
FPO (filled polyolefin) blown films are employed for packaging foodstuffs, e.g. butter and margarine

**Film Design.** The current range of packaging films extends from shrink wrapping film via synthetic paper through films made from biopolymers. From these materials packagers can themselves design a packaging unit to suit their needs. This survey points out the possibilities, including advantages and disadvantages, that the various materials and their associated processing methods afford for the production of an economical and attractive package.

# Packaging with the Right Film

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In recent years film as a packaging material has increasingly substituted alternatives such as cardboard or tinplate. Significant reasons for this include the lower specific raw materials consumption in production and the lower weight of the packaging. At the same time the complexity of the film specifications and of the corresponding formulations and processes is steadily increasing. In order to identify the film best suited to any particular task open and purposeful communications between the customer and film supplier are necessary.

The properties achievable today encompass not only the classic mechanical characteristics of flexible-elastic to rigid and stiff, but also other properties, such as selectively adjusted shrinkage characteristics, breathability, barrier action as well as tear and tear propagation properties, to name just a few. Furthermore, compatibility with the environment is growing in importance; this is often discussed under the heading of sustainability.

This paper shows, from the perspective of a film manufacturer, the extent to which the properties of film can be adjusted today in line with customer requirements and how the film industry is responding to new challenges.

## How are Specifications of Requirements Drawn up?

When the film industry is compared with other sectors of industry, such as automotive engineering, it is soon found that specifications for films are built up relatively simply and often contain only a few specified values. Specifications become all the more comprehensive and exact the ▶

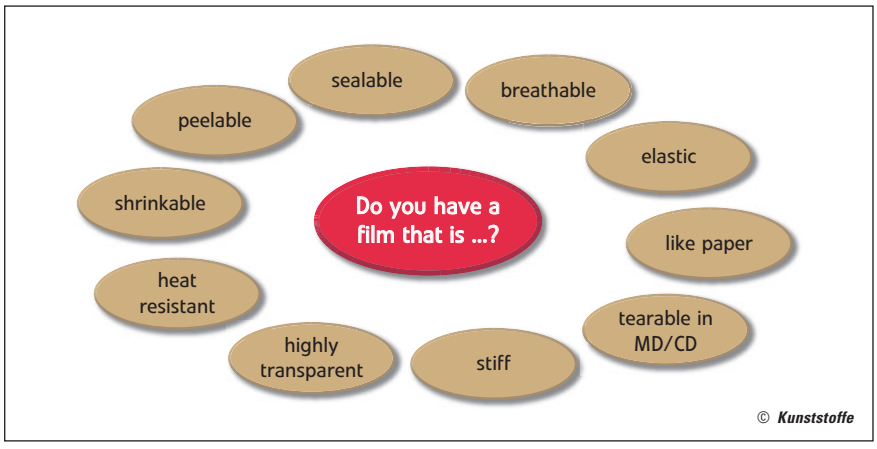


**Fig. 1. Customer requirements may be multifarious**

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**Fig. 2. Multipack shrink films are becoming ever thinner and can accept printing of high-quality images**

more intensively and longer the customer and supplier have undertaken joint development.

In enquiries, often made by dealers, that are not very well specified the properties really required often remain unclear. In such cases the required properties are not formulated in quantitative terms, but rather merely qualitatively (Fig. 1). In these cases technically trained sales advisors or application support technicians have to contact the customer in order to obtain further details. Only on this basis can the correct product be offered. The frequently found practice of handing on existing specifications of a product in current use may give rise to mistakes. The reason is that the physical properties listed there usually include both really important properties as well as some that the currently used product just accidentally also has.

Thus, in order to exploit to the full the entire potential for enhancements and savings in film procurement it is essential for both partners to engage directly in technical discussions.

