

MARKET TRENDS AND DEVELOPMENTS EXTENDING SHELF- LIFE

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THE MARKET

The Freedonia Group recently reported that world demand for converted flexible packaging would rise by 4/5% annually.

Growth would be driven by new applications and further gains would be made on rigid containers, based on environmental advantages and improving barrier properties and convenience. Plastic films would expand their lead over paper and foil.

Whilst the growth rate is impressive, there has undoubtedly been a slow down in recent months, due the economic downturn plus the effects of raw material and energy prices rises, as far as manufacturers are concerned, although these have now abated.

It should, also be noted that reduced growth does not indicate market saturation, more the technical ability to reduce thickness of products, based on new high performance polymers and films.

Indeed, Pira International reported in its recent market study that global demand for flexible packaging is expected to grow to more than 16 million tonnes by 2010, of which the majority will be in Europe.

However, according to a Nielsen Global Food Packaging Survey, nearly one in two global consumers would give up all forms of packaging provided for convenience purposes if it would benefit the environment.

At the other end of the scale, the Nielsen Survey found that consumers were least willing to give up:

- packaging designed to keep products clean and untouched by others – 27%
- packaging designed to keep products in good condition – 30%
- packaging information in the form of food labelling, cooking and usage instructions – 33%
- and most importantly
- packaging that preserved products to make them last long/stay fresher – 34%
- There were many regional variations in the survey, but the following conclusions were the key:-
- Overall, the two aspects of packaging that consumers would be reluctant to give up are:
- protective packaging – i.e. packaging that keeps products in good condition
- hygienic aspects of packaging i.e. that which keep products clean and untouched by others.

Globally, Europeans (23%) and North Americans were least prepared to give up packaging for hygiene and protective purposes.

Consumer feedback about the hundreds of packs assessed using Nielsen's packs @ work, support the global food packaging survey.

Successful packs are those whose dynamics address specific consumer needs at critical stages of the product's life cycle.

Which is why, looking to the future Nielsen predicted wider use of intelligent packaging, with two key factors:

- i. enabling product tracking from manufacture through to disposal
- ii. packaging that indicates the state of the product contents

They also observed that transparent packs provide the opportunity to inspect product contents, before purchase - a very important requirement.

What this all demonstrates is that whatever the misgivings about the role of packaging and, indeed, the benefit of packaging, consumers genuinely want the products they purchase to be in first class condition, protected, clearly visible, and, in the case of food products, fresh and ready to be eaten.

What is equally without question is that there is a greater need than ever for the industry to be providing plastics packaging with outstanding barrier properties, recyclability and wherever possible, transparency, to provide customers with longer shelf-life.

Of course, development in the use of new materials would not have happened without the advent of barrier technologies, multi-layer constructions, barrier blends, oxygen scavenger technology and other developments such as special coatings.

Plastics, has clearly given us a great deal and will continue to do so in the future, with substantial growth opportunities for innovative products and technologies.

POUCH PACKS

According to a report by the Freedonia Group in the USA, demand for pouches is expected to increase by 6.1% per year to \$7.9 billion. The report states that stand-up pouches will continue to expand compared with the other competing types of packaging because of their superior qualities including aesthetic appeal, reclosable components, portability, lightweight and reduced material use.

Demand for stand-up pouches is expected to increase by 9.8% annually until 2012.

Generally, stand-up pouches are probably one of the most important innovations to affect flexible packaging in recent years. The European market for pouches is growing significantly.

The progress in some ways reflects the wide use of this product in Japan, where an estimate 1.5 to 3 billion pouches are produced each year.

HIGH PERFORMANCE LAMINATES AND POUCH PACKS

The development of high-performance laminates has improved the image of pouch packs and, with longer shelf-lives, opened up new markets.

If we need an example of this we need look no further than Capri Sun. The children's favourite has recently launched an adult variant of its juice drinks. Fruit Rush/Wild Berries is still in a foil laminate pouch, but with a reclosable spout rather than a straw.

The pouch format is now being used in sectors such as liquid and dry foods, pet foods, household products, and hair care and bath products.

