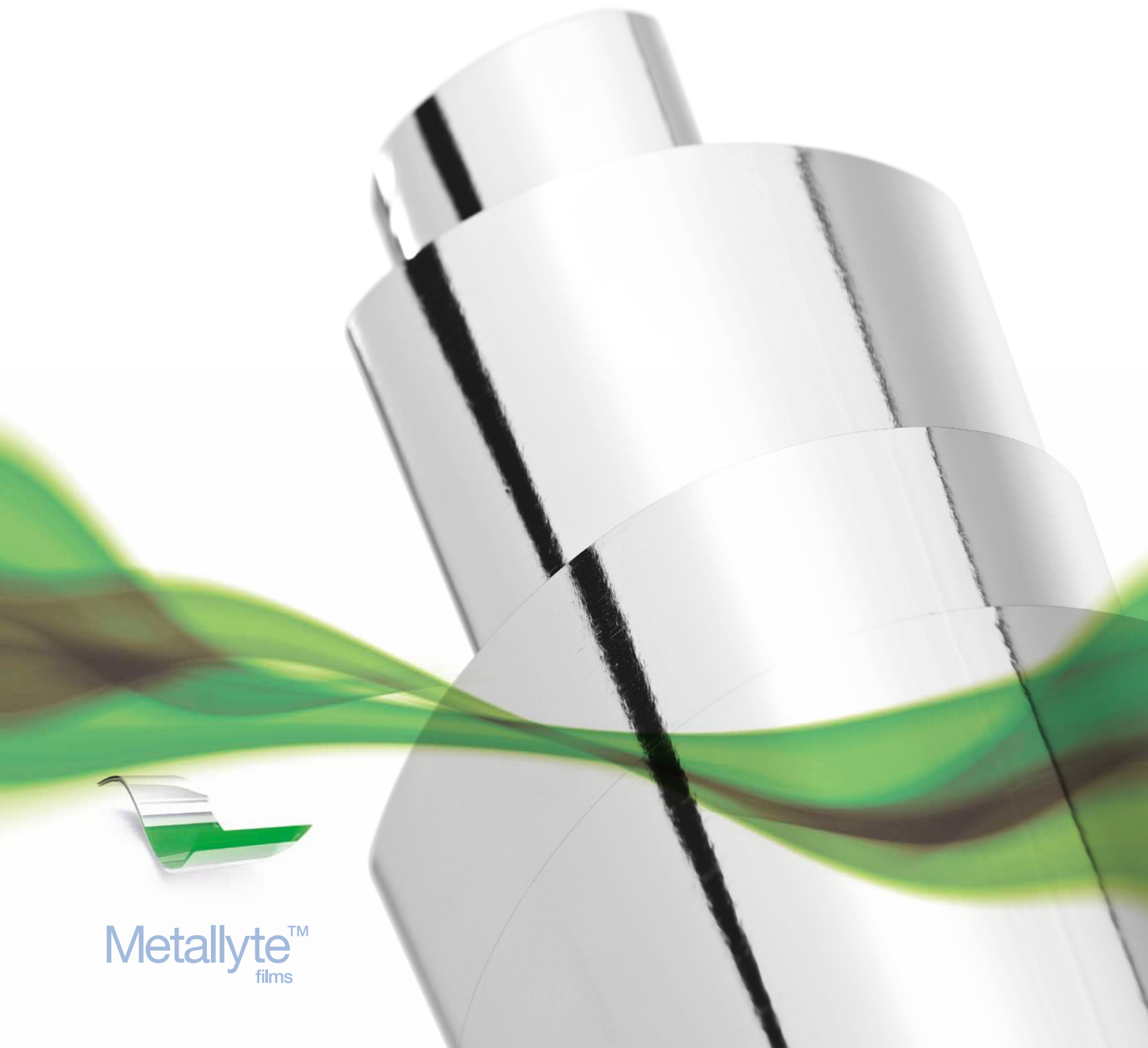


Jindal
Films

Metallyte™

high and ultra-high barrier metallized OPP films



Metallyte™
films

A world of applications

A worthy alternative

Jindal Films has developed a broad range of high-barrier vacuum-metallized oriented polypropylene (OPP) films to meet the flexible packaging industry's needs for barrier applications used in packages for dry foods and beverages that require long shelf life.

