

Permeability Testing of PET Beer Bottle

At present, the fields of application for plastic containers have been widely expanded in package industry. It has already occupied a market share of about 50% in the package market of carbonated beverage and drinking water. In the juice beverage market, the market share of plastic package is on even terms with that of paper complex packages. Enjoying a high reputation for its light in weight, high ductility, big capacity and its ability to be processed in various models and specifications, plastic package is expanding in the fields of application and it has entered the package market of alcoholic products. PET beer bottle that appeared recently in beer package market is especially attractive, which ensures plastic package a great potential for development.

1 the market of plastic packages

As far as plastic package is concerned, PE and PVC were the first to be widely used. Out of a consideration of environmental protection, permeability enhancing and cost reducing, the materials being used at present are mainly PE, PVC, PP, PET.

1. PE, synthetic resin that owns the biggest output in the world, has the biggest consumption among plastic package materials. Among that, HDPE is greatly used in blowing hollow containers like bottles, which are used to hold beverage of lemon juice and fruit juice.
2. PVC bottle manufactured through pouring and blowing is seamless and even in bottle thickness. It can be used to hold carbonated beverage; PVC bottle manufactured through blowing and molding is suitable for fruit juice and mineral water.
3. Because of the widely using of hot filling technology in canned production line of tea and fruit juice beverage, though without a better permeability, BOPP hot filling bottle that can endure a high temperature of 100 °C has earned a market share relying on its good refractory ability and cheaper cost comparing with that of PET bottle.
4. PET bottle, having a better transparency and surface glossiness, seems like glass and is the most suitable plastic bottle to substitute glass bottle. The production of PET bottle has advanced greatly in recent years. It is widely used in the hot filling beverage package of tea and fruit juice as well as the package of carbonated beverage. Now the PET bottle has emerged on alcoholic package market and showed well.

2 Development status of plastic beer bottle

With the growth of the beer market in china, consumers are demanding for higher product quality and more convenience of package. Having the advantages of combing lightness, transparency, and shatter proofing with its ability to be easily molded and a second time capped, PET bottle has become the new star in beer package industry. In Euramerican market, it has entering the field of beer package. With the excellent performance of PET bottle, its market share in beer package market is steadily increasing. Its development step in domestic marker is also gradually accelerated. Now many enterprises have already participated in the research development and manufacturing of PET beer bottle

However, different with the package of carbonated beverage, frit juice, tea and dairy products, beer has a higher demand for the permeability of package due to its easiness to be oxidized. Because common plastic bottle does not have a better permeability, beer contained in common plastic bottle has a shorter guarantee period comparing with that contained in glass bottle or metal cans (ring –pull tin). If the permeability of PET bottle can be

improved without increasing its cost too much, it is bound to have an even broader prospect for development in beer package industry.

The most direct method for improving package permeability is using the high permeability material of EVOH, PA, PVDC, PEN. Considering the higher cost of high permeability materials, increasing the permeability of common material is realized mainly through mixing together, surface coating, multi-layer compounding and orientation stretching. Suppliers of PET bottle usually use three methods to improve the permeability of plastic package, i.e. adding permeable layer in the multi-layer bottle; improving the performance of PET bottle by mixing or using the additive; using surface coating such as plasma coating, diamond type carbon coating (DLC) technology, amorphism carbon coating, permeable silica gel coating. No matter which method is being employed, the greatest challenge is how to get the best permeability with the minimum cost. This is where PET bottle permeability testing is involved.

3 Permeability testing of PET beer bottle

How to perform the permeability test of plastic package? Since improving its permeability has become one of the main factors that limit the production, permeability index of the plastic package needs to be tested accurately either in the package research and development or mass production, which makes the choice of relating instrument a primary task. Oxygen permeability testing becomes absolutely necessary for all kinds of PET bottles that enter the beer package market.

The profile variety of plastic package brought great difficulty to auto gas permeability testing. There is indeed certain disparity between the estimation results obtained though the transmitted gas of bottle body and the actual testing result because property of the package material has changed during the process of production and package's thickness is non-uniform. Therefore, test the package permeation directly is of great significance. Manufacturers that can provide package permeability testing are indeed rarity of rarities in the international market. Oxygen permeability tester TOY-C1 introduced by Languang this year makes Languang the first manufacturer of flexible package testing instrument. TOY-C1 is designed and manufactured based on the principle of electrochemistry according to the specification of ASTM F1307, ASTM D3985. It simultaneously possesses the function of container and quantity testing of permeable oxygen with a testing accuracy up to 0.0001 ml/pkg •day. TOY-C1A is furnished with special oxygen cavity and can almost satisfy the permeability testing for all kinds of plastic package. Moreover, in addition to performing the test in open air, TOY-C1 is able to complete the testing with an oxygen concentration of 100%, which can completely meet the requirement of ASTM F 1307. The long-term testing has proved that TOY-C1 has efficiently reduced the cost with its good data stability and the better reusability of its special package testing accessories.

Some measured data are listed in table 1.

Table 1. Certain measured data of package oxygen permeability testing

Number	Use	Origin	Package Characteristics	Quantity of transmitted oxygen 1	Concentration of testing gas
1	Beer	Shanghai	φ 66x160 0.53L brown	0.0200	100%O ₂
2	Tea	Japan	φ 92 x 260, 1.5 L	0.3704	100%O ₂

			transparent		
3	Daily product		φ 82x210, 1L milk white	1.9600	In open air
4	Beer	Shanghai	φ 66 x 160 0.53L transparent	0.7250	In open air
5	Beer	Liaoyang	φ 73 x 160 0.65L blue	0.2073	100%O ₂
6	Beer	Changzhou	φ 73 x 160 0.65L bottle green	0.1829	100%O ₂
7	Beer	Changzhou	φ 62 1 5 0 0.398L bottle green	0.0290	100%O ₂
8	Carbonated beverage	Changzhou	φ 62 1 8 0 , 0 . 5 L transparent	0.1400	100%O ₂
9	Beer	Liaoyang	φ 73x160 0.65L, yellowish	0.1036 0.0202	100%O ₂ In open air
10	Beer	Liaoyang	φ 73 x 160 0.65L white	1.5372	100%O ₂
11	Beer	Liaoyang	φ 73 x 160 0.65L transparent	0.2189	100%O ₂

Note 1: the unit is ml/pkg ·day

Most of the sample listed in the table is used for beer package, but sample 2, 3, 8 is used for the package of tea, dairy product and carbonated beverage. As is known, plastic package has occupied a big market share in the package field of tea, dairy products and carbonated beverage. Comparing with the test data of item 2, 3, 8 we can see that the sample used for beer package has relatively high oxygen permeability. For example, as to sample 1 for Shanghai and sample 7 for Changzhou, the quantity of transmitted oxygen is under 0.03ml/pkg ·day.

The stability of TOY-C1 package /film oxygen permeability tester is also reliable. For example, the result data of sample 7 tested in four times is 0.0224ml/pkg ·day 0.0328ml/pkg ·day 0.0256ml/pkg ·day 0.0350ml/pkg ·day respectively. The average value obtained through calculating is 0.0290ml/pkg ·day, S is 0.00593. Test sample 9 both under pure oxygen environment and in open air (under laboratory environment) and then convert the obtained result data in open air into the data in 100% oxygen, we can see that the converted data is very close to the tested data of 0.1036ml/pkg ·day.

4 Conclusion

From the above passage we can see that the application expanding of PET bottle in beer package is one of the main

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development trends. With its excellent permeability obtained from the continuously improving of manufacturing technology, the application of PET bottle will become broader and broader.