According to PIRA International, in 2002 there were 3.24 billion units of pet food sold in standing pouches in Europe. By 2007, this figure has doubled.

Generally in newer markets led by big brands, products have gone directly into pouches. In carbohydrate – based ready meals, also based on PIRA International's latest studies, there is double-digit annual growth. The global market for standing pouches was estimated at around 30 million units in 2007.

Markets which have adopted foil laminate retort packs as the norm or standard, such as pet food, are growing. Equally the ceramic barrier structures segment is understood to be growing at an even faster rate, because it is a less mature market.

However, ceramic barrier materials are more expensive than foil. Brands are only likely to choose non-foil barrier if they require microwavability, product visibility or metal detection capability.

There are, of course differences when it comes to performance, in and out of the retort. Aluminium foil clearly offers the perfect barrier, as long as it remains intact. A foil laminate provides an 18 month shelf-life. Even with the best quality transparent barrier material, shelf-life will be closer to 12 months. So there is still work to be done here.

FORM-FILL-SEAL (FFS)

Some of the leading companies in the industry are seeking greater take-up of form-fill-seal (FFS) pouch packaging

Mondi Flexibles Neo-Steam High Barrier Film Packaging is an interesting solution which features a valve integrated into high barrier films. It is suitable for frozen or refrigerated food in bags or trays. Just like a pressure cooker, the valve regulates the pressure inside the package, allowing healthy preparation that retains flavour and vitamins alike.

The Neo-Steam Solution reduces preparation time whilst enhancing product quality and can be adapted to the individual steam properties of the product to achieve the optional cooking time. Products can be prepared quickly whilst preserving vitamins and minerals.

Huhtamaki's Cyclero is a new packaging solution, an optimisation of stand-up pouches. The aim is to maintain the advantages of flexible packaging over conventional can, jar and board packaging. Cyclero is a modular system which enables several combinations of pack size, lid, base, shape and cap. The base of the packaging can be round or oval, flexible or rigid, and with or without barrier properties. The body itself is made from a multilayer laminate, which can have a transparent, opaque or metallic finish and can be produced with or without aluminium, depending on the barrier requirements. Since the packaging can be gas flushed, product protection can be improved even more.

SMART PACKAGING/INTELLIGENT PACKAGING

According to the Freedonia Group, in the US, the demand for smart packaging will rise by 13% annually to 2011. Freedonia say that this growth will be driven by the advancement of new products with improved performance as well as lower cost. Historically, the latter factor has been one of the major factors in limiting the development of the market.

It is forecast that a significant growth in intelligent packaging is likely due to the emergence of lower cost time-temperature indicators.

One such example is OnVu time temperature indicators (TTI) developed by Ciba Speciality Chemicals and FreshPoint, using novel ink technology. This relies on the properties of pigments that change colour over time and if temperatures fluctuate.

The first indicator, designed for meat, fish and convenience products with a shelf-life of 5-6 days at 5°C, has been field tested by a major German retailer. The latest OnVuTTI's are designed for chilled products with shelf-life of up to 20 days.

OnVuTTIs allow producers, retailers and consumers to check at a glance whether purchase products have been correctly transported and stored, thus helping to enhance consumer convenience and confidence, and optimise shelf-life.

The indicators are currently, supplied as labels, but in the future will also be available as printing inks for application straight on the package.

By providing essential information on chill-chain history, OnVu TTIs can help to optimise shelf-life, since suppliers and retailers will no longer need to discard products prematurely to cover for potential spoilage, caused for example, by incorrect storage.

An intelligent label from Cryolog, the eO, indicates a product's freshness in a dynamic and innovative manner.

Consumers want information on the freshness of the products that they purchase and eat. The eO is attached to the pack and changes colour when the product is no longer fit for consumption, either due to its reaching its Use by Date or breaks in required temperature parameters.

The labels are calibrated by Cryolog on the basis of the properties of the product to be treated e.g. microbiological composition, shelf-life, storage temperature, logistics circuit etc. Essentially the label contains food grade micro-organisms which match the characteristics and conditions of the foodstuff being monitored.