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## Shrink-wrap Films: From the Pack to the Label

The use of PE-LD as a shrink-wrap film for packaging purposes is probably the oldest of all applications of film. A distinction is made here between "heavy-duty shrink" (e.g. for securing pallets) and what is referred to as "fine shrink" (in the packaging of consumer goods). At the same time, especially in the consumer goods sector, there has been a trend in recent years to ever thinner films and ever more high-quality printed images (Fig. 2). Logically the formulations have developed from pure PE-LD to coextruded structures using other grades of PE such as PE-HD, PE-MD, mPE–LLD and PE–LLD.

Alongside this shrink-wrap films have established themselves in the labeling sector as prefabricated sleeves or alternatively as so-called "roll-on shrink-on" labels. The shrinkage properties needed for this (low shrink temperature, monoaxial shrinkage), however, can no longer be achieved by the blown film extrusion of PE. Special stretching processes in association with more expensive raw materials such as PVC, PET, OPP or OPS are required for this purpose. Under the name of RKW ProTec Contour a high-shrink label film oriented in the machine direction and having longitudinal shrinkage of up to 60 % was presented to the public for the first time at the "Emballage" exhibition in Paris in November 2008.

## Visually Attractive Elastic Films

One of the most important applications of elastic films in terms of volume is the stretch cover for securing pallets (Fig. 3). In this market segment "stretching" has robbed the classic shrink hood of market share in recent years. This occurred primarily due to the fact that no open heat source is needed to apply the necessary holding forces and as a result the specific energy consumption is lower. Also, as a rule the better visual appearance (smooth surface, thinner film) is a positive factor in favor of the stretch hood so that today when new equipment is installed it is predominantly in the form of stretch units.

Elastic films, however, are also employed in many other high-grade applications. Examples include the elastic components of sealing systems in diapers and in the hygiene and medical sector. These developments were also driven by the availability of new, highly elastic raw materials which could still be processed by the film manufacturers. A company that is at home not only in the packaging industry, but also engaged in the hygiene sector can exploit interesting opportunities for synergy in development.

## Sealable and Defined-tear Films

Many packaging applications sometimes require multilayer composites of complex construction. In all these composites, regardless of the mating material (e.g. Al, PET and PA), PE or PP films are used as the sealing film. In order for the composites to be opened easily many customers demand easy and straightline tearing in the longitudinal or transverse di-


**Fig. 3. One of the most important applications in terms of volume of elastic films is the stretch hood for securing pallets**



 

rection. The main requirement, however, is and remains good sealability over a broad temperature range, even when contamination by the filled product cannot be ruled out.

In this respect ultrasonic welding affords some advantages. Unfortunately, however, it has only been possible so far to weld material composites composed of a heat-resistant material (e.g. PET) and a sealing layer by this method. Thus, costly and high-input composites are employed where there are no special demands for an oxygen barrier effect. A newly developed and patented coextruded film now additionally allows direct welding with ultrasound through fatty, dusty and fluid products.

## Films like Paper

Plastic films are also being increasingly used as what is known as synthetic paper. The mineral-filled blown films can, like paper, be written on and imprinted by all standard methods and exhibit comparably high mattness as well as typical deadfold properties. In comparison with paper they also additionally have the advantage of

- high strength and elongation at fracture between 50 and 400 %;
- resistance to moisture and oil;
- very high barrier properties to light, oxygen and water vapor;
- light transmission (400 to 700 nm) adjustable to between 1 and 80 %; and
- ease of disposal in comparison with coated paper.

The FPO (filled polyolefin) blown films extruded by RKW Schweden AB, Helsingborg, Sweden, from in-house compounds based on PE or PP are available in different versions – including sealable film if required – in widths of up to 1,200 mm and thicknesses between 40 and 150 µm.

FPO films are used for the packaging of foodstuffs, in particular butter and margarine, as a labeling material and as a laminating film in association with other materials (Title photo). In these roles they substitute

- wax paper and parchment,
- paper coated with PE, and
- lid films (of sealable type).

