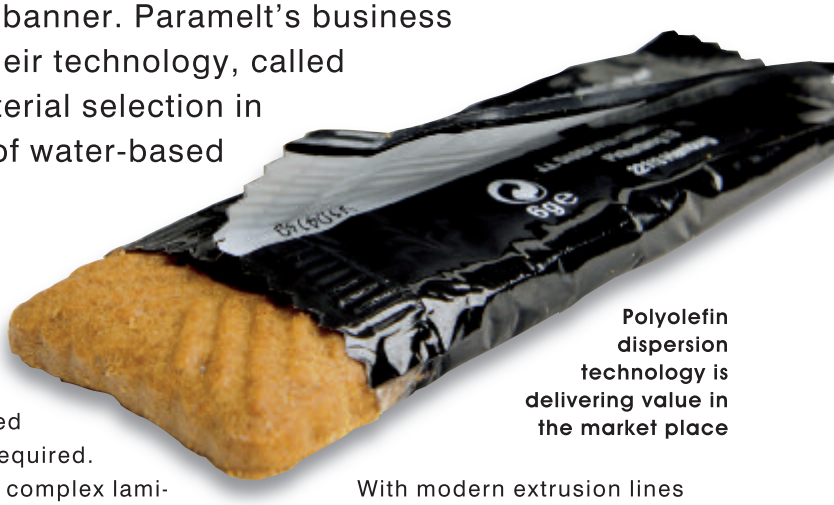
Water-based polymer breakthrough

Paramelt has worked with Dow Chemical to develop a novel mechanical dispersion capability under the Bluewave technology banner. Paramelt's business development manager Neill Dutton says their technology, called Aquaseal, allows complete freedom of material selection in optimising performance and functionality of water-based polymer coatings.



Polyolefin dispersion technology is delivering value in the market place

In the current economic climate retailers are looking for reduced packaging costs and a lower environmental impact from its disposal. At the same time they want the packaging to attract customers and maintain a brand image. This adds to customers' specifications that packaging producers are already trying to meet in a bid to preserve, promote and protect the customers' product.

The standard toolbox available to the converting industry to achieve the right blend of functionality and design comprises printing, coating and laminating. Each of these techniques has their own balance of strengths and weaknesses (see table).

Lamination has a number of limitations that affect cost and efficiency. The curing time often builds a lag into product flow. The use of 2K and/or solvent-borne adhesives can give rise to problems with residual solvents and/or functional monomers within the material.

Material consumption is often unnecessarily high because of failure to find suitable film grades and/or use of full coverage where only limited functionality is required.

For example, complex laminates can require two or three processing steps simply to achieve A-B sealability and encapsulation of the print which ideally could be replaced by inline printing and over-lacquering if suitable materials were available.

Coating techniques allow the converter a degree of flexibility in terms of material selection and application weights. By moving to the extrusion coating process, the converter can deliver many of the same features achieved by lamination.

Application weight optimised

In addition, he can select the material used based on the desired properties and optimise the application weight for performance rather than be constrained by the availability of suitable film.

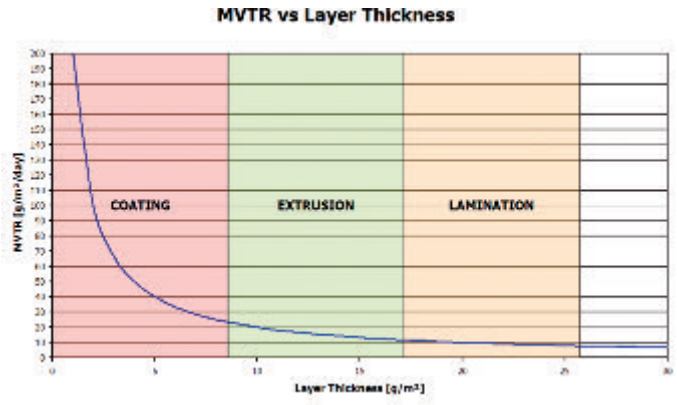
With modern extrusion lines this can be carried out at high speed with relatively low cost/surface area. The scale, cost and complexity of the extrusion coating equipment, however, mean that only larger, specialised operators will invest in this capability.