ACTIVE AND INTELLIGENT PACKAGING

Active Packaging is an exciting area of development, i.e. packaging which can actively reduce the levels of oxygen or even reduce the microbial count within the pack.

Wipac Walsrode, in Germany, introduced its active Combitherm oxygen absorbing film several years ago. The film has an EVOH barrier layer and also contains an oxygen absorbing substance sandwiched between the film layers, which interacts specifically with oxygen, binding it irreversibly within the film layers, which interacts specifically with oxygen, binding it irreversibly within the film layers.

Combitherm have done extensive trials with leading companies and the technology is particularly valuable for sliced ham, sausages and processed meat. Using Combitherm, can prolong the shelf-life of the product for as much as one year, it is claimed.

Oxygen scavenging packs such as Mitsubishi Gas Chemicals Ageless device are making progress in the market. Ageless oxygen absorbers effectively extend shelf-life by maintaining freshness, flavour, aroma and nutrients.

The Ageless FS is a new sachet style which no longer uses powder ingredients. It looks like existing sachet styles but contains an oxygen absorbing plastic sheet instead of powder.

The Ageless FL label is easy to attach to packaging materials, and with adhesive on the back may be easily fixed inside the packaging.

Also worthy of note is Multisorb's FreshPax CR system. This extends shelf-life of case-ready meats to up to 30 days, which is greater than comparable packaging alternatives, and also preserves colour.

The system addresses the primary threat to the shelf-life of packaged meats—oxidation, which can negatively affect flavour, aroma and appearance.

Meat producers have traditionally relied solely on vacuum and back flushing, which removes air from the hermetically sealed master bag in which individual cases are packed, replacing it with a mix of nitrogen and carbon dioxide. However, this process leaves approximately 0.5% - 2.0% of residual oxygen, enough to reduce shelf-life significantly.

The Fresh Pax CR oxygen scavengers are used together with vacuum and back flush systems to absorb this residual oxygen. Specially formulated to work in the chilled environment, they rapidly reduce oxygen levels to 0.01%, effectively inhibiting oxidative degradation. Individual meat cases are removed from the master bag and allowed to re-bloom, ensuring an appealing red collar at retail outlets.

MODIFIED ATMOSPHERE PACKAGING

Of course, shelf-life optimisation is key for all successful retailers. The battlefield is the extension of shelf-life. Nowhere is this more so than in the fresh and processed foods market.

Modified Atmosphere Packaging has been around for many years. The principles of rearranging atmospheric conditions are still true today in the battle to maintain product freshness over a long period of time.

MAP uses combinations of oxygen, carbon dioxide and nitrogen to inhibit the detrimental process of microbial spoilage, dependant on the physical and chemical properties of a food product.

It also delays oxidation, a problem with foods such as some fishes which are high in unsaturated fats. It prolongs the shelf-life of an increasing range of food products – meat, cheese, vegetables and salads, without resorting to artificial preservatives.

MAP is an alternative to vacuum packaging. New applications are constantly being found. New potatoes are one example in recent years, where within a MAP pack the tendency of potatoes to go green can be retarded.

MAP is of course, the established technique for packaging and storing fresh meat, with life expectancy of up to 25 days for some products. Case-ready packs account for over 80% of the raw meat sold in the UK.

The adoption of MAP for case-ready meat has been slower in countries where meat production is more fragmented. However, retailer driven initiatives are starting to bear fruit and other European countries are responding. In Germany, some leading supermarkets are spearheading the growth. In France MAP penetration has reached over 40% of the meat packaging market. In Italy, where supermarkets are more regional, the introduction has been slower.

It is forecast that the UK will continue to extend its MAP usage into new food categories. Other EU countries will also progress more slowly but with varying levels of take-up.

MODIFIED INTERACTIVE PACKAGING

Long Life Solutions (LLS) has been developing smart technology for over 3 years. Their technology is proven across many fresh product sectors including fruit, salads, vegetables and flowers. The Company has manufacturing operations in the UK and USA, and is one of the leaders in modified interactive packaging; it has a worldwide agents/distribution network.

