

## The Influence of Package on Quality Guarantee Period

**Abstract:** This article briefs on the relationship between barrier property of package materials and product quality guarantee period as well as the package cost; introduces principle of quality guarantee, testing items (permeability testing, sealing testing and aging testing) and the importance of comprehensive testing.

**Keywords:** quality guarantee period , remnant gas , barrier property and sealability

The most important function of package is to protect products. During the process of storage and transportation, products are often destroyed and influenced by various disadvantageous conditions and factors. However, this can be avoided and reduced by adopting suitable package.

The protective function of package realized by people in the initial period is its resistance to all or part of the impact and damage of external forces. Later it was discovered that package is able to prolong quality guarantee period of some products (for example, food, pharmaceuticals and chemicals). The research shows that quality deterioration is mainly caused by the content of certain kinds of gas within inner package. That is why controlling gas content of inner package can efficiently prolong the quality guarantee period of products, usually realized by using barrier property materials. For that reason, materials with barrier property have witnessed the rapidest development in recent years. Moreover, barrier property of materials becomes one of the most important testing items.

### 1. Quality Guarantee Principle of Barrier Property Package

The specific content of inner gases within package can directly influence the quality of products; among which, oxygen gas and water vapor have the most significant influence.

As is well known, oxygen gas exerts the biggest influence on food quality. Generally speaking, bacteria reproduction will cause food deterioration, and the content of oxygen gas in storage environment is one of the main factors of bacteria growth and reproduction.

In fact, it is not that the lower the content of oxygen gas is, the bigger extent that bacteria can be suppressed in growth and reproduction. This is because in environment of lower oxygen concentration, the growth and reproduction of some anaerobic bacteria will be accelerated. Therefore, only when oxygen content of inner package is controlled within a proper range can the quality guarantee period be effectively prolonged. Although fruits and vegetables are preserved with different principle, if barrier property is too good to the extent that proper breathing is hindered in the cause of storage and transportation, preservation period cannot be favorably prolonged.

The content of water vapor of packing environment can also influence product quality, especially to pharmaceutical and precise electronic components. Water vapor is the medium of chemical reaction. On the one hand, the extremely big humidity can cause chemical to absorb moisture and subsequently result in deliquescence, dilution, decomposition, mildew, and distortion of drugs. On the other hand, the too small humidity will accelerate the efflorescence of medicines. Medicine is a kind of special product, the quality of which must be secured within

quality guarantee period. Therefore, materials with excellent barrier property must be used in their package.

The preservation of different products also varies in their requirements. For example, the content of carbon dioxide should be controlled in the packing of carbonic acid drink. Therefore, there are certain requirements for carbon dioxide permeability through such packing materials. When optimal preservation condition of product is determined according to their specific characteristics, corresponding packing method and packing materials can be selected to prolong quality guaranteed period of products to the maximum extent. In some cases where quality guarantee period is decided by market requirement, barrier property of material can be reversely calculated to design reasonable packaging structure so as to save packaging costs.

## **2. Barrier Property and Sealability**

Generally speaking, the tests of barrier property and sealability are essential in evaluating barrier property of package materials and package structures.

Barrier property is said in connection with package material, with film and sheet as the main test objects. The thicker the material is, the better its barrier property. However, the increase of thickness will inevitably cause corresponding increase of package cost, follow-up transportation cost and preservation cost. Therefore, modified technology is usually employed to improve material barrier property while controlling package cost within an economical range. Multi-layer of film is one commonly used modified technology, which can be used to design material structure according to the required barrier property.

When design material structure, barrier property is only one of the factors to be considered. Other performances, like the diaphaneity, the heat sealability and so on should also be taken into consideration. At present, barrier property of materials can be tested using special barrier property testers, such as the differential-pressure method permeability testers for common gases of oxygen, nitrogen and carbon dioxide, etc, water vapor permeability testers for water vapor, the equal-pressure method gas permeability instruments for oxygen and carbon dioxide as well as the organic gas permeability instruments for organic gases with special odor.

Test object of sealability test is the wrappage, such as container and plastic bags. Sealability test is an effective measure to test the effects of sealing place. It can also be used to test defects of seal effect of other places as well as the phenomenon of leakage or damage.

Both barrier property test and sealability test take gases as their test object. However, they vary significantly in their test range, with the former used for gas leakage in large quantity and the latter used to test gas permeability of micro content. Barrier property testing is carried out on the premise of flawless materials (to finished package, it means excellent integral sealability). Otherwise, there will be no significance.

## **3. Overall Test of Package Barrier Property and Processing of Remnant Gases**

Gas environment of inner package mainly depends on two aspects: overall barrier property of package and the content of remnant gas after completion of package.

Overall barrier property of package is not equal to that of material. Barrier property of package which is made of high barrier property material is unnecessarily good. Sealing place of packaging bags and connecting place of bottle body and bottle cap are the weak points of overall barrier property of package, and are places easy to

appear leakage. At present, the understanding of barrier property is rather one-sided. Material test is highly valued while importance of overall barrier property is not fully realized, which is related with the slow development of permeability instruments and its test methods. The TOY serial oxygen permeability instruments introduced by Labthink can perform oxygen permeability testing of film and package in required positions with excellent test results. Labthink has also realized the overall permeability testing of carbon dioxide.

Except vacuum package, there are certain remnant gases existing in inner package, which (especially oxygen) will impose influences on some sensitive products. That is why the processing of remnant gases becomes extremely important. Modified gas package and vacuum package are widely used in packages with high deoxygenation requirements. Moreover, adding deoxygenation elements in the packaging material can greatly increase oxygen barrier property of materials as well as absorb the remnant oxygen of inner package. Gas content (at present, only oxygen and carbon dioxide can be tested) of package top space can be tested with headspace analyzer. However, the test precision is not high and it is only used as an assistant test.

#### **4. Other Test Items**

Special attention should be paid to the aging of high polymer materials. Material aging is caused by aging element existing within polymer structure or polymer ingredient, such as unsaturated double bond, branched chain, carbonyl and terminal hydroxyl. Polymer aging, which needs to be tested by aging test, will result in the changing of physicochemical property. It is not desirable to determine the quality guarantee period of products with permeability data of material obtained in normal condition without aging test.