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Baverstam Associates' Electronic Newsletter
Volume #10, Issue #6

Welcome to Baverstam Associates' sixth newsletter for the year 2010. In this issue, we provide an update on the latest developments in **food and beverage packaging**.

We hope that you will enjoy this newsletter. We welcome any type of feedback or questions.

Sincerely,

Maithri (Maya) Rao
Frank Ross
Editors

Past issues are on our website in PDF format at: http://www.baverstam.com/newsletter.

To subscribe or unsubscribe, or send comments, please send e-mail to: info@baverstam.com.

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TABLE OF CONTENTS

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Food Packaging: Introduction

Packaging has a significant effect on the quality and perishability of packaged food. It can dramatically affect the shelf life, as well as the freshness and safety of the food. Materials play a critical role in enabling effective and attractive packaging for food products. Although consumers are somewhat oblivious to the effect of packaging, it not only plays a vital role in attracting consumers' attention and enhancing the product's appeal, but also plays an increasing role in enhancing the quality of the food inside.

Each food product has a different amount of time in which it retains the required level of quality and safety under a particular storage condition. This defines the shelf life of the particular food. A lot of effort is made in defining and extending the shelf life of packaged foods. Each link in the food product chain –production, distribution, storage and retail– contributes to the quality of food and can influence the shelf life of the product. Packaging is designed to minimize reactions affecting the stability and quality of the food within the package: in most cases they concern reactions with gas species in the environment such as water vapor and oxygen. However, modern packaging goes beyond this, and is often designed to add other attributes to the food within it. For example, anti-microbial packaging prevents microbial growth in meats and cheese with more sophisticated systems using an on-demand release system that releases preservatives into the pack contents only when required to prevent microbial growth. Many of these fall under the active and intelligent packaging category. By using such packaging, the processors can increase shelf life, protect flavor profiles and maintain the food's appearance and texture with little to no changes to the food contents.

Active Packaging

Active packaging interacts chemically with the food inside the package to safeguard against product degradation. Most common use of active packaging is to prevent degradation due to oxygen and/or moisture. These are called active scavenging systems (absorbers). Other types are active release systems or emitters (e.g. CO_2 emitters) and controlled release packaging (antimicrobials).

Most common among these are oxygen and moisture scavenging systems. Moisture absorption is important because it lowers the water activity of the food product and therefore suppresses microbial growth. Moisture absorption typically consists of a superabsorbent polymer (SAP) located between two layers of a microporous or non-woven packaging polymer. The absorption materials can be polyacrylate sheets, propylene glycol films or in the simplest case, satchets of silica gel or clays. There are several different materials that can be used for oxygen absorption such as sulfites, boron, glycols and sugar alcohols, photosensitive dye, yeast and other enzymes, and ferrous based scavengers. Another way to inhibit microbial growth in meats and poultry is to introduce CO_2 inside the package. High CO_2 levels inhibit surface microbial growth and extend shelf life. Active release packaging with calcium, sodium or potassium hydroxide, calcium oxide and silica gel are used in this application. Because the permeability of CO_2 is much higher than

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that of O_2 in most polymer films, the package can be designed to maintain a certain concentration of the former while removing the latter. The most recent developments in active packaging incorporate antimicrobial agents such as chitosan, sorbic acid and silver oxide in the packaging material.

Although active and intelligent packaging has been available for several years, it has been slow in reaching the mass market. In recent years, with increased demand for natural foods around the world, this type of packaging has seen a rise in interest. It is currently estimated that the total global active and intelligent packaging market for the food and drinks industry will reach $6.6 billion by 2015.

A key technology in active and intelligent packaging is nanotechnology. Due to their high aspect ratio, nanomaterials have the capability of altering the properties of packaging materials without significant changes in appearance and processing performance. Nanotechnology allows reduction in weight with strength improvement, monolayer structures with multilayer capabilities, improved barrier properties against environmental factors, and increased shelf life. The addition of certain nanoparticles in polymers such as PP, TPO, and PE provides improvement in mechanical and thermal properties, and also enhances barrier resistance. They can also improve taste, flavor, texture and consistency of foods and act as sensors to trace and monitor the condition of food during transport and storage. One of the more common uses of nanotechnology in packaging is the use of an aluminum nanolayer coating on the inside of snack packages.