The technique requires long runs to be efficient and so offers limited flexibility and, in some cases, may be incompatible with other required components such as heat sensitive substrates.

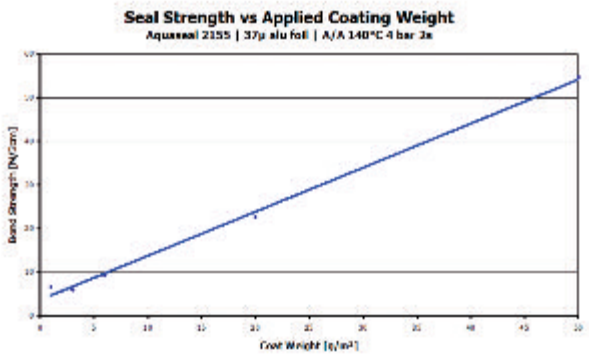
Wax and/or hot melt coating may be regarded as a comparable process but, on a simpler more flexible scale, making it more accessible to a wider range of users. It offers the possibility of shorter runs, partial coating and a diverse range of adhesive characteristics are available.

Extrusion		Hot melt coating	
Advantages	**Disadvantages**	**Advantages**	**Disadvantages**
High speed	High investment	Flexible	Second operation
Low cost at high run lengths	Low flexibility	Low cost	Limited polymer choice
	Full surface coating	Partial coating	Wax deposition
	Combi extrusion/printing	No drying	
	Heat sensitive substrate		
(Film) lamination		**Dispersions (Aqueous/Solvent)**	
Advantages	**Disadvantages**	**Advantages**	**Disadvantages**
Efficient	Second operation	Safe	Safety/residual solvents
Broad choice of films	Thick films (min 12μ)	Low investment	Limited in polymer choice
	Adhesive curing (1 week)	Flexible	Evaporation of water
		Partial coating	

Printing, coating and laminating have their own balance of strengths and weaknesses



For applications that require an intermediate level of barrier, polyolefin dispersion coatings can provide a good fit



The ultimate seal strength can be strongly influenced by the applied coating weight

Some of the same substrate constraints needed for extrusion coating apply and viscosity (or molecular weight) of the coating which can be applied must be limited. This is frequently achieved through high wax loading that in turn influences the properties obtained such as bond strength or barrier performance.

Reducing viscosity

Another approach to reduce viscosity is to disperse the coating material in liquid form, either water- or solvent-borne. The ability to do this is limited by the chemical nature of the system, including the ability to polymerise in water or the solubility in a suitable solvent.

As a carrier water has advantages. It has reduced environmental impact, lowered processing and regulatory hazards and lowered solvent costs. The industry has tried to move from solvent to water-based technology but in many cases the necessary quality of properties, such as adhesion, bond strength, chemical resistance and barrier level has not been achieved.

To address this problem, Paramelt has worked with Dow Chemical to develop a novel mechanical dispersion capability under the technology banner Bluewave to produce previously unavailable high solids and water-based dispersions of high molecular weight thermoplastic polymers.

In principle, the flexibility of Bluewave technology allows complete freedom of material selection in optimising performance and functionality of water-based polymer coatings. Paramelt's Aquaseal polymer dispersions offer numerous economic and environmental benefits:

- Solvent free alternatives to solvent-based lacquers
- Suitability for heat sensitive substrates
- Potential to significantly lower coating weight compared with extrusion
- Possibility of partial coating to provide functions only where needed
- Little or no VOC content
- High solids up to 60% offering reduced supply chain costs and environmental impact
- Application using standard printing/coating methods – flexo, gravure, rotary screen and air knife

Dispersion developments

Paramelt has concentrated initial polyolefin dispersion developments on polyolefin-based materials, offering a range of dispersions based on PE and PP copolymers as well as other high ethylene content materials such as EAA, EMA and EVA.

