POLYMERS IN FOOD PACKAGING

Increasingly fierce competition sets food companies on a never-ending quest for new packaging solutions.

USE OF INHERENTLY DIFFERENT SUBSTANCES, FOR EXAMPLE, SILVER-BASED COATINGS ON POLYMER FILMS, CREATES BRAND NEW PACKAGING PROPERTIES.

Ensuring freshness

Nikolai Logachev, CEO of cheesemaker Aldini, says that manufacturers have three priorities when it comes to packaging – design, image quality, and guaranteed shelf life. Modern polymer packaging offers all that plus an array of choice of innovative materials and storage options made possible by rapid advancements in this area.

For example, antifog films have been an increasingly attractive solution for storing wet food products. “These films can be made of anything from polyethylene to polypropylene to other polyolefins,” says Yulia Lariusina, Deputy Commercial Director for Marketing at TIKO-Plastic. “During extrusion, concentrate of a special hydrophilic additive is introduced into it. Having migrated to the surface, active substances distribute to form a thin, almost indiscernible layer. While it does not affect the product itself, it changes surface tension level to prevent accumulation of moisture drops.”
Antifog films are becoming an increasingly attractive solution.

A more traditional way of eliminating excessive moisture is to make packaging using microporous or non-woven polymers based on polyacrylic salts and starch copolymers. These solutions are not just safe for the product. In fact, they extend its shelf life.

According to the research, the most stable absorbents are activated carbon compounds with waterproof groups.

Airless environment

Changing the gaseous atmosphere surrounding a food product inside a pack is another important factor for food preservation. Thanks to its ability to suppress pathogens, carbon dioxide (CO2) is used in packaging to extend shelf lives of pre-packed meat, poultry, fish and
cheese. It works in the opposite way with fresh herbs, vegetables and fruit, as they themselves are sources of CO2, which is absorbed by substances placed inside packaging in special sachets or sheets. Their performance, however, often depends on humidity and any other gases present. According to the research, the most stable absorbents are activated carbon compounds with waterproof groups.

Oxygen concentration control is a far more challenging task. Oxygen-barrier polymer films, a type of modified atmosphere packaging, are not always helpful. Neither is vacuum packaging. Added reliability is provided by oxygen scavengers based on fine iron and iron oxide powders, ascorbic acid, sulfates or glucose oxidase. Antioxidants are introduced into packaging either mixed in a solution, after melting the polymer, or via deposition.

Analysis of the packaged product freshness.

IN THE PACKAGING INDUSTRY, SUSTAINABLE PRODUCTION IS MOSTLY ENSURED THROUGH TWO FUNDAMENTAL APPROACHES – RECYCLING AND REDUCED MATERIAL INTENSITY.
St Petersburg-based Antek (Active Packaging Company) has been a maker of oxygen-scavenging packaging since 2004. In this type of packaging, which is used by the snack, fish, bakery and other industries, iron oxide with salt is placed inside a special ethylene-copolymer film packet that has barrier properties. In 24 hours, the scavenger will remove excessive oxygen to slow down oxidation and thus extend the product’s shelf life by 2–3 times. This also eliminates the need to add any preservatives.

“Initially, we were looking for a solution for meat snacks,” says CEO Andrei Kutsenko. “Just as our peers, we used to pump gas inside, but after a month, temperature fluctuations resulted in condensation and mold. This prompted us to seek alternatives, and we have found out what is best.” While this packaging has been widely used in China, the USA and other countries, he says, Russia has yet to embrace it in full. “However unusual it might be to our market, it has great potential and a bright future,” he concludes.

**Under control**

Transported and stored fresh products are exposed to continued chemical and biological processes, such as respiration, evaporation and microflora development. Like natural gas permeability, these processes cause changes in the atmosphere inside the packaging, which, in turn, affects the product’s safety and shelf life. A controlled atmosphere relies on labels monitoring the oxygen, ethanol, hydrogen sulphide, water vapour and carbon dioxide levels.

![Diagram: Important Trends: Research Focus on Packaging](image-url)
Gas analysers not only monitor harmful compounds – they can also sense volatile aromatic compounds and amines to signal fruit ripening. These labels usually employ compounds that react to changes in pH.

PRODUCTS IN FLEXIBLE PACKAGING LOOK ATTRACTIVE ON THE SHELF AND OFFER A LOT OF OPPORTUNITIES TO CREATIVE DESIGNERS WHO CAN EXPERIMENT WITH COLOURS AND MAKE VIEWING WINDOWS FOR THE CUSTOMERS.

Another important area is pathogen monitoring. Integrated systems to monitor Salmonella, E. coli, Listeria and other dangerous microorganisms are already available in the market. These systems come as sets of antibodies that react with the target pathogen. Although they are not quite sensitive yet, research is in progress to enable production of more advanced solutions in the coming years.

**Nanotechnological packaging**

Using inherently different substances creates new properties. For example, silver-based coatings on polymer films prevent the development of pathogenic microflora.

