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INTELLIGENT AND ACTIVE PACKAGING

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ABSTRACT
This document gives information about Smart labels used in Smart/Intelligent Packaging, Smart label classification according to application criteria, advancement of printing techniques in packaging sector, Difference between conventional labels and smart labels, techniques used in smart labels.

KEYWORDS: Smart labels, Intelligent Packaging, Active Packaging

INTRODUCTION

Packaging is currently the centre of intensive research that is being carried out regarding new technologies that integrate digital data on a package. This has been fuelled by developments in Printing Technology, Materials and Processes that have the potential to create packages that can carry digital - machine readable data. These developments concern in particular, new materials (such as printed polymers, inks) and tagging applications (such as RFID and EAS systems) which are described as "Intelligent", "Smart" or "Active" packaging. One matter of particular interest is how these types of digital information can be integrated and implemented into the existing production workflow of packaging, which is normally consisted by the processes of packaging design, prepress, printing and finishing.

Packaging can be broadly classified into the following types: Passive, Active, Intelligent and Smart packaging.

i. **Passive packaging** refers to the traditional packaging that involves the use of covering material, characterized by some inherent insulating, protective or ease of handling qualities. It serves basic and fundamental properties of package i.e. Protect, Preserve and Present.
ii. **Active packaging** entails the concept of the package reacting to various stimuli- to keep the internal environment favorable for the products. A typical example would be a packaging with oxygen scavenger (an oxygen scavenger can absorb oxygen inside a package to increase the shelf -life of product.)
iii. **Intelligent packaging** refers to the concept of making innovations in the design of packaging that renders it more useful the consumer i.e. very packaging structure makes the convenient for the user to consume product without any other accessory.
iv. **Smart packaging** refers to packaging that is made much more functional and useful; it involves the use of technology that adds feature such that packaging becomes an irreplaceable part of the whole product. The smart packaging performs additional functions; responds to stimuli generated by the environment or from the product being packaged, and reflect the change in a manner that makes the product more convenient and useful for the consumer or firms in the supply chain. Smart packaging relies on the use of chemicals, electrical, electronic or mechanical technology or any combinations of them.

SMART LABEL

The latest advances in smart, smart active and smart intelligent labels offer huge potential for the food manufacturing, beverage, distribution and retail chain to reduce food and beverage wastage, enhance food freshness and performance, provide usage guidance, improve supply chain management and reduce costs. With the latest advances coming to the market, RFID smart labels and other smart solutions such as 'smart active' and 'intelligent' labels will increasingly be in a position to help monitor or improve the quality of wide range of (particularly fresh) produce in terms of freshness, temperature, odour, light exposure, etc.

Making labels cleverer, smarter and more intelligent is where the future is said to lie. After all, smart labels can communicate data at levels that far exceed those achieved by printed text, optically-readable bar codes or graphic images. Everyone is familiar with programmable RFID tags which transmit data via radio frequencies to an RFID reader. They use silicon chips and antenna inlays (variously called a transponder or integrated circuit) embedded in a thin polyester or polyamide film. Now we are seeing the growth of 'smart-active' labels (SALS), as well as 'intelligent' labels. The smart-active labels (SALS) and intelligent labels mentioned earlier are the polar opposites of the commodity labels. There are numerous examples, such as SALS that respond to external/internal conditions to monitor microbial growth, and time or temperature-sensitive conditions. Others indicate sterilization or autoclaving levels, as well as eliminate oxygen and manage moisture levels in pharmaceutical packs. Many smart labels respond to trigger-type activities, such as container filling, the release of pressure or gases, or exposure to UV energy. Food freshness indicators represent another important SALS market. Cumulatively, they can provide proof of some essential process control, or proof of proper handling and storage.

CLASSIFICATION OF SMART LABELS

So called 'Smart' or "Intelligent" labels perform a function rather than, or in addition to providing a protective or decorative function. There are 3 categories of smart labels:

Smart Interactive labels – commonly used for labels with an RFID function where there is an indirect exchange of data between the sender and the label.

