RESEARCH SMART-PACKAGES WITH ACTIVE PACKAGING SYSTEMS

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Abstract. *In article the results of research "smart-packages" with the active oxygen system scavenging from consumer packaging. Results of research allowed: to pick up the packing material and determine the size of the sachet, in which decreases allocation heat accompanying a chemical reaction oxygen consumption under; the optimal amount of reagent that meets the requirements for the absorption of oxygen in packages with the test food product. The research results can be used to increase the shelf life of food products.*

Key words: oxygen scavengers, iron powder, consumer packaging, active packaging, food

Modern consumer every day more and more requires the manufacturer of new packages and packaging materials, which not only would not only protect the packaged products from physical, chemical and biological processes, but also to be effective and easy to use. Manufacturers, in turn, try to keep up with the needs of consumers. One of the new types of packages, which are gradually emerging and gaining a place in the food products are «smart-package" with the use of active packaging systems.

The notion of «Smart-package" consider new types of packages, which include the "active" and "intelligent" packaging, as well as functional components for the creation of "smart" packaging design. Introduction of «Smart-packages" using active packaging systems covers all aspects of the use of advanced packaging materials, and the introduction of mechanical and chemical components, or a combination thereof, extending the shelf life of food products while maintaining their qualitative and quantitative characteristics.

One of the first places in the world among of packaging materials used for food packaging is confidently occupy polymer films. Analysis of existing methods extend the shelf life of food products packed in polymeric film package shows that gained widespread use vacuum packaging and use of modified atmosphere (MAP). Like any other ways to extend the shelf life of foods they have a number of advantages and disadvantages.

Packing in MAP is a way of packing, in which air is removed from the package and replaced with a gas or gas mixture. Gas mixture is selected depending on the type of product (usually the air is replaced with nitrogen and carbon dioxide). Gases are not deformed and not compressed products, that is very important for packaging of many meat products, fresh bread, ready meals, convenience foods and etc. During the period of storage of the product gaseous atmosphere inside the package is constantly changing. This is due to factors such as the "breath" of packaged products (oxygen consumption and carbon dioxide emissions), biochemical changes in the product and the associated allocation of vapors and gases, and the gradual penetration of the head space of atmospheric gases and vapors through the walls of the package and through pinholes in the welds. Oxygen, which is in the package, allows you to preserve the freshness and natural color of chilled meat, prevent botulism of fish products, as well as support the process of "breathing" for fruits and vegetables, and, conversely, inhibit the growth of anaerobic organisms in some types of fish and vegetables. But, in turn, he is the originator of oxidation and rancidity of fats, food spoilage as a result of the growth of aerobic bacteria. On the other hand, without him can not do, if you want to, for example, to keep a bright red color of beef, which is associated by consumers with its freshness. One way to address these concerns in the process of food storage is the targeted impact on the MAP.

Due to the problems that occur during storage of raw materials, food products and semi-finished products in the MAP, the active development of the concept becomes larger storage stability by controlling and regulating the composition of the gas in the package using the «smart-packs" with a self-regulating and actively controlled atmosphere. Active packagings call type of packaging, components or materials that change their properties to protect the product, increasing the shelf life of the goods [1]. The main function of "active packaging" is the targeted impact by the product or the internal environment of the packaging for long-term storage of its quality, as well as to extend the stability and availability [8]. Technologies associated with "active packaging" expanded function from passive packaging barrier relative to the external exposure to the active product protection [2]. The principle of "active" control of the atmosphere founded on the absorption and emission of gases in the package.