One of the manufacturers of such films is Danaflex-Nano, a joint venture between RUSNANO and Danaflex, a leading packaging company in Russia. Its flexible nano-coated packaging is used by mayonnaise producers, among others.

“For several years, we had been focused on creating packaging that would be able to substitute foil, as its production requires a lot of energy and generates significant CO2 emissions. The new material had to have barrier properties on a par with foil while being more eco-friendly. Eventually, we created a metallised nano-coated film. It has a special protective layer that is less than two microns thick. Its robust barrier properties are ensured by dense distribution of particles during the coating process,” says Evgeny Bantukov, Head of Marketing at Danaflex-Nano.
Testing of the packaging material properties.

**Sustainable future**

As environmental issues become more pressing, the sustainability discourse has put great emphasis on finding ways to meet the needs of the present generation without compromising the ability of future generations to meet their own needs. In the packaging industry, sustainable production is mostly ensured with two instruments – recycling and reduced material intensity.

The world’s leading producers have already adopted initiatives to make 100% of its packaging recyclable. In particular, Unilever and Mars plan to achieve this goal by 2020 and 2025, respectively. The approach is twofold. First, packaging must be phthalate-free. Second, it needs to utilise mono structures for easier recycling. In Russia, such solutions are offered by BIAXPLEN, its leading producer of BOPP films.

**INTELLIGENT PACKAGING USES SPECIAL LABELS TO COLLECT DATA ON THE PRODUCT'S CONDITION.**
Phthalate-free plasticisers are designed to meet the most stringent requirements, including those of the medical equipment, toy and food packaging industries. “The phthalate-free trend is taking centre stage: many customers are increasingly looking for greener solutions, SIBUR is already producing phthalate-free polypropylene for BIAXPLEN’s films,” says Natalya Malkova, Chief of Multinational Sales at BIAXPLEN.

“Another critical issue is excessive packaging materials. Packaging has to be redesigned,” says Andrey Kostin, Head of RUPEC. Major manufacturers are doing just that. For example, the USA’s ExxonMobil has recently unveiled Achieve Advanced PP6282NE1, a polypropylene-based solution for rigid packaging. Thanks to its high stiffness, container wall thickness can be decreased by 15%. Moreover, such packaging is microwavable, dishwasher-safe and reusable.
The biggest challenge is to find something suitable for viscous and granular products. One option is doypacks, a type of vacuum packaging. They are made of two flat sturdy sheets sealed together along their sides, with a W-fold running along the bottom to make the pouch stand when filled. Artur Mekhanov, Development Director at Terra-Pack, says that doypacks
are widely used for dairy products, sauces, jams, fruit purees and baby food. Products in flexible packaging look attractive and offer a lot of opportunities to creative designers, who can experiment with colours and make viewing windows. Such packaging is made of polyethylene plastic pellets, with metal materials, such as aluminium, used to form inner layers in some cases.

Some people think that packaging should be made of paper, glass or other “green” materials. But specialists disagree. “Plastic packaging will always exist, as there is no viable substitute. It is not just cost-effective and easy to handle or transport – actually, it is more sustainable,” notes Valery Balashov, Deputy Head of Pakgrad. “There is always sustainability in cost-effectiveness. Craft packaging costs 50–100% more than its plastic alternatives. In turn, low costs mean less resources consumed in production – that is, energy, not just raw materials.”

Translucent and extremely light plastic blister packs are used as containers for a variety of goods, including cakes, dragées, eggs, sweets, ice cream, seafood, and ready-to-eat, ready-to-cook and dairy products. Pharmaceutical companies, perfume houses and electrical equipment manufacturers have also embraced these solutions. This type of packaging is manufactured using materials that boast superb mechanical strength and can withstand greatly varying temperatures without any change in the chemical properties. “It is light, compact, hygienic, airtight and can display the product – a whole range of benefits for the consumer,” says Valery Balashov. Once the product is consumed, this packaging can be divided into components and recycled.
Doypacks are an ergonomic and time-proof polymer packaging solution used for various types of food products.

**Smart packaging**

Another technological trend in plastic packaging is the so-called intelligent or smart packaging (IOSP), which uses special labels to collect data on the product’s condition.

The most common type of such labels are analogue time temperature indicators (TTIs). Some can only signal that the product has been exposed to a critical temperature, some can measure the duration of temperature anomalies, and some can register all temperature fluctuations. TTIs based on metal nanoparticles (usually gold ones), enzymes, chemical compounds (after polymerisation, photochromic and oxidation reactions) or biopolymers are printed or deposited on, or simply glued to the packaging. Any deviation from the optimal storage conditions causes them to change their colour.

Despite the increasingly rapid digitalisation, electronic TTIs have yet to gain ground due to a sustained imbalance between price and consumer properties (size, recycling potential, ability to collect data without special devices). The same is true for radio-frequency identification.
(RFID).

However, the great potential of such TTIs has prompted intensive research into ways of maintaining their functionality at a reduced cost. In the mid-term, this will be a key trend in food packaging.