Recycling collation shrink film

Collation shrink films may no longer need to be designated as single-use plastics, say three companies that have successfully innovated a solution for mechanical recycling of shrink films containing 50% recycled material content.

Some collation shrink films may no longer need to be designated as single-use plastics, thanks to an innovative solution that may help enable them to be mechanically recycled multiple times without compromising their performance.

The solution, enabling collation shrink films that incorporate 50% recycled content, has passed "proof of concept", meaning the films met required performance parameters after three months of testing in a tripartite collaboration involving materials firm **ExxonMobil**, Malaysian processor **Thong Guan Industries Berhad** and Malaysian test centre**, Newton Research and Development Centre**.

"Shrink films play a critical role in keeping food and drinks safe to consume, but are typically discarded after use. This is due to the lack of collection and sorting amenities and perceived processing challenges posed by recycled plastics," shares Chan Kwee Lin, ExxonMobil's Asia Pacific Advance Recycling and Sustainability Market Manager.

"ExxonMobil is developing solutions to improve the recyclability of these essential films. We hope this will change the mindset of the industry, encourage more companies to extract value and extend the use of shrink films not once, but repeatedly, therefore potentially reducing a source of plastic waste in the world," he adds.

The tripartite collaboration was initiated by Thong Guan, a leading packaging film manufacturer in Malaysia and Southeast Asia. Its senior general manager, David Ang, explains the project's origin: "The primary value we see in using recycled shrink films is that it can contribute to less materials being sent to landfills. Alongside the potential recyclability of polyethylene (PE) shrink film, it is an excellent opportunity to help support our vision of closing the plastic loop. Our primary mission, leveraging the results of this project, is to demonstrate that we can still retain quality performance in shrink films by incorporating post-consumer recycled (PCR) content. This, in turn, supports our company's effort to promote plastic circularity."

The incorporation of recycled content (especially PCR) in collation shrink films, however, can lead to challenges.

When producing collation-shrink films from mechanically recycled PE, there are three stages where the raw material is subject to heat exposure: film production, shrink tunnel operations and film re-pelleting for recycling.

Each of these exposures to high heat and shear rate can lead to polymer chain degradation and the lowering of mechanical performance.

If one were to continually collect, sort, and recycle the same collation shrink film, it would mean that the same recycle stream would be going through these heat exposures again and again, adding further

ExxonMobil's blown film testing at its Shanghai Technology Centre in China

Typical heat exposure through a collation shrink film's production, usage and recycling

Typical film production
Film converter
- Ext temp: 160-200 degrees C
- Residence time: 5-20 mins

(May need to consider re-feed of trim)

Typical shrink tunnel
Brand owner/bottler
- Shrink temp: 160-200 degrees C
- Residence time: 15-30 secs

Typical film re-pelleting
Recycler/film converter
- Shrink temp: 200-220 degrees C
- Residence time: 5 mins

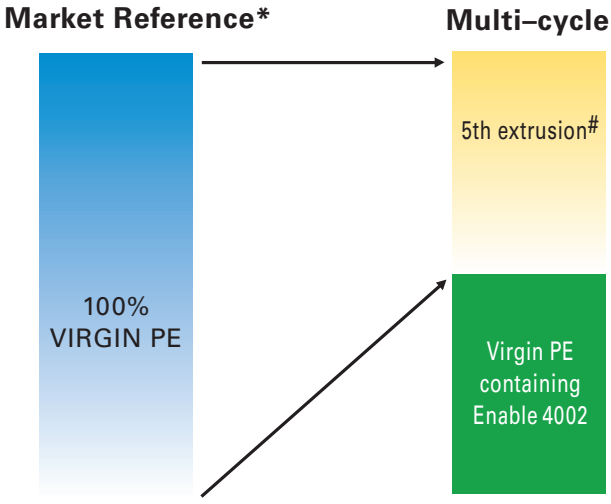
challenges to maintaining film properties via mechanical recycling.

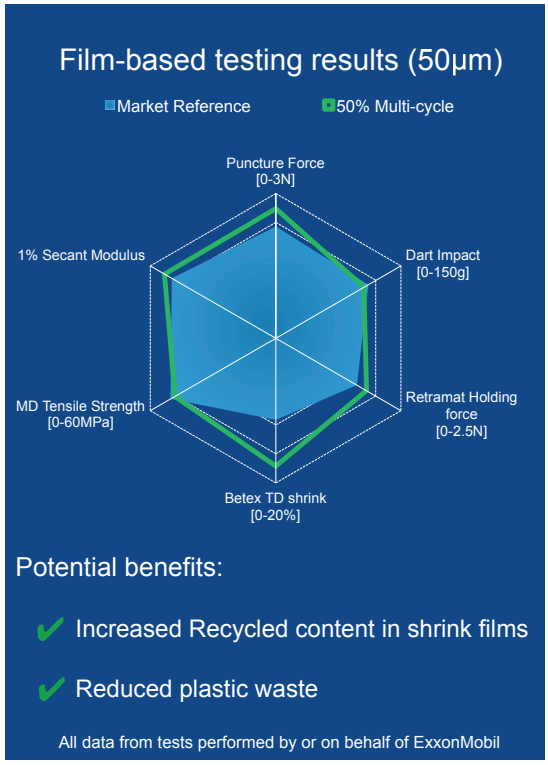
Mitigating loss of strength of film

Thong Guan collaborated with ExxonMobil for a solution to help mitigate the potential loss of mechanical strength from the incorporation of recycled content. They sought further help in testing the solution from Newton Research and Development Centre, a leading research institute in Malaysia specialising in packaging solutions for palletised loads.