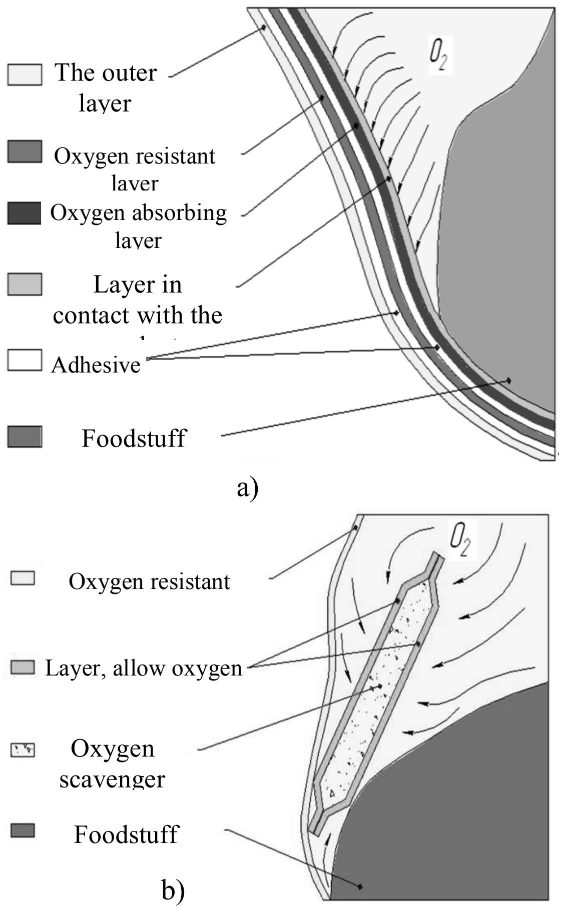

Fig.1. *The design of packages: a) with active oxygen absorbing layer b) with the sorbent, which is located in the sachet.*

This provides meaningful regulation of the atmospheric environment in the package due to the chemical or enzymatic removal of unwanted gases [4]. Absorption, with a specially selected sorbent be all residual oxygen, which is in the package at the time of sealed and flow through the film during storage. In this case persist, as close as possible to the initial, parameters such as taste, smell, color and consistency of many perishable foods. This is what contributes to the reduction of growth of aerobic microorganisms [6].

Existing packaging systems controlling the amount of oxygen is conventionally divided into two types - with oxygen scavenger layer in the package design or with the sorbent-oxygen scavenger, which is located in a special envelope (Fig. 1). As oxygen scavengers use substances that can be chemically or enzymatically remove oxygen, which will provide product protection and preservation of its quality.

Representatives of sorbents - iron oxide (iron powder), ascorbic acid, iron-salt powder, mixture of iron oxide and potassium chloride, calcium etc. Polymers such as nylon fibers ducted cobalt MXD 6, can be used as an oxygen-absorbing layer inside bottles of polyester. Other systems may be based on the absorption of unsaturated polymers, such as 1, 2-polybutadiene [3, 5]. The use of multilayer polymer films with active oxygen scavenger layer for the packaging of food is limited. This is due to the incompleteness of scientific research in the field of their application for the packaging industry and the likelihood of contact is the chemical reaction of oxidation and food. Most manufacturers prefer to use when packing the sorbent, which is placed in a special envelope - package. However, it also raises a number of specific issues to be addressed, namely, what kind of packaging material used for the production of packages, because it should provide the penetration of oxygen to the sorbent and hold inside the shell products of the chemical reaction; how many of reactant must placed in the package for effective oxygen consumption; what should be the geometric parameters of the package with the sorbent.

That is why the purpose of the research was the choice of packaging material, the geometric dimensions of containers for oxygen scavengers, as well as quantification of the reactant necessary for the chemical reaction of oxidation of the sorbent and the absorption of oxygen. As the oxygen scavenger were elected packages-sachet (Fig. 1.b) which are packaged in the consumer packaging. The choice of this method of controlling the gas atmosphere in the package based for simplicity and high efficiency. As a sorbent-scavenger oxygen was elected iron oxide as one of the most common materials for absorbing. Object of research were plastic packaging with dried meat, production company "Drayd Fudz" (Ukraine). To determine the efficiency of oxygen scavengers, which are packaged in a variety of packaging materials, was used analyzer brand OpTech-O2 Platinum (Fig. 2).