This extends the range of materials available to the packaging converter using standard printing and coating methods. For example, the same materials, which are typically applied by film lamination, extrusion coating and high performance hot melt formulations, can now be directly coated from dispersion in water.

This versatility in material selection enables product property optimisation based on application requirements rather than material limitations. In this way products can be designed to achieve the best balance of characteristics such as:

- Adhesion to both polar and non-polar substrates
- Tailored seal initiation temperature and sealing range for maximal operating window
- Effective wetting and lay-down of coating
- Controlled coefficient of friction
- Low in-reel blocking
- Effective barrier
- Direct food contact

Of course this approach can not change the fundamental properties of the materials involved.

In terms of moisture barrier, for example, the moisture barrier per gram of PE is a fundamental property of the polymer. If an extremely low MVTR is required, it is clear that lamination or extrusion may still be the best way to go.

A good fit

For some specific applications that require a controlled, intermediate level of barrier polyolefin dispersion coatings can provide a good fit (see graph).

The same can be said for the cohesive strength in sealing applications where the ultimate seal strength can be strongly influenced by the applied coating weight (see graph).

It is not often that such high levels of bond strength are required and more frequently the ability to reduce the extrusion coating weight is set by process constraints rather than the heat seal requirement.

These novel polyolefin dispersions enable design engineers to produce packaging based on product requirements, unhampered by process constraints. As can be seen from the following examples, polyolefin dispersion technology is delivering value in the market place.

1.Partial coating – ream wrap

Traditionally, paper reams are packaged using PE coated paper, which is closed inline with a hot melt adhesive. Increasing consumer sales of paper have driven the use of heat sealable transparent BOPP for on-shelf appeal and direct visualisation of products like coloured paper.

The machines used for the heat sealable materials operate at higher speed and offer better wrap efficiency than the hot melt system. With polyolefin dispersion technology a high solids PE dispersion can now be applied in the seal areas using flexo or gravure when printing the pack design, offering the ability to run paper based structures on the heat sealable process line.

2. Inventory reduction – paper sachets

A number of products, such as sugar and yeast, require only a moderate level of moisture barrier protection. While these are frequently packaged in PE extrusion coated paper, this often results in a higher barrier than is needed or desired.

To service the specific needs of each client the converter is forced to hold a broad range of substrate grades. With polyolefin dispersion technology it is possible to keep a base paper stock and dial up the required heat seal and barrier performance through inline coating.

3. Material compatibility – seal to PP

PP is one of the most difficult materials to bond or seal against. When building packaging involving cast or oriented PP films it is often necessary to use pre-coated film or to laminate an additional PP-based material into the structure to enable sealability between the two sides of the film.

With Aquaseal, a number of PP copolymer dispersions are available which can be coated on to paper, film or foil, giving direct sealability against this difficult material.

4. Material reduction – Heat sealable papers

Extrusion coated papers are frequently employed in heat seal applications where the barrier function of the extruded layer is not critical. In such cases the sealant is only required in those areas of the structure where the package is to be closed.

Using high solids polyolefin dispersions, these areas can be printed in a single step at high coat weight on the base paper. This often allows much higher coat weights, seal strength and hermeticity to be achieved while still reducing the total amount of polymeric material in the overall structure.

5. Heat resistant applications – IML

In mould labelling is an increasingly popular decorating technique for rigid containers. When producing blow-moulded and thermoformed containers, a heat-activated hot melt is often used as the adhesive medium. To speed up production, the industry uses a process requiring the combination of low MST and high wax content, which in turn leads to poor hot tack performance.

The use of polyolefin dispersion technology removes the need for wax in the system since the required coating application viscosity is achieved through dispersing in water. Consequently, much higher levels of hot tack, bond strength and heat resistance are possible and, frequently, the required coating weight can be significantly reduced.

The potential of this innovative, new technology is only just beginning to break through into the market place but is already bringing benefits in a number of areas. Time will tell just how wide ranging its impact will be in optimising and enhancing the packaging materials we use every day. ■

Bluewave™ is a trademark of The Dow Chemical Company