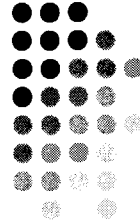


Active & Intelligent Packaging



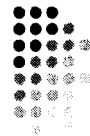
Department of Packaging,
Yonsei University

November 2006

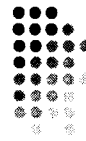


Overview

- Active Packaging
 - Oxygen (O_2)
 - Moisture (H_2O)
 - Ethylene (C_2H_4)
 - Microbiological (Antimicrobials)
- Intelligent (Smart) Packaging
 - Time/Temperature (TTI)
 - Location (RFID)
 - Microbiological status (indicator)

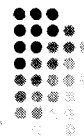


Active Packaging



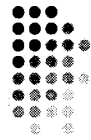
- Active packaging is the overt manipulation of the environment in the package to enhance or better retain food content quality
 - Purge absorbers
 - Oxygen scavengers
 - Moisture absorbers or emitters
 - Odor absorbers or emitters
 - Antimicrobials
 - And other controllers of active variables

Active Packaging

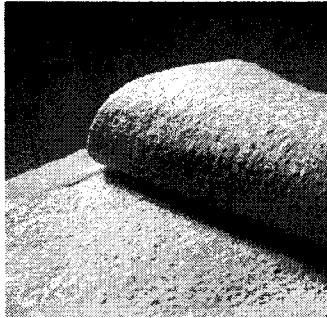


- Purge absorption
 - To remove liquid squeezed or leaking from fresh products such as meat and fruit
 - Controlled by pulp or polymers
 - Can be enhanced by active additives (Antimicrobials)
 - The largest commercial application of active packaging

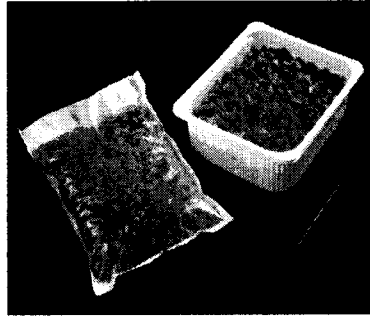
Purge Absorber



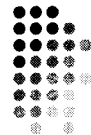
Purge Absorbers – Pulp



Chase Polymeric Purge Absorbers



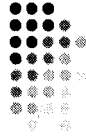
Active Packaging



- Oxygen scavengers
 - To remove oxygen and retard oxidative reactions
 - As sachets in headspace (Jerky , Pepperoni , Pasta)
 - As labels with less active component
 - Incorporated into Package materials (Plastic beer bottles, Pasta, Retortable pouches and trays)

Active Packaging

- Oxygen scavengers
 - Mitsubishi gas chemical Ageless
 - Multisorb Technologies, etc., oxygen absorbers
 - Ascorbic acid , Sulfites , Photosensitive dyes, and ligands
 - Oxbar cobalt catalyzed nylon MXD6 imbedded in the plastic structure

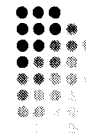
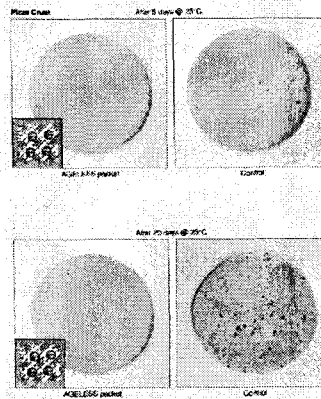


Oxygen absorber

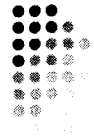
Mitsubishi Ageless oxygen absorber



Comparison Effect of AGELESS



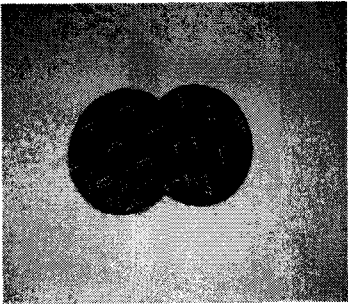
Oxygen scavenger



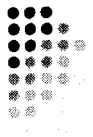
Oxygen scavenger



Oxygen scavenger label

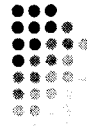


PET Beer bottle with oxygen scavengers



Active Packaging

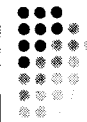
- Moisture control
 - Desiccant for dry food
 - (Internal)
 - (Multiphase plastic for both pre and post opening activity)
 - Humidity controllers
 - (For high moisture foods, e.g. cut fruit, vegetables)
 - (To retard moisture loss)
 - (To retard excess moisture in headspace and interstices where microorganisms can grow)
 - Antimicrobials

