Recyclable paper coatings

Leon Krings, business development manager, Paramelt, examines how functional paper coatings offer recyclable packaging solutions.

Today's packaging landscape is shifting; packaging engineers now have to take a much more holistic view by considering sourcing as well as end-of-life scenarios for the packaging material, and taking much more responsibility for product stewardship.

This has created a highly favourable environment for paper-based packaging aligning strongly with documented consumer preferences. Paramelt provides functional solutions for paper-based flexible packaging based on two key platforms of strong current relevance:

- **Paraflex:** wax-based recyclable paper coatings.
- **Aquaseal:** water-based coating solutions based on high solids dispersions of conventional extrusion-grade plastics.

Both approaches offer significant benefits for designers of paper-based packaging, enabling the creation of high-performance, environmentally responsible packaging papers.

Vegetable wax-based coatings

In nature, waxes provide excellent repellency and barrier properties. For example, both mineral waxes such as Paraflex paraffin grades as well as Paraflex Nowax organic waxes, based on hardened vegetable oils, yield equivalent barriers to polyethylene and provide MVTR under tropical conditions (38°C/90%RH) of between 150– 200g/m^2/day per µm of coating.

This characteristic alone led to huge volumes of wax paper in use providing the first flexible packaging material for food preservation. However, the use of wax paper has been reduced to a small number of niche applications like confectionery packaging, and cheese and meat wrappings being largely superseded by plastics. As a result, there is now little familiarity with wax paper structures. Nonetheless, wax-coated paper offers significant benefits in the context of today's packaging demands leading to renewed activity in this area.

In contrast to plastic-coated paper, waxed paper is inherently biodegradable, degrading at about the same rate as leaf mulch. This is especially beneficial in individual confectionery and fast-food wrap applications, where the risk for littering is high. Moreover, appropriate wax-coated paper structures meet the requirements for industrial composting according to EN 13432.

More recent studies have also shown that contrary to common wisdom, wax-coated paper is repulpable for use in standard recycled paper production. Certification testing at CTP France shows that excellent results are achieved, producing paper with very good strength and visual appearance.

In this way, wax-coated paper can offer a comprehensive solution in all 'end of life' scenarios, be that energy recovery, littering, recycling or composting.

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While this goes partway by addressing the 'waste issue', mineral waxes do not tackle the renewability of the source material and reduction in fossil-based carbon use. In order to tackle this aspect, Paramelt has invested significant R&D efforts to identify and establish sustainably sourced, vegetable-based alternative waxes to close the loop in regard to sustainability.

Under the brand name Nowax, various vegetable oils and fats are modified and blended to provide direct countertypes to traditional paraffin-based materials. These Nowax coatings offer equivalent or superior performance to mineral-based waxes. By using these Nowax materials for the coating of paper, effective packaging structures are achieved that contain in excess of 90% renewable, bio-based raw materials.

Of course, cost impact remains an important consideration for retailers and brand-owners, although it is less and less the primary driver in today's packaging environment. Wax-based solutions offer a comparative cost basis compared with both plastic films and extrusion coated papers while providing numerous environmental benefits.

Water-based barrier and heat seal coatings

Many papers rely on combinations with plastics, by extrusion coating or film lamination, for their functionality. Paramelt's unique Aquaseal technology provides water-based polyolefin dispersions (PODs) from the same polymers used for extrusion and film production.

In this way, packaging producers can achieve the same paper functionality at lower applied weights, via conventional printing and coating methods.

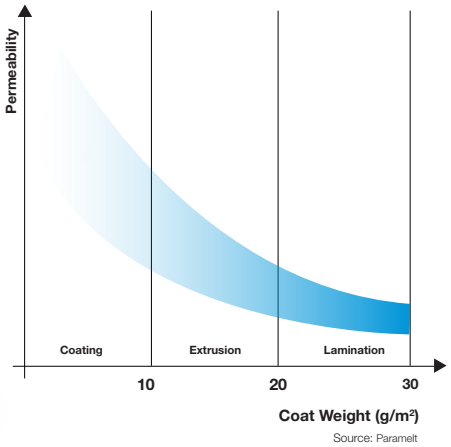
Functionalised paper based on extrusion or film lamination is difficult if not impossible to recycle, because the polymer film cannot be broken down in the repulping process and is difficult to separate causing significant process disruption and losses.

