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Active packaging, migrating and non-migrating systems

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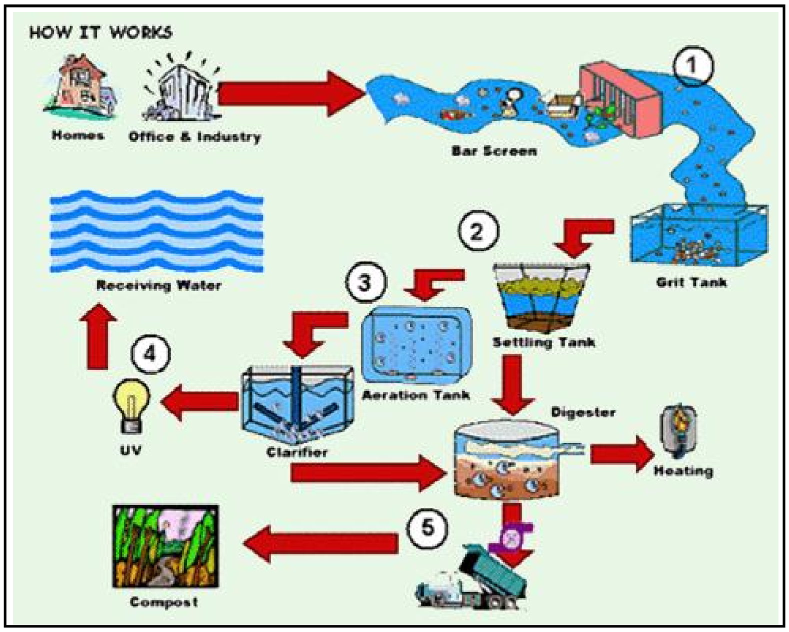
In recent years, the major driving forces for innovation in food packaging technology have been the increase in consumer demand for minimally processed foods, the change in retail and distribution practices associated with globalization, new consumer product logistics, new distribution trends (such as Internet shopping), automatic handling systems at distribution centers, and stricter requirements regarding consumer health and safety (Vermeiren and others, 1999; Sonneveld, 2000). Active Packaging (AP) technologies are being developed as a result of these driving forces. Active Packaging is an innovative concept that can be defined as a mode of packaging in which the package, the product, and the environment interact to prolong shelf life or enhance safety or sensory properties, while maintaining the quality of the product. This is particularly important in the area of fresh and extended shelf-life foods as originally described by Labuza and Breene (1989). Flores and others (1997) reviewed the products and patents in the area of AP and identified antimicrobial (AM) packaging as one of the most promising versions of an AP system. Han (2000) and Vermeiren and others (2002) recently published articles focused on AM systems, but without a detailed discussion of some of the principal AP concepts.



Antimicrobial migrating and nonmigrating systems:

Antimicrobial food packaging materials have to extend the lag phase and reduce the growth rate of microorganisms in order to extend shelf life and to maintain product quality and safety (Han, 2000). Alternatives to direct additives for minimizing the microbial load are canning, aseptic processing and MAP. However, canned foods cannot be marketed as "fresh". Aseptic processing may be expensive and hydrogen peroxide, which is restricted in level by regulatory agencies, is often used as a sterilizing agent. In certain cases, MAP can promote the growth of pathogenic anaerobes and the germination of spores, or prevent the growth of spoilage organisms which indicate the presence of pathogens (Farber, 1991). If packaging materials have self-sterilizing abilities due to their own antimicrobial (AM) effectiveness, the need for chemical sterilization of the packages may be obviated and the aseptic packaging process simplified (Hotchkiss, 1997).

Food packages can be made AM active by incorporation and immobilization of AM agents or by surface modification and surface coating. Present plans envisage the possible use of naturally derived AM agents in packaging systems for a variety of processed meats, cheeses, and other foods, especially those with relatively smooth product surfaces that come in contact with the inner surface of the package. This solution is becoming increasingly important, as it represents a perceived lower risk to the consumer (Nicholson, 1998). Table 4 lists a number of substances, which can be bound to polymers to impart AM properties. Such substances can be used in AM films, containers and utensils (Ishitani, 1995). Antimicrobial materials have been known for many years. However, antimicrobial packages have had relatively few commercial successes, except in Japan. Table 5 (Brody and others, 2001) summarizes some of the antimicrobial systems. Antimicrobial films can be classified in 2 types: (1) those that contain an AM agent that migrates to the surface of the food, and (2) those that are effective against surface growth of microorganisms without migration.

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