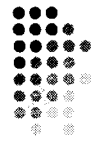


Moisture control



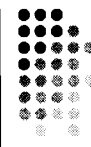
MiniPax Sorbent silica gel packets are Formed of heat sealed Tyvek spunbonded polyolefin





Active Packaging

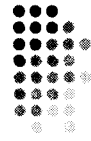
- Ethylene absorbers
 - Ethylene is respiratory gas from fresh produce (also from engine exhaust fumes)
 - Excess ethylene accelerates respiration
 - Remove ethylene extend shelf life
 - Physical absorption
(on active surfaces .. Activated carbon , Zeolite)
 - Chemical removal with permanganate
(Effective and commercial in bulk distribution)



Ethylene absorbers



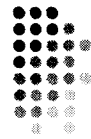
Active Packaging



- Antimicrobial

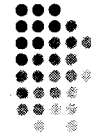
- Antimicrobial or counter microbial
Objective is to reduce the rate of growth of spoilage and / or pathogenic microorganisms in the contained food and thus extend the shelf life
- Technologies under study
 - (Silver ion)
 - (Allyl isothiocyanate)
 - (Chlorine dioxide)
 - (Ethyl alcohol)
 - (Natural spices)

Intelligent packaging



- An intelligent package senses change and communicates that information to can provide benefits(such as more convenience, better safety , or higher quality) if used
- Examples
 - Time/temperature , etc. indicators can imply/signal user the quality of the packaged product
 - Biosensor in theory can inform the user of the growth of microorganisms, spoilage and even pathogenicity in the package
 - Bar code can help to provide better reheating and / or cooking
 - Ripeness
 - Nutritional attributes
 - Gas concentration in modified atmosphere packages

Intelligent packaging



- Time-Temperature indicator (TTI)

TTI history can be related to the extent of food deterioration, food quality, and safety

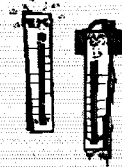
Time

The shorter the distribution time, the better the food quality is retained.



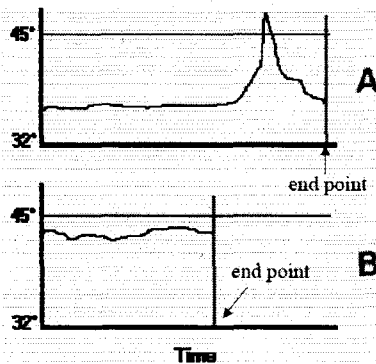
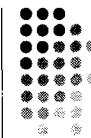
Temperature

The lower the temperature, the slower the deterioration rate. the better the food quality is retained



Hot Cold

Time-Temperature indicator (TTI)

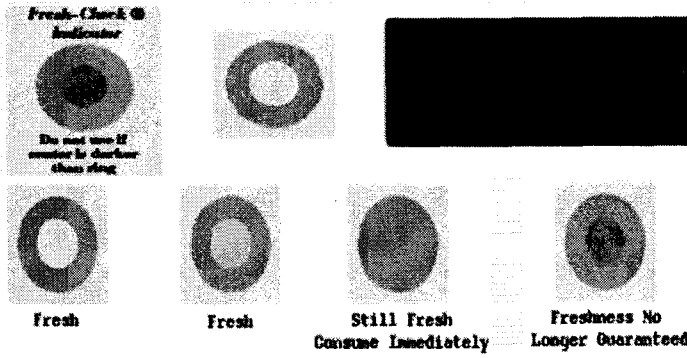


TTI determines the end point based on the time-temperature history (area under the curve). "A" has a longer time run than "B", although the time-temperature history is the same.

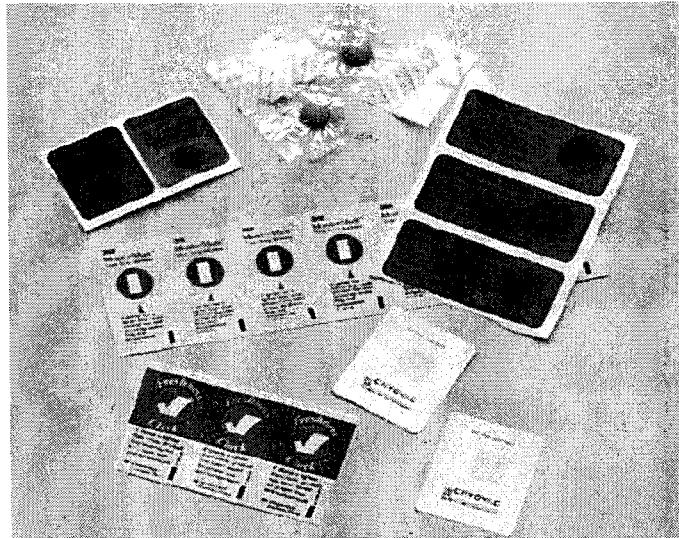
Unlike the temperature limit indicator, TTI is not triggered when the temperature reaches a certain limit.

