Labthink Instruments CO.,LTD.
144 Wuyingshan Road, Jinan, China
Tel: +86-531-85811021 85864214
Fax: +86-531-85812140
Website: www.labthink.cn
E-mail: trade@labthink.cn

The Need to Test Overall Barrier Property of Package

Abstract: This article briefs on the current conditions of package barrier property testing. Based on field test data, the need to test overall barrier property of package is analyzed.

Key words: package, barrier property, oxygen permeability, and bottle cap

Liquid is mainly packaged in containers. Except for metal cans and packing box of pulp-molded aluminum, one complete package mainly consists of bottle body and bottle cap, with the former usually being made of glass and plastic and the latter being made of metal and plastic. Since barrier property of the package can directly influence quality guarantee period of its inner content, how to improve barrier property of bottle body and how to improve barrier property and sealability of bottle cap become focal point of current package manufacturing. In fact, the connecting point of bottle body and bottle cap is a key factor that influences overall barrier property of package.

1. Current State of Package Barrier Property Testing

First of all, this article will clarify how to test overall barrier property of package. Strictly speaking, such test 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. For the reason that barrier property of bottle cap will be tested simultaneously in the testing of the last part, these two parts can be consolidated. In this way, barrier property testing of package can be divided into the test of bottle body as well as the test of bottle cap and connecting place.

At present, the testing of package barrier property takes oxygen permeability as its main field. This is because on the one hand, oxygen is the main reason for product deterioration. On the other hand, oxygen-probing technique has got the rapidest development. Oxygen permeability test of bottle body at present has normalized and got support of test standards. The test mainly aims at bottle body or bottle cap. However, to one package, so long as its bottle body and bottle cap are not one integral part, leakage of the connecting place will greatly decrease overall barrier property of package, even if both bottle body and bottle cap can achieve high barrier property. Connecting place of the bottle is like heat-sealing place of flexible package, where leakage point will cause a failure of barrier property protection to inner content. Therefore, the connecting place of package (especially the detachable package except for metal cans and packing box of pulp-molded aluminum) is one weak point of package barrier property.

2. The Need to Test Overall Barrier Property of Package

The connecting place of package is an important part in overall barrier property testing of package, which is also the most difficult to carry out. On one hand, bottle body and bottle cap are usually from different manufacturers. On the other hand, test of connecting place at present focuses on sealability testing. The need to test barrier property does not attract enough attention. Also, test methods are deficient.

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In Labthink Lab, oxygen permeability of the package-connecting place is tested according to standard ASTM F 1307. Specimen preparation and specimen attachment is similar with that of bottle body oxygen permeability testing and test process of the connecting place is completely the same with that of bottle body. Using TOY-C1 package/film oxygen permeability instruments, oxygen permeability of the connecting-place of several packages is tested by Languang.

Figure 3. Test condition

To what extent will oxygen permeability of the connecting place influence overall oxygen permeability of package? Here we take test data of glass1＃(tested for Spanish customer) as an example for explanation. With the bottle cap being made of aluminum metal ,thickness of 1＃glass body is about 3mm(thickness of bottle body, bottle bottom and bottle neck is not the same).. Oxygen permeability of the connecting place is the main test object. The results of repeated tests are all 3ml/pkg·day (test is carried out in air). In the following part, by comparing with oxygen permeability of bottle body tested by Labthink lab, practical value of the test data will be analyzed

Table 1. test data of package oxygen permeability test

Number	Function	Producing area	Characteristics of specimen	Oxygen permeability

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1	beer	Shanghai	Φ66×160、0.53L、 brown	0.0042
2	tea	Japan	Φ92×260、1.5L、 tansparent	0.0778
3	dairy products	——	Φ82×210、1L、 milk white	1.9600
4	beer	Shanghai	Φ66×160、0.53L、transparent	0.7250
5	beer	Changzhou	Φ73×160、0.65L、 bottle green	0.0384
6	carbonated beverage	Changzhou	Φ62×180、0.5L、 transparent	0.0294
7	beer	Liaoyang	Φ73×160、0.65L、 buff	0.0202
8	beer	Liaoyang	Φ73×160、0.65L、 white	0.3228
9	beer	Nantong	PET（ including coating layer）	0.0168

Note 1 : unit is ml /pkg·day, the test is carried out in air with oxygen content of 21%.

Specimens in table 1 are all made of plastic and are mainly used for beer package. Number 2.4,and 6 is used for the package of tea, dairy products and carbonated beverage respectively. Since oxygen permeability of glass bottle is very little and cannot be tested, bottle glass can be considered as non-oxygen permeable package. Oxygen permeability of the plastic bottles listed in table 1 is mainly between 0.02 and 0.4ml/pkg·day. After special barrier property disposing, plastic bottles can achieve an oxygen permeability lower than 0.02ml/pkg·day.

Comparing with the data listed in table we can see that 3ml/pkg·day is a rather big value. Oxygen permeability of number 3 is the highest. Its test data obtained in air is 1.9600ml/pkg·day, which is still a little lower than that obtained in the test of connecting place this time. Taking the 3mm thickness of bottle body into consideration, oxygen permeability of the bottle body can be omitted. Bottle cap is also made of aluminum and has an excellent barrier property. For this reason, it can be considered that oxygen permeability obtained in the test is mainly caused by the connecting place. From the above statement we can see that connecting place of the package imposes a significant influence on barrier property.

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It should be noted here that barrier property is not equal to sealability. Reliable sealability of the package is a base of ideal barrier property. If there is leakage on the package, there will be no significance for the test as a result of extremely bigger oxygen permeability.

3. Conclusion

As people are having better understanding of the function of package barrier property, barrier property testing already became very popularized. The specialty of package profile makes barrier property testing present different characteristics. Comparing with film, test methods of package develop more slowly. Among that, oxygen permeability testing has got the rapidest development. Labthink is able to complete oxygen permeability test of the bottle body and the connecting place using one same oxygen permeability instrument (TOY-C1 or TOY-C2). With good stability of test data, it offers an effective testing measure for comprehensive understanding of package barrier property.