Fraunhofer Institut
Verfahrenstechnik
und Verpackung

Oxygen-scavengers combat retort-shock

When ready-to-eat meals are sterilized in plastic packaging systems (containing ethylene-vinyl alcohol copolymer (EVOH) as the barrier layer), the sterilization step temporarily diminishes the effectiveness of the oxygen barrier.
This effect, known as retort-shock, has adverse consequences for the shelf-lives of the products. Oxygen-absorbers (scavengers) incorporated into the packaging material can combat this problem and protect the packaged food against oxygen.

The Fraunhofer Institute for Process Engineering and Packaging IVV has investigated these issues in a project funded by the Bavarian Ministry for Commerce, Infrastructure, Transport and Technology.

EVOH as an oxygen barrier layer for prolonging the shelf-life of foods

In order for ready-to-eat-meals to have a long shelf-life, the packaging must act as a high barrier against the penetration of oxygen. In this regard, multilayer films (PP/EVOH/PP) with EVOH as the oxygen barrier (ca. 0.1 – 2 cm^3 $O_2/(m^2\ d\ bar)$) have considerable advantages over monolayer films (ca. 5 – 2000 cm^3 $O_2/(m^2\ d\ bar)$, for a thickness of 100 µm).

The effectiveness of the EVOH oxygen barrier is highly dependent on the relative humidity. The gas barrier is significantly reduced (retort-shock) following a sterilizing wet-heat treatment step. Only after a longer period of time (days/weeks) does the barrier become fully established again.

Although there are other barrier materials such as SiO_x or LCPs (Liquid Crystal Polymer) which show no retort-shock, these materials either cannot be deep-drawn (e.g. for meal trays/containers) or are unfavorably priced. Increasing the thickness of the layer is a strategy which does not eliminate retort-shock.

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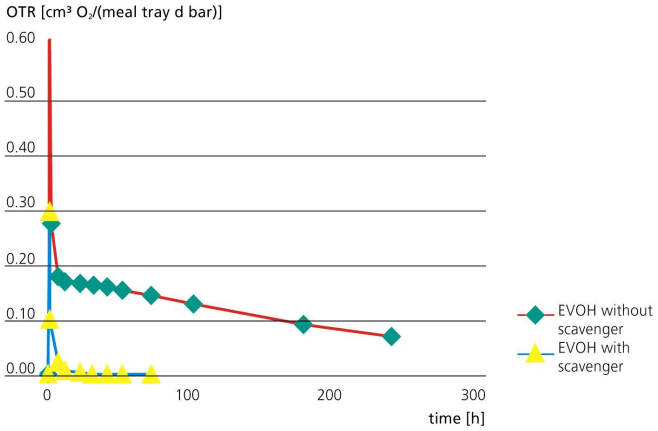
During the retort-shock phase, oxygen is able to penetrate into the packaging in increased amounts. The result is significant quality loss during storage.

A strategy to overcome the susceptibility of EVOH to retort-shock is to incorporate an oxygen-scavenger layer into the packaging material structure. It is preferable here to use iron-based oxygen-scavengers which are rapidly activated by the autoclaving process. Any oxygen which penetrates during the cooling phase is thus immediately scavenged, meaning considerable quality improvement for the packaged food. This also prolongs the shelf-life. The experiments also showed that use of an oxygen-scavenger allows the amount of EVOH that is employed to be reduced.

Meal trays containing different concentrations of oxygen-scavenger and layers of different EVOH thickness were studied and evaluated as part of this project.
A 9-month storage trial involving filled meal trays allowed analytical and sensory demonstration that optimized meal trays improved the quality stability.



Oxygen permeability (after autoclaving) as a function of time for PP/EVOH/PP meal trays with and without oxygen-scavengers

The use of oxygen-scavengers for pasteurization and sterilization resistant plastic laminates is novel and innovative.
With satisfactory protection for the contents, this opens up opportunities for designing novel packaging systems with reduced usage of materials, and possibly also dispensing with additional aluminum layers.

In the fast-growing convenience food sector there will be opportunities for developing new food products due to the fact that molded multi-compartment packaging systems with improved barrier properties will be able to be manufactured.

Color changes in stored ready meals:
Left: Packaging with O_2-scavenger
Right: Packaging without O_2-scavenger