



1 Film with printed Fraunhofer-oxygen indicator based on methylene blue.

2 Film with natural light protection.



ACTIVE AND INTELLIGENT PACKAGING

Attention! Detailed knowledge and know-how required!

Consumers, industry, the retail sector and foods themselves put very complex requirements on packaging materials. These requirements can only be met by developing customized solutions. The list of requirements on the packaging is long and includes: attractive and fresh appearance of the food product during the whole storage period, maximum microbiological safety with no or only very small addition of preservatives, stability of the high-value ingredients (e.g. vitamins, flavors) and low transport weight.

In order to realize these requirements, researchers at the Fraunhofer Institute for Process Engineering and Packaging IVV are optimizing packaging materials and developing additional functionalities. This work is being carried out in the Materials Development, Retention of Food Quality, and Product Safety and Analysis departments at the Fraunhofer IVV.

The Fraunhofer IVV has established an Expertise Center for Active and Intelligent Packaging which brings together all the

expertise in this area. In collaboration with users, packaging solutions customized to the food contents are found.

Active Packaging

Active packaging systems *actively* improve the conditions for storing a food product. Ongoing work at the Fraunhofer IVV in this area includes packaging systems designed with:

- Protection against light
- Oxygen-scavengers
- Antimicrobial surface coatings
- Humidity-regulating materials
- Ethylene absorbers

As consumers like being able to visually appraise a food product before buying, the transparency of a packaging is playing an ever more important role, and consequently so is **light protection**.

The aim is to suppress light-induced oxidation processes which are responsible for the loss of vitamins, bleaching, and taste changes such as lightstruck flavors and rancid tones.

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Protection against these reactions is achieved by employing:

- UV filters
- Materials which filter in the visible region (pigments, dyes)
- Partially transparent packaging systems with light-impermeable layers or dense printing
- Measures to reduce or exclude oxygen

The team at the Expertise Center for Active and Intelligent Packaging offers customers advice and provides the following services:

- Evaluation of the sensitivity of food products to light
- Testing the permeability of packaging materials to light
- Storage tests under defined climatic and light conditions
- Quality tests on foods during and after storage

Oxidation can be prevented by excluding oxygen. Various approaches for this are being used and combined:

- Packing products in a protective gas atmosphere (MAP, **M**odified **A**tmosphere **P**ackaging)
- High barrier films which prevent the penetration of oxygen
- Incorporation of an **oxygen-scavenger** as the active component. This binds any residual oxygen in the packaging and any oxygen penetrating from outside

The most important types of oxygen-scavengers are:

- Polymer-based, integrated as a functional layer into the multilayer structure. They are activated by, for example, exposure to UV light
- Iron-based, enclosed as either inlets or sachets in the finished packaging or incorporated directly into the packaging material. They are activated by the

moisture from the contents

- Oxygen-consuming, enzymatic reactions

The Fraunhofer IVV Test Center for Oxygen-Scavenging Packaging offers the following services:

- Development of oxygen-scavengers
- Manufacture of prototypes
- Analysis of oxygen absorption and scavenging kinetics, plus other functional properties
- Information and advice about the latest technologies

One interesting development for protection against microbial spoiling is **active**

antimicrobial packaging. The idea here is to concentrate microbiological agents at the interface between the food surface and the packaging. The use of preservatives in the food can therefore be reduced to a minimum. The Fraunhofer IVV uses the preservatives benzoic acid and sorbic acid, which have been approved for foods.

These are applied to the film by lacquering, laminating or coextrusion and diffuse to the surface of the food.

There are potential applications here for paste-like and solid foods whose surfaces come into direct contact with the film.

In this area, the Fraunhofer IVV also offers customers its extensive know-how on:

- Development of packaging materials
- Evaluation of the microbiological status of foods
- Design of new test methods for determining germ suppression by thin films

Humidity regulation during the storage of many foods has positive effects on taste and shelf-life and results in reduced wastage in the shop.

Applications cover meat, fruit and vegetables.

Researchers at the Fraunhofer IVV are cur-

rently developing a variety of models for:

- The selection and modification of polymers
- Micro-perforation and macro-perforation of packaging
- Incorporation of active substances into the polymer matrix

Another way of prolonging the freshness of agricultural products such as fruit and vegetables is selective absorption of ethylene. Ethylene is responsible for both ripening and spoiling. Researchers at the Fraunhofer IVV have developed a corrugated board material which contains an ethylene absorber. The optimally ripened food hence remains fresh up to the moment of consumption.

Intelligent Packaging

Intelligent packaging systems possess diagnostic and indicator functions for:

- Gases/leaks
- Time/temperature
- Freshness

Shops and consumers can therefore easily see from the indicator whether a critical limit value has been exceeded.

Food approval for active packaging

EU legislation on limit values of relevance for active and intelligent packaging systems is at present being drawn up .

Currently laid down are limit values for substances which may be released by a packaging and also limit values for substances which if exceeded in the food itself is illegal.

The Product Safety and Analysis department offers migration tests and also tests to ensure there is compliance with the latest EU legislation on foods.