As a research of packaging materials were chosen: EVA film - (20mkm), low density polyethylene - LDPE (20mkm) and films Ecolean with various impurities Ca (15 mkm). Focusing on the production of "Drayd Fudz" were made the packages-sachet.

Fig.2. *Gas analyzer brand OpTech-O2*

In the ready package was placed 4 grams of iron powder and 0.6 ml of water, after which he was closed and placed in a package with food. The next step was to seal the consumer packaging. For dried meat need of the oxygen concentration in the consumer pack over 48 hours was less than 0.1% [7]. On the basis of this condition, the duration of the measurement cycle was 48 hours; the kinetics of the absorption oxygen in each of the packages was measured every 4 hours.

Results are presented in Fig. 3.

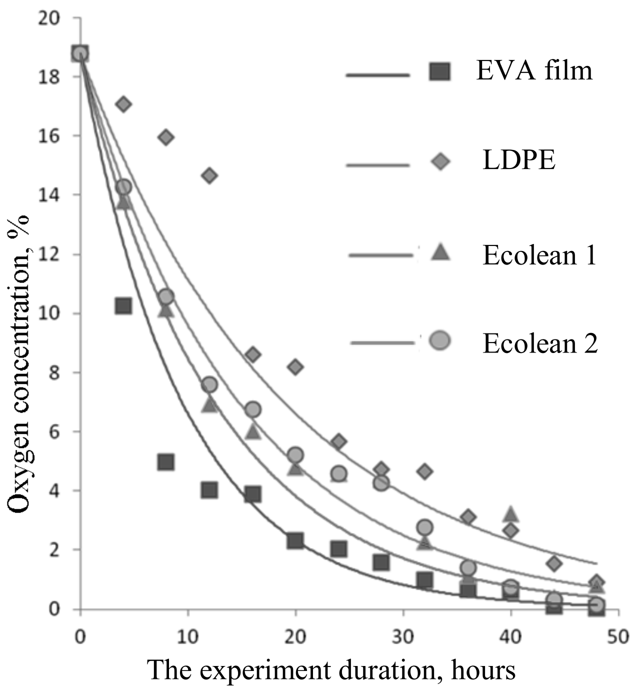

Fig.3. *Chart of absorption package-sachet.*

This diagram shows that the intensity of the absorption of oxygen decreases with time; she is accompanied by a decrease in the degree of oxidation. The highest gas permeability of packaging materials was at the EVA film with a thickness of 20 microns.

To determine the efficiency of oxygen consumption in the consumer packaging with food (meat snacks) were made bags-sachets with different amounts of water in the structure of an oxygen scavenger. As a packaging material was used film of EVA, with a thickness of 20 microns. Amount of Water for 4 grams of iron powder was

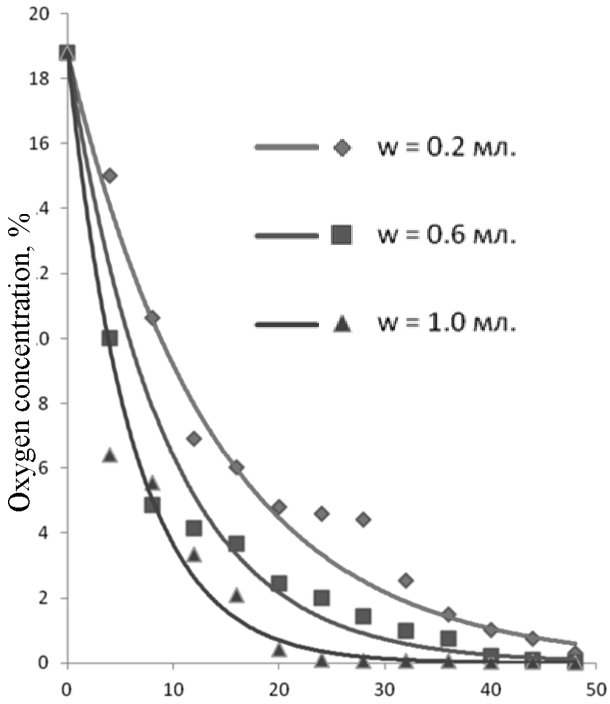

Fig.4. The experiment duration, hours *'ifferent moisture content in the packages-sachet*

