Labthink Instruments Co., Ltd.
144 Wuyingshan Road, Jinan, P.R.China
Phone: +86 531 85068566
FAX: +86 531 85812140

Film Oxygen Permeability Testing-Equal Pressure Method

Abstract: This article presents a detailed introduction about the testing principle, relating standards and testing process of equal pressure method. It also briefs on some testing information about oxygen permeability tester of equal pressure method.

Keywords: oxygen permeability, oxygen permeability tester, equal pressure method , differential pressure method

At present, most of the test methods employed by gas permeability testers are either differential pressure method or equal pressure method. These methods are based on different test principles and their test conditions also vary significantly. But both methods are important in the field of permeability testing. Oxygen permeability directly influences the quality and storage of package content. That is why it is one of the most concerned indexes of property. Gas permeability testing of material usually refers to the oxygen permeability testing of materials.

1. Outline of Equal-pressure Method

The definition of equal pressure method comes from standard ISO 15105-2, which is corresponding to differential-pressure method in ISO 15105-1. It makes the classification of gas permeability testing methods more systematic. At present, equal pressure method applied in gas permeability testing is mainly sensor method (there is gas chromatography method in addition to sensor method).

Testing principle of sensor method provided in standard ISO 15105-2 is as below: (see fig 1): use the package to divide the permeation cavity into two independent airflow systems with one side being the flowing testing gas (A, can be pure oxygen or mixed gas of oxygen) and the other side being the flowing dry nitrogen gas (B). Pressures of the two sides are equal but oxygen partial pressure is different. Under the function of oxygen concentration difference, oxygen transits through the film and divert into the sensor by nitrogen carrier gas. Oxygen gas transmission rate (O2GTR) of the package can be calculated according to the oxygen quantity that is precisely measured by the sensor in nitrogen carrier gas.

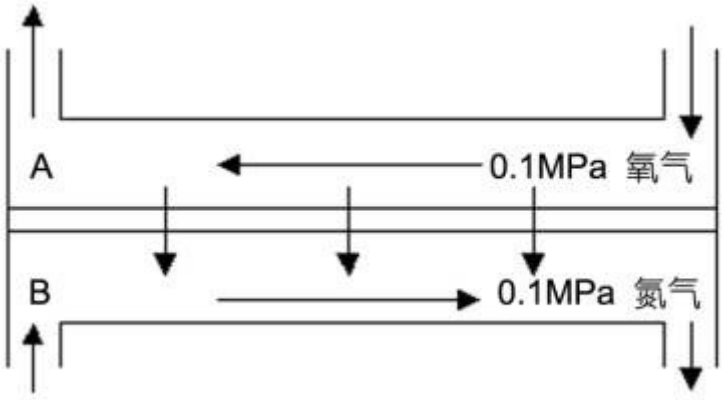

Fig.1. Testing Principle of Sensor Method

2. Testing Standard of Equal-Pressure Method

In ASTM standards, ASTM D 3985, ASTM F 1927 and ASTM F 1307 are equal to standard ISO 15205-2. Germany and Japan also have corresponding standards.

In equal pressure method, both sides of the specimen maintain normal atmosphere to make the two sides of the specimen an equal pressure. This is also a basis for the testing of container package oxygen permeability testing and can avoid package burst resulting from big pressure difference existing between two sides. Among the commonly used ASTM standards, ASTM F 1307 is used for the testing of container package oxygen permeability, while ASTM D 3985 is suitable for the testing of film and sheet oxygen permeability. These two standards are widely used in the world and have been accepted by many countries.

Methods employed to oxygen sensor and other relating instruments in ASTM F 1307 are similar to that in ASTM D 3985. When package-testing accessories are removed, the same instrument can well complete film and sheet oxygen permeability testing according to standard ASTM D 3985. Therefore, oxygen permeability tester of equal pressure method can perform dual operation of both film and container package oxygen permeability testing and thus, realize multi-functions.