Long Life Solutions "Smartbag" film technology is defined as interactive i.e. using the ability of fresh produce to adjust its respiration rate via a biofeedback mechanism. Rather than predict an outcome and force an atmosphere around the produce via a feed forward mechanism (as in Modified Atmosphere Packaging) its interactive packaging allows the product to sort itself out via its own biofeedback mechanisms. It provides higher gas permeability's so as to allow greater inflow of oxygen and outflow of carbon dioxide from the package surrounding the produce, thereby allowing the produce enough flexibility to modify its surround air so that it can survive in a state of reduced metabolic activity.

The Smartbag film should work in tandem with LLS's Smart sachet technology, thus allowing supermarkets to increase shelf-life (freshness), reduce losses due to rot and improve shelf image. It could mean the end of shrink-wrapped vegetables such as cucumber and broccoli.

Sharp Interpack (Sharpak) are claiming a breakthrough, in extra shelf-life for fresh fruit and vegetables. The concept is called Extrafresh. It is a combination of Sharp's packaging knowledge and Multivac's heat-seal machinery application. It is a solution in perforation technology to enhance

freshness and reduce packaging costs and waste in fresh produce. Sharpak claim that Extrafresh goes some way to making it easier to eat fruit over a longer period of time.

PET DEVELOPMENTS – SENSITIVE BEVERAGES

As we will all acknowledge, PET bottle solutions that feature multi-layer technology or material blends are part of the progression of utilising barrier technology for premium brands.

However, producers of oxygen sensitive beverages such as beer and wine have been cautious about switching to PET, owing to shelf-life and product quality concerns.

Nevertheless, activities of companies such as PET Engineering of Italy have recently highlighted the development of packaging for sensitive foodstuffs. They have predominantly centred on juices and dairy products and specifically beer and, more recently, wine. All of these are beverages that require particular attention in terms of barrier performance in order to guarantee optimum shelf-life.

PET Engineering works on the basis of establishing whether the product being filled requires an active or passive barrier, such as a coating system, a multilayer preform or a material blend. A passive barrier is a physical barrier to oxygen or CO² built into the bottle wall. It offers an increase in the material's performance without a chemical, interaction with the PET or any oxygen that enters the container. An active barrier will react with, and neutralise any oxygen that tries to enter the bottle or which may already be in the product.

In the wine and beer market PET Engineering's latest developments have been a 100ml single dose pack for milk-based drinks and functional drinks, the asymmetric beer pack and glass-like 0.75 litre wine bottles.

PET Engineering worked with Constar International to create preforms featuring Constar's proprietary oxygen-scavenging, monoOxbar technology, which preserves the wine's quality during its shelf-life.

Faerch Plast, a Danish Company, has launched AMPET, a modified mono-layer PET material, as a less expensive solution when compared with glass jars and cans, for long-life ambient products. It can withstand sterilisation in retorts or autoclaves and does not taint food over a long shelf-life because of minimal migration from the polyester material. Larsen Danish Seafood already uses the AMPET solution for their long shelf-life fish products.

PP DEVELOPMENTS

At Lyondell Basell Industries an experimental grade of custom polypropylene (PP) has been chosen by Container Corporation of Canada (CCC) for use in the commercial production of oriental PP (OPP) hot-fill jars and bottles.

The introduction of blow moulded OPP bottles and jars at commercial speeds with clarity equal to PET and with desired hot fill and barrier properties, now makes PP a cost-effective alternative to glass, PET, composite cans and multi-layer cartons for a broad variety of applications. Until now, PP applications had been limited to water bottles, pill vials and other containers where oxygen barrier properties were not critical.

Marketed under CCC's Enviroclear Barrier System brand name, the OPP bottles and jars feature patented oxygen and CO² barrier coating, applied through a dip/spray process, which creates the enhanced performance characteristics. The coating improves the oxygen barrier on a 500ml OPP bottle by approx 140 times over an uncoated PP version, according to Lyondell Basell.

The introduction of blow moulded OPP bottles and jars with clarity equal to PET and with hot-fill and barrier properties makes PP a cost-effective alternative to glass, CPET and cans in hot-fill applications

PET Material Developments

Bar PET/Beer PET (a PET/PTN alloy containing 10% PTN*, which is produced by Futura Polymers), is aimed at enhancing thermal stability and further improving the gas, UV and water vapour barrier properties of PET packaging. The Bar PET/Beer PET solution is targeted mainly at products requiring extended barrier protection from CO² loss or oxygen ingress, such as soft drinks and beer.