Traditionally, thin aluminum foils were used to protect products from moisture and oxygen. But today, the industry can also rely on Jindal Films's **Metallyte™** OPP films. By combining the inherent advantages of biaxially-oriented polypropylene with state-of-the-art metalization technologies, Metallyte OPP films are more than a viable alternative. They are cost-effective solutions that combine puncture and flex-crack resistance with barrier levels previously unavailable in OPP films.

Some Metallyte OPP films allow structure simplification by shifting from 3-ply to 2-ply laminated structures enabling simpler converting processes, reducing raw materials and improving the life cycle inventory (reduced emissions, energy requirements and solid waste).

Enhanced barrier integrity

- high barrier technology for cost effective aluminum foil replacement in hygroscopic packaging applications
- ultra-high barrier technology for oxygen-sensitive dry products in modified atmosphere packaging (MAP) applications to help achieve long shelf life periods
- both technologies deliver excellent light-barrier characteristics to protect sensitive products from UV rays
- improved barrier integrity compared to aluminum foil across distribution chain (packaging and transportation)

Enhanced puncture resistance

- three-fold improvement in puncture energy compared to thin aluminum foil structures
- protects barrier layer from sharp dry products (e.g., coffee beans, noodles, croutons, etc.)

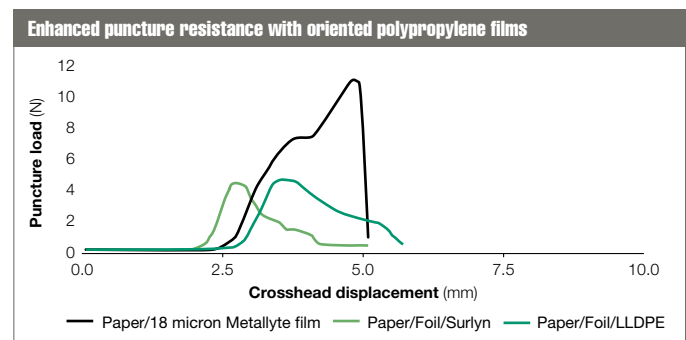
Replace to enhance



Substrate replacement

The flexible packaging industry is using Metallyte OPP films to replace thin aluminum foils and enhance packaging performance. The biaxial orientation process provides OPP films with high puncture and flex-crack resistance. Puncture resistance helps reduce product-induced barrier loss from sharp ingredients perforating the foil layer, while flex-crack resistance maintains pack barrier integrity in comparison to more brittle barrier materials such as aluminum foils.

These technical performance advantages create interesting possibilities. Stand-up bags and pouches (SUP), for example, are proliferating in stores in response to an increasing consumer need for convenience. Consumer packaged goods companies can now effectively address barrier loss (flex-cracking) in their folded bottom or side gussets. Metallyte OPP metallized films enable brand-owners to take advantage of SUP package formats to differentiate their products on the store shelf, while not having to compromise packaging quality, thus maintaining product quality across the packaging and distribution chain.



Source: Jindal Films laboratory data

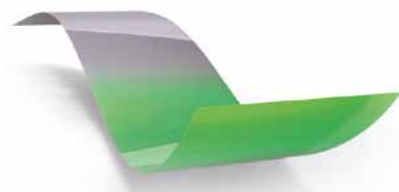


Substrate replacement

High barrier

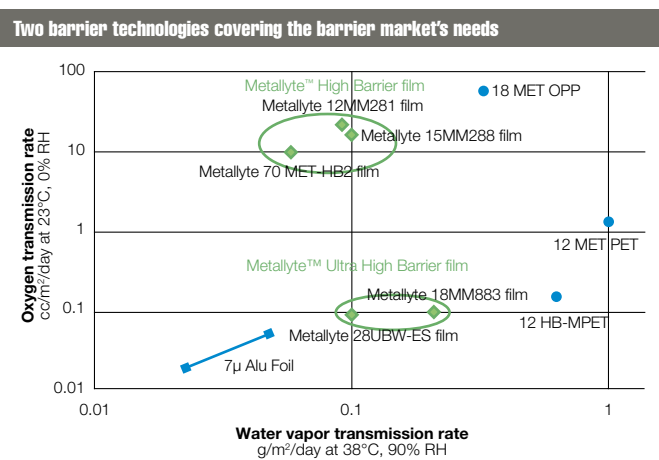
Metallyte™ 15MM288 and **12MM281** films are non-sealable metallized OPP films used to protect hygroscopic product with long shelf life requirements. They are both designed for adhesive lamination to provide robust barrier performance during packaging and converting processes.

