

Latest Developments in Barrier Property Test of Package

Abstract: this article deals with the test principle of barrier property (auto gas permeability and water vapor permeability) test of package. It also presents the important things to be noted during the process of test. Various test methods are explained and comprised in this article.

Key words: water vapor permeability, gas permeability, package and test

Packages are directly used in liquid package. Since raw material of packages is often processed with high temperature and cooling, some indexes of the raw material cannot indicate the final property of package. That is why various indexes of package should be comprehensively tested.

1 The realization of Package Barrier Property Test

Being one of the important indexes of flexible package, barrier property directly influences the quality guarantee period of inner content. In fact, except for metal cans and packing box of pulp-molded aluminum, one complete package mainly consists of bottle body and bottle cap. Bottle body is the main test object of barrier property test. However, massive tests have proved that the connecting place of bottle body and bottle cap is a key point influencing barrier property of package. The barrier property test of package should include three parts. Firstly, test barrier property of bottle cap. Next is barrier property testing of bottle cap. The last one is to test barrier property of the connecting place of bottle cap and bottle body. Since bottle cap is often made of metal, it can be considered as possessing high barrier property. Therefore, barrier property testing of package can be divided into the test of bottle body and the test of bottle cap and connecting place.

The special shape of package makes barrier property tests presents specific characteristics. Comparing with film, test methods of package develop more slowly. In the past, gas permeance and water permeance of package are estimated by testing the sheet material of package. However, package wall is not uniform in thickness and the nature of material will change in the process of production, which will cause certain disparity exist between estimated and actual gas permeance of the package. Among various test technologies, test method of packages oxygen permeability enjoys the rapidest development. The introduction of ASTM F 1307 standard for package oxygen permeability test method not only accelerated the research and popularization of package oxygen permeability instruments, test results also becomes more scientific and accurate, which changed the former condition of chaotic test methods and lower credibility of test data.

Labthink is the first domestic manufacturer that sets foot in barrier property test. It develops the first domestic package/film oxygen permeability tester in 2004. Based on electrochemistry principle and possessing double function of film test and package test, this instrument meets the requirements of ASTM F 1307 and ASTM D 3985. This year, Labthink introduced the TSY-W3 for water vapor permeability test of package, which also adopts electrochemistry principle and possesses double function of film test and package test.

2 Principle of Package Gas Permeability Test

In auto gas permeability test of package, test technology of equal pressure method must be adopted. Since the inside and outside pressure difference of package is big enough to destroy bottle body or the high barrier property coating layer and in turn causes the test unable to continue. At present, traditional differential-pressure method cannot be used in the field of auto gas permeability test of package.

Test principle of package gas permeability test is similar to that of film gas permeability test of equal-pressure method. Here we will take oxygen permeability test of package as an example. First, use the package to divide the permeation chamber into two independent airflow systems with one side being the flowing testing gas (pure oxygen or mixed gas of oxygen) and the other side being the flowing dry nitrogen gas. Pressure of the two sides is equal but oxygen partial pressure is different. Under the function of oxygen concentration difference, oxygen transmits through the film and diverts into the sensor by nitrogen carrier gas. Oxygen gas transmission rate (O_2GTR) of the package can be calculated according to the oxygen quantity that is accurately measured by the sensor in nitrogen carrier gas .

With this instrument, oxygen permeability of the connecting place can also be test, which provides an efficient test method for the understanding of package barrier property. The difference between oxygen permeability test of the connecting place and the pure package oxygen permeability test mainly lies in the preparation of specimen. Oxygen permeability Test of the connecting place is shown in figure 1 below:



Figure 1. Package test condition

Similar with film gas permeability test of equal-pressure method, this method is mainly used in oxygen permeability test of specimens. It can also realize carbon dioxide permeability test. However, it is not able to test gas permeability of nitrogen and other gases.

3 Principle of Water Vapor Permeability Test of Package

Water vapor permeability test of package can be tested with gravimetric method and sensor method. Since the measuring range of weight sensor limits its precision in gravimetric method, it is not ideal to test water vapor permeability of package with gravimetric method. Moreover, too long the test period (about one month) will increase the difficulty of environment controlling.

Test principle of package water vapor permeability test with sensor method is similar to that of gas permeability test (see figure 2). Replace the upper test chamber with special encloser (attached with instrument), and then use the package to divide the permeation chambers into two independent airflow systems with one side being the flowing carrier gas (dry) and the other side maintaining certain relative humidity. Water vapor concentration of the two sides is different but the concentration difference (relative humidity difference) is stable. Under the function of concentration difference, water vapor transmits through the

package wall and diverts into the sensor by carrier gas. Water vapor transmission rate of the package can be calculated according to the water vapor quantity that is accurately measured by the sensor in carrier gas. Labthink TSY-W3 can just test over water vapor permeability test of package.

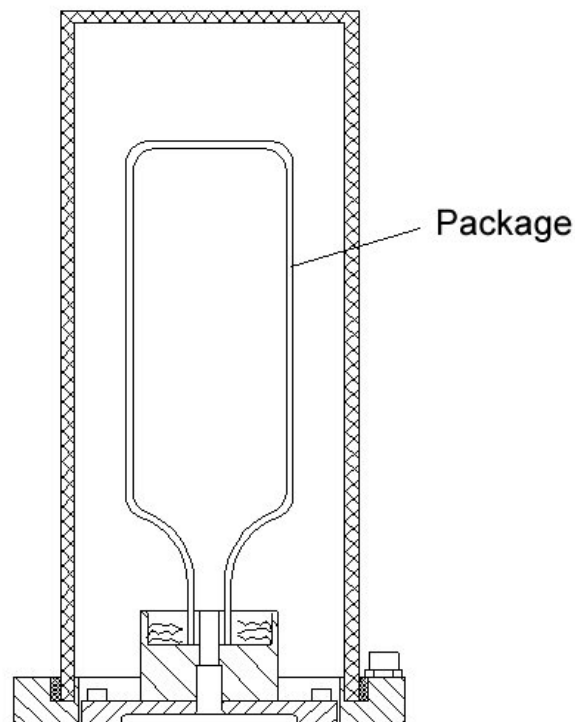


Figure 2 principle of water vapor permeability test of package

4 Conclusion

Barrier property of package is a great progress of traditional barrier property test of film. Using the test methods introduced in this article, water vapor permeability test of almost all flexible packages (including flexible bag, paper box and bottle) can be tested, which can provide more comprehensive test data in surveying the influence of package barrier property on quality guarantee period of inner content.