## Further Refinement of Films

In many cases the properties demanded by customers may only be achieved by modifying the formulation and the choice of film production method. To obtain an extended range of properties different modification processes are available today. Outside the packaging sector these processes have already been tested on a large scale and are highly efficient. Thus, e.g. functional surfaces and surface textures can be produced by embossing and by stretching or perforating breathable films.

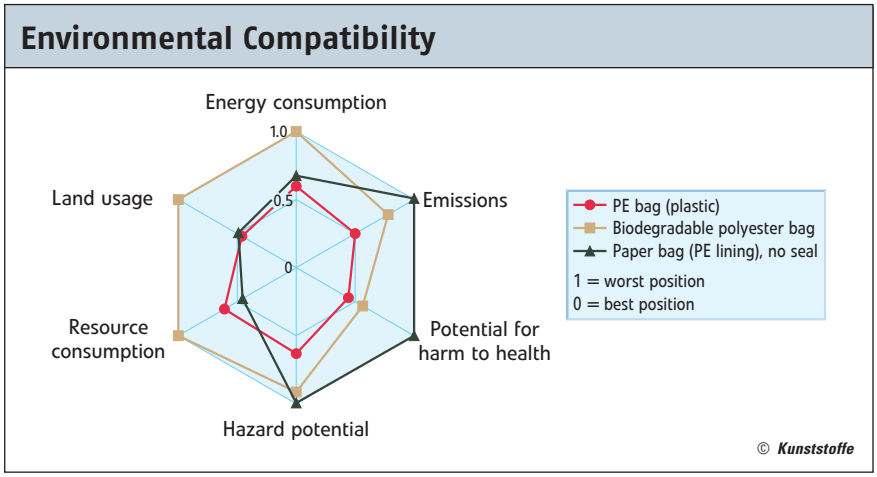


**Fig. 4. Lifecycle analysis of bags made from different materials**

## Sustainable Product Development: Biopolymers

Conservation of our natural resources and the economical use of raw materials are growing more important in almost all sectors of industry. The problem then arises when the aim is to judge the environmental compatibility of different product alternatives. For this purpose one can really only make use of a comprehensive analysis which takes into account all aspects relevant to the environment.

Such an analysis from the "cradle to the grave" of the product was carried out in close collaboration between RKW SE, Frankenthal, Germany, and the user, Lafarge Cement, Great Britain (Fig. 4). This shows that a FFS bag composed of PE causes lower environmental pollution than a standard paper bag with a PE liner. Surprisingly, at first glance the PE bag in comparison with a bag made from biopolymers (mixture of PLA and Ecoflex) of the same thickness is in some respects distinctly superior with regard to all criteria. This can be explained primarily by the lower density of the PE (-34 %) and the lower weight of the bag.

This study shows that the simplified statement "Bio = environmentally friendly" certainly does not apply without qualification. On the other hand, more intensive development activities in the field of renewable raw materials will result in future bioplastics exhibiting more favorable ecological balances. Even today there are many (niche) applications in which the use of biopolymers makes sense. Only by way of example here reference may be made to compostable bags in which biowaste is discarded or also packaging units for vegetables and salad. In such cases specific properties are selectively used for the new class of products, such as biodegradability or comparatively high gas permeability. Use on a wider front makes only limited sense compared with systematic reduction in thickness and/or more intensive use of classic recycled materials.

## Conclusion and Outlook

Large film manufacturers such as RKW have wide-ranging know-how in the choice of materials and processes to help develop, jointly with customers, optimum solutions to the problems set by customers at any time. The availability of production capacity in blow molding and cast film processes in association with different further processing technologies additionally makes it possible to select the process in question and the finishing technology best suited to any problem posed. Only by flexibility in choice from various possible solutions can an enduringly successful innovation be launched onto the market. In doing so open and trusting collaboration between the user and manufacturer is indispensable for developing not only the cheapest solution, but also the one which is the most low cost and most capable of enduring in future. ■

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