ExxonMobil recommended a solution incorporating Enable 4002 performance polymers. "When used in conjunction with recycled PE streams, Enable polymers can help maintain the required mechanical and processing capability to help reduce the performance variability typically associated with mechanically recycled PE film. This approach leads to a final product

Performance of Enable-based 50% recycled content shrink film versus similar market reference 100% virgin shrink film





All data from tests performed by or on behalf of ExxonMobil

** Reference: Commercially available film used for shrink film application*

 # 5th extrusion: Extruded reference film after 4 more passes through pelletiser to simulate extreme heat exposure from multiple rounds of mechanical recycling

that incorporates recycled content, while helping to maintain its mechanical strength and properties," Chan explains.

In plastic recycling, sorting of waste at the source has a great deal of impact on the quality and consistency of the plastic recycling stream. The three-company team simulated the typical collection and sorting of the collation shrink films to provide a known and consistent source of recycle for mechanical recycling.

The team tested and compared a commercially available three-layer, 50-micron market reference shrink film against a three-layer, 50-micron shrink film with virgin PE containing Enable 4002 in the skin layers and 100% simulated fifth extrusion recycle material in the core layer. The Enable-based shrink film solution incorporated a total of 50% recycled content.

By incorporating 50% virgin PE containing Enable 4002 in the solution, film performance consistency can be achieved across multiple extrusion cycles. This allows the potential for films containing recycled content to be recycled back into shrink films up to five times through the process without compromising film consistency.

In summary, Enable 4002 in shrink film that incorporates up to 50% recycled PE content can maintain major mechanical properties and comparable shrink performance versus a market reference film (100% virgin reference film), allow increased use of recycled PE content and enable the potential to reduce plastic waste.

Market for recycled shrink films in beverage sector

Is there a market for recycled shrink films? Yes, says Ang, "Recycled shrink films are most popular in the beverage industry. We distribute some locally and export to countries like Australia and New Zealand."

Ang also revealed that recycled shrink films can be more expensive to produce than virgin films, but there is still a demand from companies with sustainability goals and commitments, and that they may benefit from potential tax savings depending on their market.

"Our customers can potentially save on plastic packaging costs by meeting the requirements of various plastic packaging tax schemes like the one imposed in the UK, where companies using plastic packaging with less than 30% recycled content are required to pay tax of £200 per tonne of plastics."*

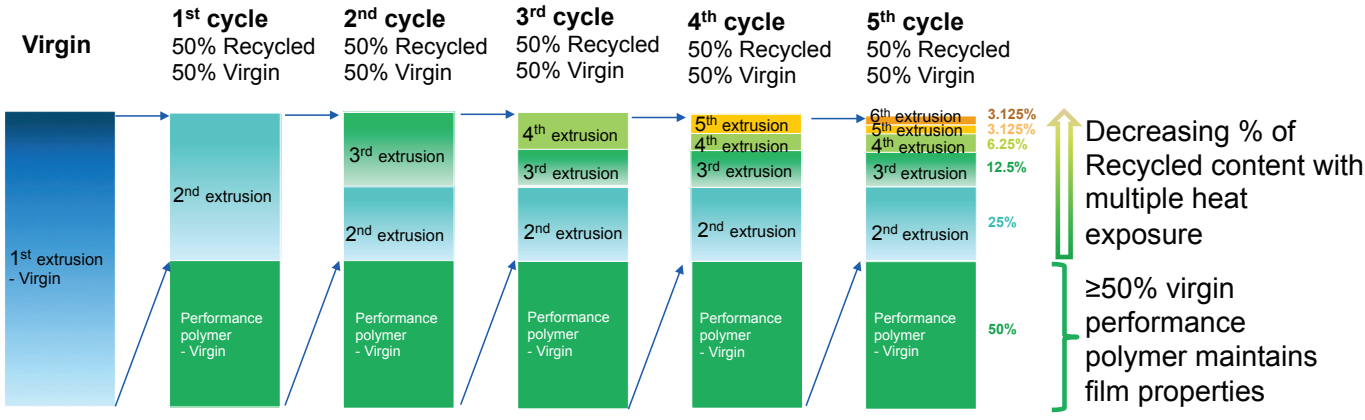
For now, perhaps only one thing stands in the way of the production of more shrink films with recycled content.

Quips Ang: "The response to our recycled shrink film is excellent as more companies are pursuing their sustainability goals and commitments. However, the commercialisation of shrink films containing recycled content is largely dependent on the availability of quality recycled content. Making quality recycled content widely available will require investment and close collaboration along the entire packaging value chain."

**Source: https://www.gov.uk/government/publications/introduction-of-plastic-packaging-tax/plastic-packaging-tax*

Enable performance polymers help shrink films with mechanically recycled content maintain performance over repeated extrusion cycles

Illustration – 50% recycled content film over 5 extrusion cycles



High quality performance polymer ensures film performance cycle after cycle

Illustration shows the components of a 50% recycled content film that have undergone multiple heat exposures from production, usage and recycling. The recycled component may have lower film performance, due to potential polymer chain degradation. The inclusion of 50% polymer from virgin raw materials potentially helps to maintain the film properties.