The rapid adoption of nanoparticles in food packaging has raised health and environmental concerns, requiring further knowledge in long term effects of nanoparticles on consumer health and the environment.

Eco- friendly Polymers

Similar to the concerns about nanotechnology, consumers and scientists are also concerned with the use of other chemicals in food contact materials. One area with growing implications is the use of bisphenol-A (BPA). Scientists have raised concerns about the health hazards of using BPA, which has caused a near panic among some consumers. Although conclusive evidence is lacking, scientists claim that BPA can disrupt endocrine function and exposure to the chemical can cause serious developmental issues in children. As a result of these claims and growing public and interest group demands, many states are considering banning the chemical from baby products. Recently, New York State signed a new bill banning the use of BPA in childcare products. The Australian Government is also signing deals with major retailers like Heinz Australia to begin phasing out of baby products containing BPA. The North American Metal Packaging Alliance (NAMPA) recently issued a statement that the canned food and drinks sectors were bowing to consumer pressure and seeking BPA replacers. This has triggered intense research to find suitable substitutes for BPA and other chemicals considered hazardous to human health.

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This growing public awareness is also helping the growth of biodegradable packaging in recent years. Although it has been available for several years, it has only recently started growing in popularity. Biodegradable packaging is lighter, easier to dispose and environmentally friendly. A broad range of biodegradable resins based on aliphatic polyesters and aliphatic-aromatic copolyesters have been commercialized in the past five years and demand for them is growing at 30% per year. Europe and Japan lead the market, but North America is catching up with these regions in the development and use of biodegradable packaging.

In this newsletter, we report recent developments in food packaging related to advanced materials.

Latest Developments

Active Packaging

Graphene-based Antibacterial Paper

July 2010
Researchers from **XXXXX** have developed an antibacterial paper made from graphene-based nanomaterials that can inhibit the growth of E. coli. The paper is made from dispersible graphene derivatives: graphene oxide (GO) and reduced graphene oxide nanosheets. They can be made into a thin paper used for packaging meats.
[weblink]

Transparent Nano-thin Coating Provides Barrier Resistance

July 2010
Scientists at the **XXXXX** have developed a coating technology that coats polymer films with an ultra-thin clear barrier layer to enhance product shelf-life. The plasma-assisted technology allows the creation of a 10 nm thick aluminum oxide coating with the same barrier properties as thicker films. The coating is transparent and made using a roll-to-roll process, which allows for volume production. The technology was developed in partnership with a German company, XXXXX was also involved in the development of the process and is planning to commercialize the technology. The company **XXXXX** demonstrated pilot scale production with the technology at a plant in Mexico.
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Nanocellulose Material with Excellent Barrier Properties

May 2010

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Researchers at Swedish company, **XXXXX**, developed a technique to produce nanocellulose for packaging at remarkably reduced cost. The renewable nanocellulose material is extracted from wood fibers and can be used to make high barrier films for food packaging applications. The newly developed process is highly energy efficient with electricity consumption a fraction of the conventional processes for plastic production.
[weblink]

Antimicrobial Packaging Curbs Listeria in RTE Foods

April 2010
A team of scientists from **XXXXX** is developing a new antimicrobial active packaging that can control the growth of Listeria monocytogenes (LM) on the surface of ready-to-eat (RTE) foods to extend their shelf-life. The packaging contains pullulan films containing the bacteriocin sakacin A, which can inhibit growth of LM in turkey deli meat. Pullulan is a biopolymer that also has good oxygen permeability and appropriate barrier properties for packaged foods.
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Packaging with Embedded RFID Tag

March 2010
Researchers at **XXXXX**, in collaboration with researchers at the **XXXXX** in Korea, have built a printable RFID transmitter that can be embedded into food packaging. The RFID tag can replace bar codes and avoid the checking out process for customers. A scanner can read the tags of all the packages as the customer exits the store. The thin film transistors for the RFID devices are ink-jet printed using ink infused with carbon nanotubes.
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New Line of Oxygen Scavenging Films