These products are intended for use as the middle layer between a printed outer substrate (e.g., paper, PET or OPP) and an inner sealant (e.g., PE or CPP).



Ultra-high barrier

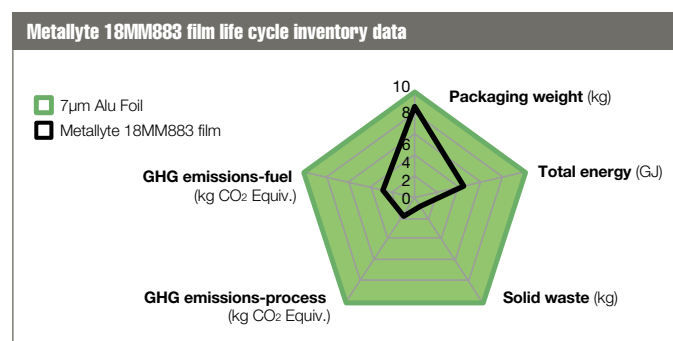
Metallyte 18MM883 film is a non-heat sealable metallized OPP film that is intended to protect oxygen and moisture sensitive products with long shelf life requirements, typically using gas flushing (N_2 or CO_2) in modified atmospheric packaging (MAP) applications. Metallyte 18MM883 film is designed for adhesive lamination in a three layer structure.



Note: Typical barrier values and Jindal Films laboratory data
Source: Jindal Films laboratory data

Substrate replacement

Metallyte OPP films provide a significant reduction in density ($\rho_{OPP} = 0.91 \text{ g/cm}^3$) when replacing aluminum foil ($\rho_{AL} = 2.7 \text{ g/cm}^3$) as a barrier material. This difference in density results in a significant surface yield or unit weight improvement for barrier laminates as illustrated below. For example, replacing 7µm aluminum foil with Metallyte 18MM883 film yields a weight reduction of 13%, and results in a significant reduction in energy consumption, green house gas (GHG) emissions and solid waste.



Source: Franklin Associates Ltd. "LCI of Film Packaging Structures" April 2008

Reduce to improve



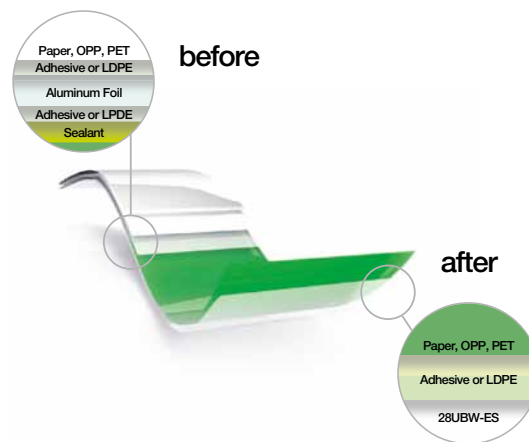
Structure simplification

Metallyte™ UBW-ES film is a white opaque metallized OPP film utilizing Jindal Films's proprietary UHB technology. It provides exceptional oxygen, aroma and moisture barrier and is combined with the new enhanced sealant technology (-ES) that can replace extrusion coated or extrusion laminated sealants and deliver high seal strength in most cases.

This new proprietary sealant technology allows brand owners to simplify their foil based flexible packaging structures and helps provide such benefits as:

- **reduced** packaging weight and cost
- **reduced** converting complexity with a simplified process
- **improved** mechanical properties
- **reduced** life cycle green house gas (GHG) emissions, energy consumption and solid waste

Replacing aluminum foil and PE sealant with Metallyte 28UBW-ES film provides energy and solid waste reductions, per the life cycle inventory data shown in the diagram below.



