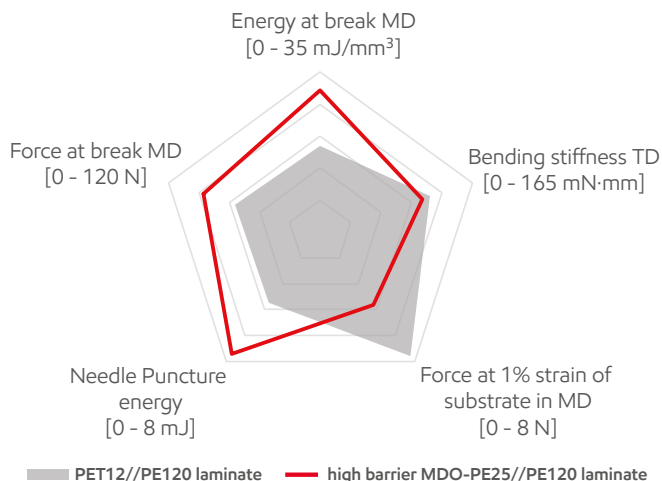
*All barrier values are to be considered as indicative as they may strongly depend on various parameters and test conditions.

Mechanical properties:

This pouch incorporates the latest performance

polyethylene resin, Exceed™ S, 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 & deinking properties:

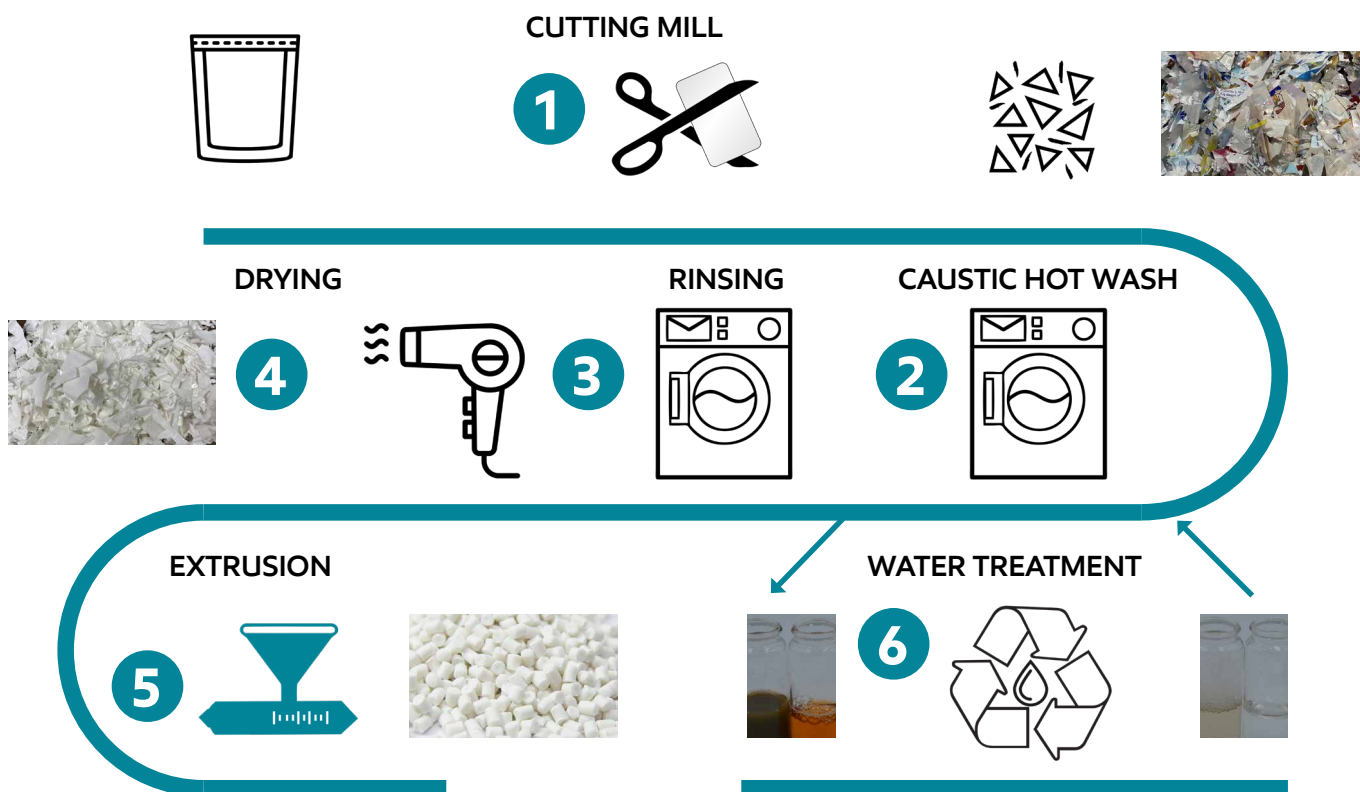
After delamination and removal of the printing ink and coating from the laminate structure, a nearly colorless recyclate (see picture 1) can be produced. The below visual provides an overview of the deinking process.

Picture 1 - Almost colorless recyclate



*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 of the partners' (W&H / ExxonMobil / Henkel / Siegwirk / Kraus) control 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.

DEINKING OF PRINTED PLASTIC PACKAGING



*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 of the partners' (W&H / ExxonMobil / Henkel / Siegwerk / Kraus) control 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.

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

Why ExxonMobil PE? Why today?

tomorrow's
performance
today

What some might view as solutions that will only happen in the future, ExxonMobil PE is making possible today – through our innovative and reliable products, collaborative approach, technology leadership and support, and our unmatched global supply and resources. Learn more about how we're helping our customers create solutions with potential sustainability benefits. Why wait for tomorrow to advance your business today? Contact your ExxonMobil PE representative and begin experiencing tomorrow's performance today in flexible packaging.

© 2023 ExxonMobil. ExxonMobil, the ExxonMobil logo, the interlocking "X" device and other product or service names used herein are trademarks of ExxonMobil, unless indicated otherwise. This document may not be distributed, displayed, copied or altered without ExxonMobil's prior written authorization. To the extent ExxonMobil authorizes distributing, displaying and/or copying of this document, the user may do so only if the document is unaltered and complete, including all of its headers, footers, disclaimers and other information. You may not copy this document to or reproduce it in whole or in part on a website. ExxonMobil does not guarantee the typical (or other) values. Any data included herein is based upon analysis of representative samples and not the actual product shipped. The information in this document relates only to the named product or materials when not in combination with any other product or materials. We based the information on data believed to be reliable on the date compiled, but we do not represent, warrant, or otherwise guarantee, expressly or impliedly, the merchantability, fitness for a particular purpose, freedom from patent infringement, suitability, accuracy, reliability, or completeness of this information or the products, materials or processes described. The user is solely responsible for all determinations regarding any use of material or product and any process in its territories of interest. We expressly disclaim liability for any loss, damage or injury directly or indirectly suffered or incurred as a result of or related to anyone using or relying on any of the information in this document. This document is not an endorsement of any non-ExxonMobil product or process, and we expressly disclaim any contrary implication. The terms "we," "our," "ExxonMobil Product Solutions" and "ExxonMobil" are each used for convenience, and may include any one or more of ExxonMobil Product Solutions Company, Exxon Mobil Corporation, or any affiliate either directly or indirectly stewarded.

Contact us for more information:
exxonmobilchemical.com/pe

ExxonMobil