July 2009
XXXXX recently introduced the XXXXX line of active packaging materials, which contain oxygen scavenging components. The films are formulated to inhibit mold growth, color degradation, nutrient loss, and flavor and odor change. They are intended for a wide range of foods including meats and cheeses. The film is transparent and can be used on existing equipment.
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New Barrier Film with Oxygen Scavenging Properties

June 2009
XXXXX also introduced a barrier film with oxygen scavenging properties. The latest addition to the company's XXXXX line of active packaging materials incorporates a scavenging material directly into the barrier layer of film. This polymer material traps any oxygen that can migrate into the film from the package headspace or from the environment. The incorporation of the polymer in the film makes processing simpler and more effective.
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Novel Nanotechnology-based Barrier Layer

February 2009
Scientists at the **XXXXX** polymer research unit have developed a nanotechnology-based technique to block the transport of damaging gases through a polymer. This will help keep food fresher for longer while using less packaging material. By confining polyethylene oxide (PEO) in nanolayers, the scientists were able to crystallize the PEO as a single layer that reduce the gas permeability by a factor of 100.
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Nanosensor to Detect Salmonella

January 2009
Scientists at the **XXXXX**, in collaboration researchers at the **XXXXX** have built a nanorod-based biosensor that enables rapid detection of the Salmonella pathogen with high sensitivity. The new biosensors include fluorescent organic dye particles attached to Salmonella antibodies that light up when the antibodies attach to Salmonella. The nanosensor can be built into food packaging, which will enhance the food safety and security.
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Biodegradable and Eco-Friendly Packaging

New CO_2-based Plastic Offers BPA Alternative

July 2010
XXXXX has developed a breakthrough process to convert waste carbon dioxide into food packaging and coatings that can be used to replace bisphenol A (BPA) in the linings of food and drink cans. The process uses a proprietary catalyst that enables the carbon dioxide to copolymerize with propylene oxide. Carbon dioxide, sourced from a gas or ethanol plant waste stream is used to pressurize the reactor and trigger the reaction. The polypropylene carbonate

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(PPC) polyols are BPA free and can be used as a replacement for epoxy in can linings. The company signed a joint development agreement with **XXXXX**, who will enable commercialization and convert the polyols into resins and formulate them for target applications. XXXXX recently spun off the research by Professor XXXXX at **XXXXX**.
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New Technique to Sequester Carbon Dioxide from Air for BPA Free Plastics

June 2010
Researchers at the **XXXXX** in have developed a way to pull carbon dioxide out of the air and use it to make plastics that do not contain bisphenol A. Using ionic liquids and techniques similar to those employed by plants during photosynthesis, scientists sequestered CO_2 from the air. Chemicals such as imidazoliums and N-heterocyclic carbenes (NHCs) are then used to couple CO_2 with epoxide molecules to form polycarbonates. This new material has 40% CO_2 by weight.
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Transparent Film with Excellent Aroma and Oxygen Barrier

May 2010
The XXXXX flexible packaging company **XXXXX** has developed a new high performance film for fresh meat packaging that combines easy opening with maximum protection. The XXXXX film is easy-to-open, and offers both aroma and oxygen barrier. It also has standout anti curl and flatness properties.
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Fruit Skin Derived Biodegradable Polymer

May 2010
Researchers at the **XXXXX** developed a biodegradable plastic packaging from tropical fruit skins such as bananas, rambutans and chempedak. The XXXXX product is 8-10 times less expensive compared to commercial biodegradable plastics such as polylactic acid and polycaprolactone and even cheaper than petroleum based plastics such as PE and PP.
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New Eco-coating as Replacement for Plastic Packaging Films

May 2010
Researchers at the UK's **XXXXX** and **XXXXX** in Sweden have jointly developed a packaging coating material made from starch and clay that is designed to replace plastic films. The

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XXXXX coating is moisture and oxygen resistant and can be used for cardboard and paper packaging. The research team is looking for partners for commercialization of the technology.
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Sugar-derived Epoxy Lining Could Replace Bisphenol A

February 2010
Researchers at the **XXXXX** developed a chemical derived from sugar with the potential to replace bisphenol A in a number of products, including the lining of food cans. The epoxy resin is based on isosorbide diglycidyl ether and the hardener used in the epoxy is also plant derived. Isosorbides have been used in the pharmaceutical industry for many years and pose no health safety risk.
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New Compostable Packaging Material

