Ecodesign in food packaging

UNIT 10: Active and intelligent packaging

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Content unit 10, Ecodesign in food packaging

Contents

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After learning this unit:

After learning this unit, the student will be able to:

Objective 1: To know the main types of active and intelligent food packaging;

Objective 2: To know the principles underlying technologies for producing active and intelligent food packaging;

Objective 3: To know the active and intelligent food packaging applications

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10.1 Definitions

- Regulation (EC) no. 450/2009 includes the following definitions and requirements:
- "**Active materials and articles**" means materials and articles intended to extend the shelf life or to maintain or improve the condition of packaged food; they are designed to deliberately incorporate components that would release or absorb substances into or from the packaged food or the environment surrounding the food;
- "**Component**" is an individual substance or a combination of individual substances which cause the active substance and / or the smart feature of a material or of an article, including the products of those substances; it does not include the passive parts such as the material to which they are added or incorporated;
- **The active packaging** is a type of food packaging with an additional function, besides the fact that it provides a protective barrier against external influence. The active packaging is intended to influence the packaged food. The packaging absorbs the chemical substances related to the food derived from food or the environment surrounding

Active packaging	Applications
Oxygen absorbants	Practically to all classes of food
CO2 emitters	Practically to all foods affected by mold
Water vapor absorbants	Dry and motion sensitive foods
Ethylene absorbants	Horticultural products
Ethanol absorbants	Cooked food (where it is allowed)

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10.2 Active materials and articles:

"Intelligent materials and articles" means materials and articles which monitor the condition of the packaged food or the environment surrounding the food.

Intelligent packaging provides the user with information about the status of the food provided to be reliable and accurate. The component base can be positioned on the outer surface of the pack and can be separated from the food by a functional barrier.

A) absorption / cleaning systems:

- **Moisture absorbers** Part of the vapors from the packaging environment pass through it because of its permeability and condense in the packaging due to temperature changes. There are also drops from the water contained in the food. Likewise, water is also produced during the breakdown of fats and carbohydrates. Accumulated water can cause the growth of microorganisms leading to food degradation. Typical absorption systems (pads) include a superabsorbent polymer positioned between two layers of microporous or nonwoven polymer. Polyacrylate salts, carboxymethyl cellulose (CMC) and starch-based copolymers are used.

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- **Oxygen absorbers ,** iron powder and ascorbic acid absorbers are used in the packaging of pasta, milk powder, biscuits etc. These absorbers are usually in the form of envelopes. The most commonly used is iron powder which has a large surface area reaction. Absorbers can reduce the concentration of oxygen in the free space of the packaging to 0.01%. You can use different amounts of absorbing oxygen from 20 to 2000 ml of oxygen. Modern cleaning pads use a mixture of iron powder and sodium chloride for O2.

- **Ethylene absorbers** (a natural growth hormone of plants, is a key to the ripening process of fruits and vegetables, being released during respiration) can be used as envelopes or incorporated in a polymer film. The active component of the polymer is designed to prevent excess ethylene, to extend the shelf life of the product packed. Most of the ethylene absorbents are based on potassium permanganate. Other ethylene absorbers are activated carbon, bentonite and aluminosilicates (e.g., zeolites).

- **Carbon dioxide absorbers.** a) containing the absorbent physically (zeolite); b) containing the absorbing chemically (calcium hydroxide).

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B**) Food substance delivery systems:**

Applications are packaging that contain substances that are emitted to the food such as preservatives, antioxidants, flavourings, enzymes.

- Antimicrobial agents- Meat and meat products are more susceptible to damage microbial. The main purpose is reducing, inhibiting or retarding the growth of microorganisms. Antimicrobial agent increases the phase delay and decreases the phase of the growth curve of microbial development and, ultimately, reduces the growth of microorganisms.

Organic acids, silver zeolite, spice extracts and medicinal herbs, synthetic antioxidants such as ascorbic acid (vitamin C), BHA (butylhydroxyanisole, E 320) / BHT (butylhydroxytoluene, E 321) or natural ones such as vitamin E, chlorine dioxide and sulfur dioxide. The use of antioxidants in food in EU is regulated by Directive 2 of 1995.

- The ethanol emitters can be used to enhance the storage life of the bread, dried fish products and semi-dried and for the preservation of the bread.

Fig. 1: Absorbent cushions and envelopes and an ethylene absorbent bag
A) Moisture absorbers, B) Oxygen absorbers, C) Ethylene absorbers

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C) **Systems with inserted or applied substances on the wall of the pack:**

Applications are packaging that contain an additive or an enzyme which is applied on the surface in contact with food and has a technological effect on the food. These materials incorporate one or more active components that influence deliberately the condition of the food without migration intent. This category of packaging is thus similar to the previous one with the difference that the active substance is not released in food, but remains applied or inserted on the surface of the pack; any migration into food is not intented.

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10.3 Smart materials and articles

Smart Packaging can be grouped into:

A) Product quality indicators - the Indicators time-temperature (Time Temperature Indicators - TTI), Gas indicators, Fresh indicators etc.