3. Testing Process of Equal Pressure Method

Testing process of equal pressure method is simple and clear. (As is shown in fig.2, blue pipe is testing gas and red pipe is nitrogen gas, flow direction follows the arrow). Testing procedures are as follows: purge the system, divert oxygen gas into upper testing chamber, output value (oxygen gas transmission rate) of sensor becomes stable (equilibrium of transmission), and obtain testing results. During the testing, whether the flow of nitrogen gas for the lower cavity is appropriate will have a direct influence on the test result. That is why the instrument has a very high requirement for the controlling device and the flowmeter of nitrogen gas flow rate.

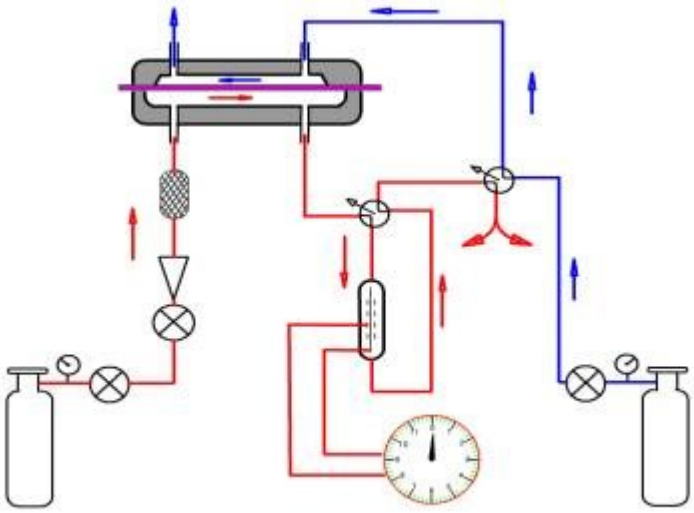

Fig.2. Testing Process of Equal Pressure Method

After testing, turn off oxygen gas source to stop oxygen supply to the upper cavity and adjust the system to purging condition (nitrogen gas to lower cavity bypass the sensor). If the instrument will be used for further testing, in order to prevent the air from backward permeation to the system, the nitrogen gas can be adjusted to a flow rate of about 5ml/min to supply the system over a long period. An alternative method is to close the sealing valve and

then carefully remove the testing components. If the instrument will not be use for testing in the near future, close nitrogen gas source after the sealing treatment with seal O-ring.

4. Film Oxygen Permeability Test with Equal Pressure Method

Film oxygen permeability testing using equal pressure method has been implicated widely in the world. Some manufacturers of package testing instruments have developed their own oxygen permeability tester of equal pressure method. Although all these instruments based on the same testing principle of equal pressure method, they have their own characteristic in aspects such as detailed testing procedure, property of sensor, dimension of specimen and specimen preparation.

Now we present a brief introduction taking Labthink TOY-C1 as example: specimen diameter is φ140mm. If specimen is thicker than 1mm, corresponding accessories are needed in specimen placement. It can perform three-chamber testing, and seal specimen edge with vacuum grease in the process of specimen placement. Pay attention not to contaminate testing area by the vacuum grease. Testing process is the same as stated before.

Fig.3. TOY-C1Package/Film Oxygen Permeability Tester (fitted with the film sample)

5. Prospects

Oxygen permeability tester of equal pressure method is already very common for the product testing in international trade. There is still no corresponding standard in our country. However, with the accelerating internationalization speed of domestic package industry, equal pressure testing in our country will enter a new stage.

Labthink is the first domestic manufacturer in independent research and development of oxygen permeability tester. The introduction of TOY-C1 makes an end of the fact that domestic permeability testing instruments of equal pressure method are monopolized by foreign brand. These instruments have also attracted the attention of domestic and international package industry. Especially for domestic package enterprises, Labthink permeability testing instruments of equal pressure method will no doubt provide perfect technical support to them.