*PTN is PolyTrimethylene Napthalate

NANOTECHNOLOGY

Nanotechnology has attracted more public funding than any single area of technology. On a global basis, governments are spending some \$3bn on nanotechnology, with each year seeing a fresh effort by Europe, the USA and Japan to out-rival each other. It has, been estimated that this public funding, is being matched by corporate R&D spending, giving a total of \$5-6bn a year.

In packaging the market itself is growing rapidly. The worldwide sales of nanotechnology products to the food and packaging sector were valued at almost €700 million in 2005. It has, been predicted that nanotechnology will change 25% of the food packaging business in the next decade.

Of course, there are technical barriers to commercialism, the principal ones being the development of techniques for mass production and reducing the cost of nanomaterials.

Notwithstanding these issues the packaging sector has the potential of being a good receptor of advances in material and composites in nanotechnology.

In packaging the development of nanocomposites is gaining momentum as the opportunities offered from such technology are identified and realised.

Already the present generation of nanocomposite materials has shown enhanced product performance characteristics including thermal stability increased mechanical strength and improved barrier properties. The barrier applications of nanocomposites have been identified as areas of considerable scope for growth. Nylon films have been commercialised with improved gas barrier properties by nano scale additives.

The property advantages that nanomaterial additives can provide in comparison to both their conventional filler counterparts and base polymer include:

- mechanical properties
- decreased permeability
- thermal stability
- flame residency
- chemical retardancy
- surface appearance
- electrical conductivity
- optical clarity

Nanocomposite applications in packaging include:

- gas barriers
- oxygen barriers
- food packaging
- films

An exciting future waits in the nanotechnology field.

Scientists at Clemson University in the USA (Centre for Flexible Packaging – CEFPACK) have created a bio-based, nanocomposite barrier material featuring fish gelatine and nanocomposite packaging film, making use of the million plus tonnes of fish by-products generated from the Alaska Fishing Industry each year.

Perhaps it is true that whilst much effort has been devoted to preparation and characterisation of nanocomposites, little attention has been paid to final applications.

Nevertheless, nanotechnology is present in packaging films already commercialised including LDPE – clay and EVOH composites in ready-to-eat (MRE) packaging, co-injection stretch blow moulded PET bottles, barrier liner materials for closures by Alcoa CSI, Nylon-6/clay composite (Aegis NC resin) by Honeywell, Nylon-MXD6 for bottles by Mitsubishi Gas Chemical and Nylon-6/clay composite by Toyota research group.

Another development in the packaging arena of note is Nanoskin technology. Developed by General Applications in conjunction with UK Innovation Consultancy PERA, Dupont Teijin Films and PA Consulting Group, the nanoskin material is a micron-thickness film that provides a thermal protection layer by using small cells containing a vacuum.

It can be applied during packaging production, either on the inside or outside of a container and is sufficiently flexible to be formed and shaped without losing its vacuum properties.

The developers say that it should be possible to produce packaging for cold, chilled and frozen foods using less material because of its higher insulation properties. Similarly nanoskin can also be used to keep warm products at a constant temperature.

It is claimed that there are numerous food and drink applications where nanoskin should be suitable both as a primary and secondary layer. It should keep ice-cream and beverages colder for longer and it should be possible to extend shelf-life by maintaining the desired temperature longer.

CONCLUSION

Innovation in Packaging has given us a great deal. Barrier technologies, multi-layer constructions, barrier blends, oxygen scavenger technology, special coatings, smart/intelligent packaging, active packaging and nanotechnology are just some of the examples of major development over recent years.

Whilst these are exciting innovations and of great merit, there is undoubtedly still more to come from progressive producers and new technologies.

The major challenge in the fast-moving world of today is the need to ensure even greater freshness of product in the stores.

This means that the battle for extending shelf-life will continue and will be an area of great debate and discussion for the foreseeable future.

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