Intelligent indicator

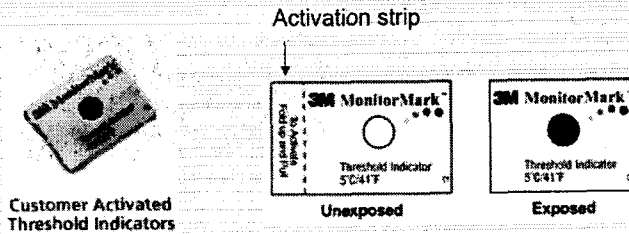
- Fresh check indicators



Lifelines' Fresh Check indicators are color-changing, self-adhesive labels which respond to cumulative exposure to temperature. Attached to packages at production.

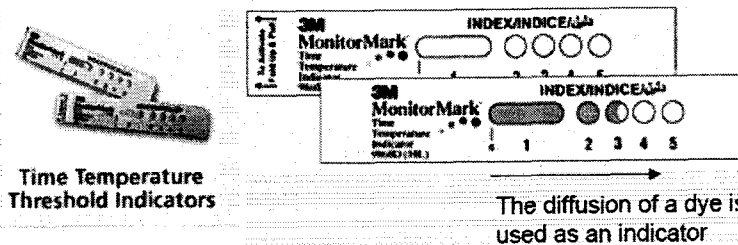


- 3M Monitor mark temperature limit indicators



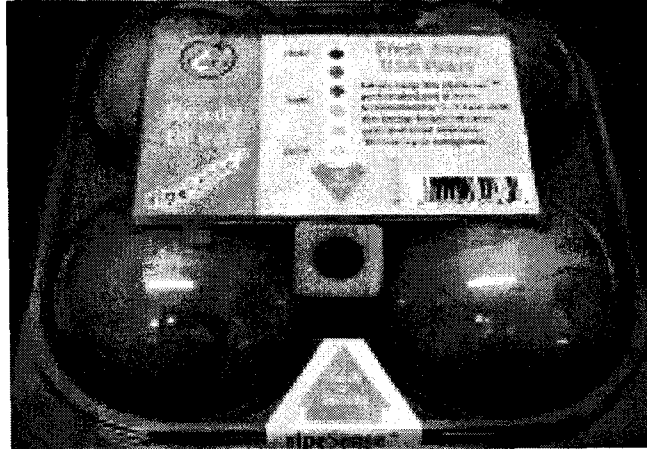
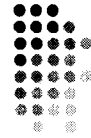
These indicators are activated by pulling out an activation strip. Upon exposure to temperatures above the threshold, the activated indicator's window irreversibly turns blue.

- 3M Monitor mark TTI

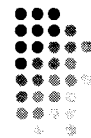


The MonitorMark time temperature indicator contains layers of paper, film, adhesive and other components. A porous wick indicator track strip, one end of which is positioned over a reservoir pad containing a blue dyed chemical with a desired melt point. Before activation, a removable activation strip separates the indicator track from the reservoir.

Ripeness indicator



Microbial grow indicator



AVANT REACTION

TRACEO : Transparent

Lecture Code-Barres : Possible

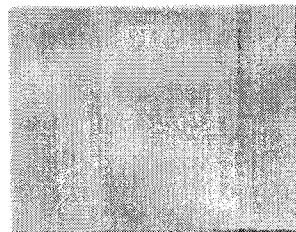
Produit : Frais

APRES REACTION

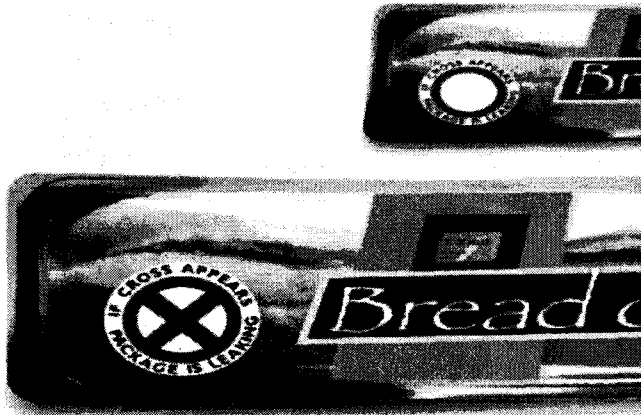
TRACEO : Opaque

Lecture Code-Barres : Impossible

Produit : Ne plus consommer



Oxygen indicator



The active & intelligent packaging is a multi-disciplinary area and the following know-how will be required in the future

- Materials science
- Chemistry & Biochemistry
- Biology & Microbiology
- Advanced printing techniques
- RF electronics
- It system engineering
- Production engineering