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The Need to Test Overall Barrier Property of Container Package

Abstract: This article briefs on the current conditions of container package barrier property testing. Based on field test data, the necessity of testing overall barrier property of container package is analyzed.
Keywords: container package , barrier property , oxygen permeability , OTR , bottle cap

Liquid is mainly packaged in containers. Except metal cans as well as pulp-molded aluminum packing boxes, 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 the inner content, how to improve barrier property of bottle body and how to improve barrier property and sealability of bottle cap have become focal points 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 container packages.

1. Current Status 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 body. Next is barrier property testing of bottle cap. And the last 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 connecting part of bottle cup and body, these tests can be combined. In this way, barrier property testing of container 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 test through containers mainly. This is because oxygen is the main cause 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 supportive test standards. The test mainly aims at bottle body or bottle cap. However, as to one container package, even if both bottle body and bottle cap can achieve high barrier property; 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 container package. Connecting place of the bottle is like heat-sealing place of flexible package, where leak point will cause a failure of barrier property protection to inner content even if the barrier property of the material is excellent. Therefore, the connecting place of package (especially the detachable package except metal cans and packing box of pulp-molded aluminum) is one weak point of package barrier property.

2. The Necessity 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 be carried out. Firstly, bottle body and bottle cap are usually from different manufacturers. Secondly, test of connecting place now focuses on sealability testing; and the need to test barrier property does not attract enough attention. Thirdly, 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 to that of bottle body oxygen permeability testing and test process of the connecting place is completely the same as that of bottle body. Using TOY-C1 package/film oxygen permeability instruments, oxygen permeability of the connecting-place of several packages is tested by Labthink.

Test Condition

To what extent will oxygen permeability of the connecting place influence overall oxygen permeability of package? Here we take test data of glass 1＃(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 (thicknesses of bottle body, bottle bottom and bottle neck are 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 some oxygen permeability of bottle body tested by Labthink Lab, practical significance of the test data will be analyzed

Table 1. Test Data of Package Oxygen Permeability Test

Number	Function	Production Place	Characteristics of Specimen	Oxygen Permeability
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 lab 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 are 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 disposition, plastic bottles can achieve an oxygen permeability lower than 0.02ml/pkg·day.

Comparing with the data listed in Table 1 we can see that 3ml/pkg·day is a rather high 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.

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

3. Conclusion

As people are having better understanding of the function of package barrier property, barrier property testing has already become much popularized. The specialty of container package figure 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.