Replacing aluminum foil and PE sealants with a single web, Metallyte 28UBW-ES film offers significant material reduction opportunities.

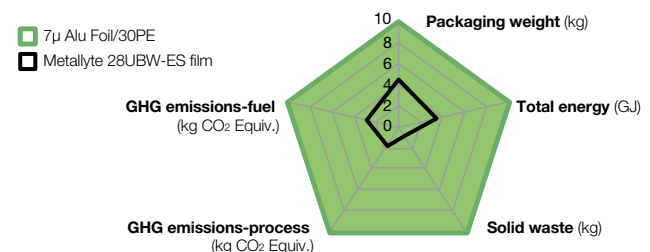
For example:

- old structure: 57 g/m² MG paper / 11 g/m² PE / **7.0 μ foil / 23 g/m² PE**
- new structure: 57 g/m² MG paper / 11 g/m² PE / **Metallyte 28UBW-ES film**

Results in a:

- **55% weight reduction of total structure**
- **92% reduction in solid waste**
- **64% reduction in energy consumption**
- **72% reduction in CO₂ emissions**

Metallyte 28UBW-ES film life cycle inventory data



Weight, Energy or Emission units per 1,000m² area

Source: Franklin Associates Ltd. "LCI of Film Packaging Structures" April 2008



Reduce to improve

Structure simplification

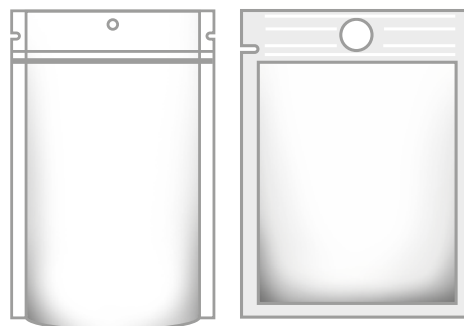
Jindal Films challenged and surpassed previous limits of OPP seal capability through the development of its new enhanced sealant technologies (-ES).

In combining this new -ES sealant platform with its barrier technologies, Jindal Films aims to replace the barrier (e.g., thin aluminum foil) and sealant webs or extrusion coated PE in flat seal formats. The combination of barrier and enhanced sealant provides opportunities for structure simplification and allows the packaging industry to reduce packaging weight.

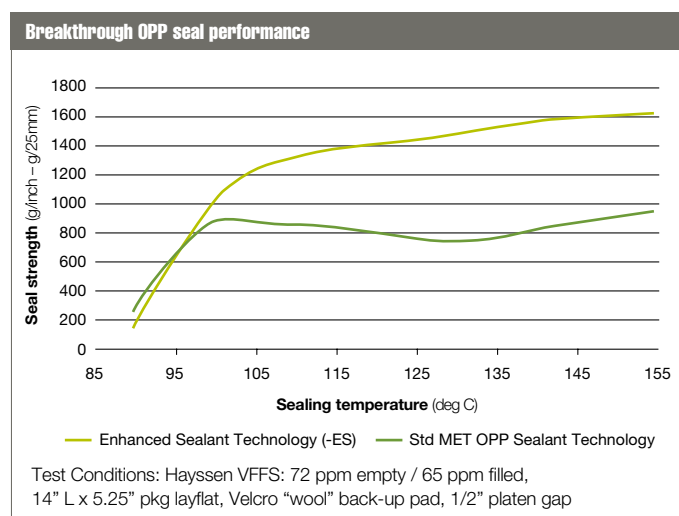
Improved seal performance

- approximately 2-fold seal strength improvement over standard sealable coextruded OPP films
- good seal performance in flat seal formats (pouch, sachets, SUP, etc.)
- lap seal capable with most sealable OPP films
- available with ultra-high barrier OPP film technology

Sealing performance using the -ES technology provides seal strengths approaching that of extrusion-coated polyolefin sealants and thin cast or blown polyolefin sealant films.



Metallite™ OPP films using Jindal Films's Enhanced Sealant technology help provide good seal performance for dry food and beverage applications in stand up pouches and four-side seal packaging.



Source: Jindal Films laboratory data

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