respectively 0,2; 0,6 and 1,0 ml. To process the measurement results was necessary to define the regularities of variation of oxygen consumption for the period of time equal to 48 hours for each oxygen scavengers with different moisture content

The results are shown on Fig. 4.

This diagram shows that the intensity of the absorption of oxygen decreases with time; it is accompanied by a decrease in the degree of oxidation. Effectively works oxygen scavenger with the amount of water 1,0 ml. which for 24 hours absorbs the oxygen before concentration 0,01%. At the same time, with such intensity absorption is allocated significant amounts of heat, which does not meet the requirements established by the manufacturer with respect to the tested product. Oxygen scavenger with 0,2 ml of water works inefficient, as it is not consumed the right amount of oxygen for 48 hours; only the oxygen scavenger with 0,6 ml of water fully complies with established requirements.

For the selection of the most efficient geometric dimensions of sachets with oxygen absorbers were examined three variants of the size sachets: 10x15 mm., 20x30 mm., 40x60 mm.

The results are shown in Fig. 5.

The diagrams show that the intensity of the absorption of oxygen decreases with time; it is accompanied by a decrease in the degree of oxidation. Most efficiently works oxygen scavenger in the sachets with the geometric dimensions 40x60 mm., but absorption of oxygen passes with a temperature of 32 ° C, which leads to

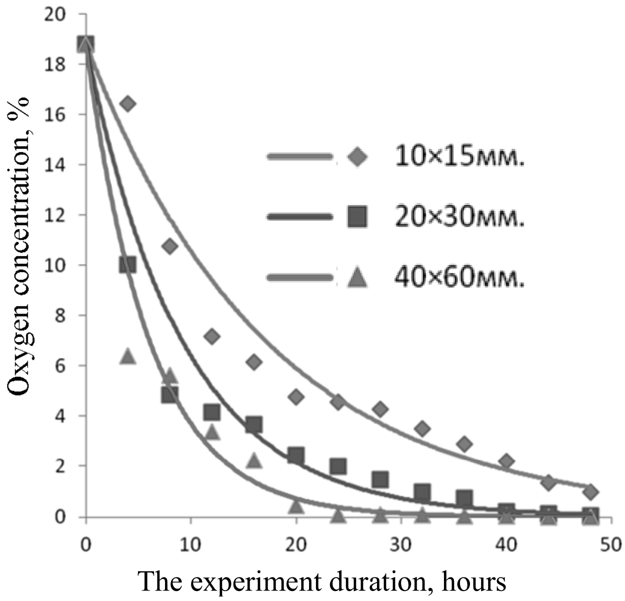

Fig.5. *Diagram of oxygen absorption with packages-sachet different sizes*

heat the food and the loss of quality. Oxygen scavenger with dimensions 10x15 mm. showed the lowest absorption efficiency because its effective area was smallest. Oxygen scavenger per sachet with dimensions 20x30mm., as seen from the diagram (Fig. 5.) for 48 hours reduced the oxygen concentration to 0.05%, which fully meets the requirements of the manufacturer.

Output. The research led to the development of plastic packaging for oxygen scavengers. Was chosen packaging material (EVA film with thickness 20 micron), allowing the absorb oxygen from the interior of the consumer packaging for food product. Also identified the oxygen scavenger, at which the decreases heat during the chemical oxidation of iron powder. It was determined the optimal number of the reactant, which came to a chemical reaction of oxidation of iron powder and provide of the requirements for the absorption of oxygen in the test food product.

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