B) Product protection – Package breaking, stealing, etc.

C) Increase the usefulness - during preparation and cooking of food.

In addition, each indicator used in the packaging should be characterized by the following features: low price; the ability to read without having to use a device; non-toxic; stability; sensitivity; the reaction must be irreversible; easily inserted in the package.

Examples: TTI: LifeLinesFresh-Check, based on the polymerization reaction, 3M Monitor Mark, based on dye diffusion, Vitsab®TTI (Cox Technologies), based on color change of lipase (enzyme from digestive juices that hydrate fats, being separated in glycerin and in fatty acids). A typical oxygen indicator consists of a redox dye (e.g., methyl blue), an alkaline compound (e.g., sodium hydroxide) and a reducing compound (e.g., reducing sugars).

Fig 2. TTI indicators

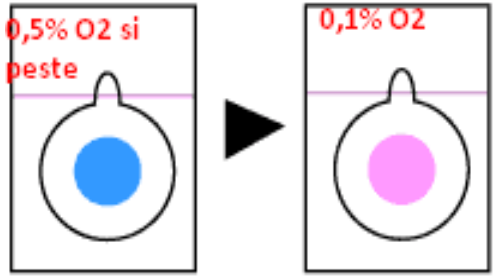

Fig.3. Indicator of O2. Present blue O2, limited red O2

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10.4 The functional barrier

This barrier is a layer of the material or articles which come into contact with food, preventing the migration of substances from the face of the barrier in food. The maximum level of migration tolerated is 0.01 mg of substance / kg food for a substance.

This migration limit is applicable to a group of substances, in particular from the point of view of structural and toxicological interdependent, in particular if they are isomers of the same substance or substances of the same functional group; it also includes the transfer possible outside of the pack.

So far they have been found in three types of situations:

- **for recycled plastics**: recycled plastic materials can be contaminated by different chemical products in the consumer environment; to prevent such contaminants to reach the food, a functional barrier between the recycled plastic and food is intercalated;
- **for substances not approved by regulation**: according to a draft EU regulation, the industry will be authorized to use substances which are not approved by the authorities responsible for public health, (i) if these substances are not carcinogenic, and (ii) if they are separated from the food by a functional barrier, which ensures that are not detectable in food. Such substances are called in the regulation, "substances of the functional barrier;
- **for active packaging**: in the area of active packaging, the functional barriers can prevent migration of active substances or of constituents of the active substance.

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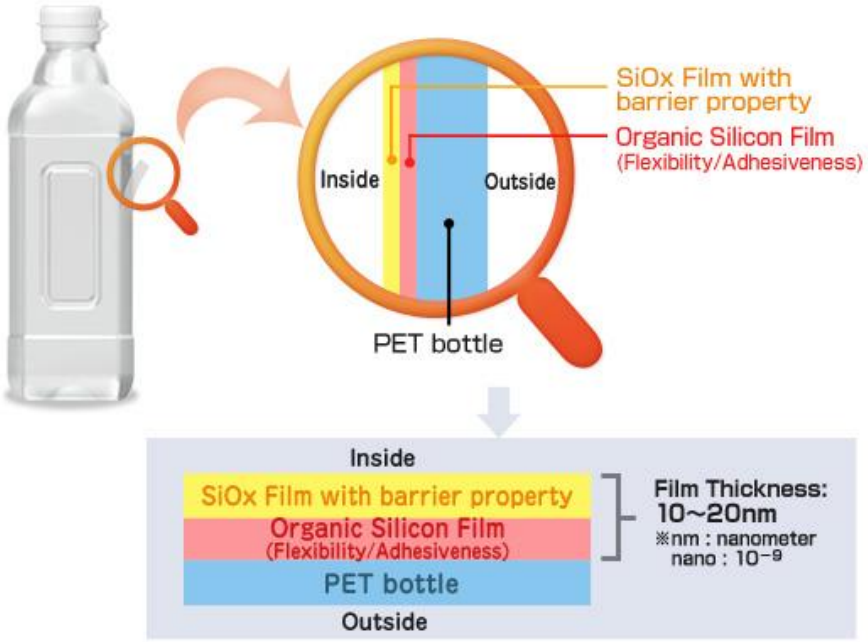
Glass or metals are absolute barriers over a minimum thickness

For plastics, it is not possible to indicate general rules. Efficiency depends on the history of the food or the polymer, as well as on the geometrical properties of the packaging, mainly its thickness. Some general indications can be given:

- polyolefins (PE, PP etc) and EVA are unlikely to behave as functional barriers, whatever the thickness of the layers;
- other polymers, PET, EVOH, PVC, PVDC, may act as functional barriers

if the barrier layer is thick enough.

To decide the minimum thickness can be used a software that takes into account the entire history of the food contact material, for example the [MULTITEMP and MULTIWISE] (INRA).



https://www.toyo-seikan.co.jp/e/technique/petbottle/barrierbottle/

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ECOSIGN

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