Smart Active labels – labels become active in response to an event and change the environment around them in some way, e.g. O_2 scavenging labels in food packaging

Smart Indicator labels – labels whose principle function is to indicate that an event has taken place e.g. exposure to prescribed levels of gas, radiation, tamper, sunlight, time etc.

Smart Label Product - Smart labelling products include label lock, a suite of high end tamper indicating labels and tapes and Gammatex, a gamma radiation indicator label.

TYPE OF SMART LABELS

There are various types of smart labels that are been used now-a-days. Out of them the one which are commonly used are the followings:

Freshness Indicators: It is a Visual freshness indicator for poultry products. Nanolayer of silver reacts with hydrogen sulphide and forms silver sulphide due to which a visually detectable colour change from light brown to white.

Time -Tempeature Indicators -TTI technology relies on the properties of nano-pigments that change color over time and if temperatures fluctuate. It allows producers,retailer and consumers to check at a glance whether perishable products have been correctly transported and stored.It also helps to enhance consumer convenience and confidence, strengthen the reputation of brands using them and optimize shelf life.

Ripeness Indicator Label - Ripe Sense is the world's first ripeness indicator label developed in New Zealand. The Intelligent ripeness indicator responds to the aroma released as fruit ripens, giving consumers a better way to determine the shelf life of the fruit before they take it home. It also helps shoppers to reduce wastage.

Printed Oxygen Indicator -Many foods are packed or under MAP technology. An Oxygen- sensitive ink could be used to show if the MAP remains intact, throughout the whole distribution chain. Intelligent ink was created using light-sensitive nanoparticles such as titania nanoparticles.

Inkjet printed oxygen indicator - With inkjet printing, the indicator can be attached directly to the packaging material during packaging. Enables the manufacture of an individual, product-specific indicator on the packaging line without the disadvantages associated with handling and storing pre-made oxygen indicators that must be kept in an anaerobic state.

SCOPE FOR SMART LABELS

Certainly, the next few years should see the cost of RFID smart labels steadily decreasing further as chip manufacturers, inlay manufacturers, equipment suppliers, systems suppliers and label converters all become more specialized in what they produce, can control costs better, can control quality and yield at all stages more effectively. They will also be able to achieve the manufacturing efficiencies that will ultimately be demanded by the food and beverage manufacturer and retailer. Increases in volume requirements will also aid manufacturing efficiencies. But it is not just in smart labels where major advances of significant benefit to brand owners and retail groups in the food and beverage sectors are taking place. Recently, there has been the launch of new generations of 'smart active' and 'intelligent' labels, which become active in response to a trigger event (i.e. filling, release of pressure or gases, exposure to UV or moisture), or are able to switch on and/or off in response to external or internal conditions. These new generations of labels have the ability to sense, act, react, inform, etc, according to activities or conditions and, to date, probably offer some of the most important potential benefits to the food supply and retail chain.

Today's smart label solutions can minimize the level of fresh produce that a store may have to discard because it is no longer fresh. They can help ensure that perishable food products are safely packaged in order to reach consumers in optimum condition, or indicate the best temperature to store or drink beverages (i.e. wines) or foodstuffs.

CONCLUSION

- Printing technologies enables cost-effective, mass production of smart labels integrated in flexible packaging
- Much of the technology is still confined to the lab
- Consumer acceptance of the use of printed smart labels in packaging is very important and will be greatly dependent on the demonstrated benefits and safety of the new packaging products
- Undoubtedly, the ongoing development and excitement surrounding the fast-changing world of Smart labels is one of the key routes to introducing many of these requirements. Smart labels certainly have potential benefits for brand owners, retailers, logistics and product manufacturing sectors in terms of minimizing inventory and stock levels, tracking through the whole supply chain to guarantee safety and authenticity of goods, reducing scanning time at checkouts, in the introduction and use of 'smart shelf' technology, prevention of shoplifting and store shrinkage, and in improving brand protection.

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