February 2010
Scientists at the **XXXXX** are developing a packaging polymer that can be composted at home similar to other household organic waste. The degradable polymer is made from sugars known as lignocellulosic biomass that come from non-food crops and renewable biomass from agricultural or food waste. The oxygen-rich sugars in the polymer allow it to absorb water and degrade in a few months.
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Liquid Crystal Layering for Improved Sealants

February 2010
Scientists at **XXXXX** discovered a technique to manipulate liquid crystals into forming distinct and separate layers, which significantly improve their sealing properties. The process involves creating discs by exfoliating crystals of a compound of zirconium phosphate and the layering process, also known as “smectic phase”, occurs during a process of self-assembly. This phenomenon has heretofore not been observed with disc shaped liquid crystals. Using the new material as sealant can enhance the shelf life of packaged foods.
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Modified Corn Nanoparticle with Extended Oxidation Resistance

December 2009
Researchers at **XXXXX** modified nanoparticles of corn that have extended oxidation resistance, which can lead to extended shelf life of food products in packages. Allowing the nanoparticles to attach to oil and emulsifying them can make the particles oxidation resistant. By incorporating

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these nanoparticles into food packaging, active packaging with high oxygen barrier properties can be achieved.
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Large Scale Production of Bioplastics from Sugarcane

December 2009
The petrochemical company **XXXXX** and XXXXX enzyme producer **XXXXX** launched a research project to develop large-scale production of polypropylene (PP) from sugarcane at a lower cost. XXXXX is using its expertise in fermentation techniques to engineer a microorganism that will produce the plastic from sugarcane.
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Other Packaging Developments

New Resin with High Transparency and Gloss

July 2010
XXXXX introduced a new polystyrene resin that has high transparency and gloss properties specifically for food packaging applications. The XXXXX is a high impact polystyrene resin also has easy processability and reduced formulation costs.
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New Nanotech Foil and Wax Paper

May 2010
XXXXX company **XXXXX** launched a new nanotechnology based coating for aluminum film that can be used as chocolate wrappers. The nanocoated foil is insect proof and has higher strength. Also, under development is nanocoated waxed paper that has higher strength and better heat sealability. The use of nanoparticles allows thinner papers that can be used for twist wraps. The product is currently under trial at a XXXXX confectionery manufacturer.
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UV Low-Migration Inks for High-speed Inkjet Printing

April 2010
XXXXX launched a new range of UV curable low-migration inks for digital ink-jet printing on a wide range of food packaging substrates, including aluminum and multi-layer aluminum, PET, PE, PP, and OPP. The XXXXX inks are formulated using photoinitiator systems and XXXXX's proprietary complete cross linking technology. The inks provide superior adhesion on several

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substrates and have excellent light fastness characteristics, according to the company. The inks do not contain any solvents and therefore potentially offer lower operating costs due to the elimination of solvent recovery costs.
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New Breathable Anti-Fogging Film

October 2009
XXXXX introduced a breathable, shrink lidding film with high gloss and anti-fogging properties. The multi-layered film is fully co-extrudable and heat sealable and is aimed at frozen foods and fresh poultry.
[weblink]

Water-based Anti-Fogging Film with High Oil Resistance

July 2009
XXXXX introduced a water-based anti-fog coating for food packaging with high oil and grease resistance. The XXXXX is the first water-based product and offers an alternative to solvent coatings. The coating is repulpable and biodegradable. The coating contains no volatile organic compounds (VOCs). The coating can be coated onto finished packaging and can be used for coating food wrappers, covers, trays and containers for frozen food packaging.
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Project Listings Available Online

Our project listings have been updated to segment our past project works into five main categories. Please follow the links to the PDFs on our website. This should provide you with a better idea of our range of services:

- Assisting clients with various aspects of new product development, including technology searches and technology roadmaps.
- Providing technology assessment, including state-of-the-art technology and future projections.
- Assessing and recommending improvements for clients' existing manufacturing processes, including quality aspects and costs.
- Assisting clients with all aspects of new business development.
- Providing a variety of strategic market studies in our clients' existing market segments.

Feedback

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