As consumers frequently have difficulty in material separation, these structures nonetheless often find their way into the paper stream causing significant down-time and loss of efficiency. In contrast, when applied by coating from aqueous dispersion, Paramelt is able to formulate Aquaseal-based coatings, providing the same functionality which are fully repulpable.

Extrusion-coated and laminated paper provides excellent barrier against water, water vapour and grease, as well as heat seal functionality. This strong balance of properties find application in many market segments such as disposable paper

Due to consumers' sustainability concerns, paper-based packaging has come to the industry forefront.

Schematic representation of permeability as function of coating weight for a specific material



Source: Paramelt

cups and fast-food containers, portion packs and confectionery wraps.

The layer or film thickness is often selected depending on the barrier requirements and typically ranges 10–100µ. However, for heat sealability, a coating thickness of only a few microns would be needed. While seal strength is related to coat weight, it quickly exceeds the inherent strength of the substrate, especially for paper. However, it is technically difficult to achieve consistent layer thicknesses below 10–12g/m^2 by extrusion coating, so often much thicker coatings are used even where the barrier is not required. This results in products that are overdesigned in terms of heat seal and barrier performance.

In contrast to PE-coated or laminated paper, there is only very limited uptake of water-based heat-sealable barrier coatings for paper and these are mainly based on acrylics or PVdC-based emulsions.

Acrylic dispersions offer some barrier, but tend to be highly sensitive to ambient humidity, while heat seal performance is only moderate, especially in regard to hot-tack. PVdC-based systems exhibit excellent barrier properties and a level of heat sealability, but halogens continue to have a negative environmental image linked to potentially hazardous air and water emissions.

In contrast, Aquaseal coatings are based on the same polymers as used by extrusion coating and film lamination and therefore offer the same level of barrier performance on a gram-per-gram basis, are resistance to moisture, acids and other chemicals as well as providing excellent sealability and hot tack performance.

Packaging specifications are generally established to control the consistency of an existing solution and not always the functional requirements of the material. Many replacement activities have failed since the target specification is defined on a 1:1 transfer of the properties achieved with extruded PE. Of course, the barrier performance of a PE-based coating is directly related to the coating thickness. A thinner, water-based coating will inherently therefore yield a lower overall MVTR but this is frequently sufficient for the target application.

When applied from dispersion, the coating microstructure is different to a continuous plastic film. By control of formulation, we are able to render the coatings largely redispersible in the recycling process without negative impact on the barrier or sealing characteristics. This offers a number of drop-in solutions for existing paper-based packaging structures, but which are fully repulpable.

Testing on cup stock board of 250g/m^2 with 10–12gsm POD coating easily disintegrates under typical recycling conditions, giving a fibre yield of >99%. Paper produced from the recovered pulp shows a very good quality and this structure has been verified by CTP France as meeting the requirements of recyclability according to EN13430 Numerous other examples, such as sachets for condiments, sugar and tea bags, point-of-sale pouches and wrapping sheets, barrier sack paper and cheese wrap are now in the market place or well on the way to commercialisation.

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Exciting possibilities

Vegetable wax-based coatings for paper provide a sustainable barrier solution suitable for use in a wide range of packaging applications. The waxes themselves are based on renewable green carbon and, in combination with appropriate base papers, are fully recyclable and biodegradable.

The emergence of novel water-based polyolefin dispersions enables exciting new routes to heat seal and barrier functionality for flexible packaging, enabling drop-in solutions for existing structures. Because these dispersions can be applied using conventional coating and printing techniques, much lower coating weights can be achieved while the microstructure of the coated layer makes the functionalised paper readily repulpable allowing such structures to be directly recycled via existing waste streams. ●

For further information

www.paramelt.com/packaging