

Film Oxygen Permeability Testing

- Equal Pressure Method

Abstract: auto gas permeability testing can be divided into differential pressure method and equal pressure method. 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.

Key words: oxygen permeability, oxygen permeability tester, equal pressure method, differential pressure method, oxygen permeability testing.

At present, most of the test methods employed by auto 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. Auto gas permeability testing of material usually refers to the oxygen permeability testing.

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 auto gas permeability testing methods in more systematic. At present, equal pressure method applied in auto 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). Pressure of the two sides is 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(O_2GTR) of the package can be calculated according to the oxygen quantity that is accurately measured by the sensor in nitrogen carrier gas.

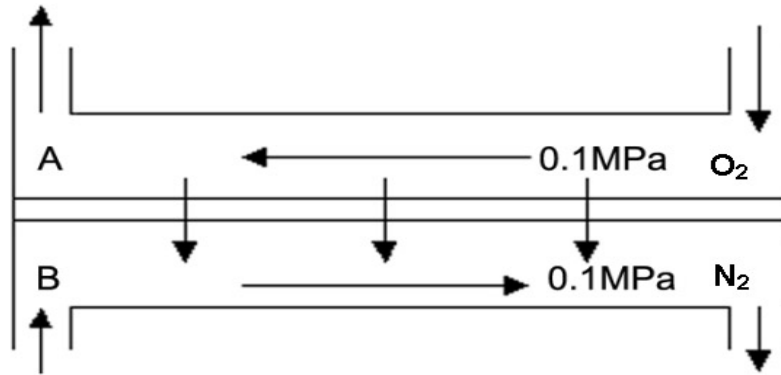


Fig.1. Testing principle of sensor method

2. Testing Standard of Equal-Pressure Method

In ASTM standards, those that are equal to standard ISO 15205-2 are ASTM D 3985, ASTM F 1927, ASTM F 1307. Countries like German and Japan also has corresponding standards.

In equal pressure method, both sides of the specimen remain normal atmosphere to make the two sides an equal pressure. This is also a basis for the testing of 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 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 package oxygen permeability testing.

3. Testing Process of Equal Pressure Method

Testing process of equal pressure method is simple and clear. (As 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: purging the system, diverting oxygen gas into upper testing chamber, output value (oxygen gas transmission rate) of sensor becoming stable (equilibrium of transmission), and obtaining 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.

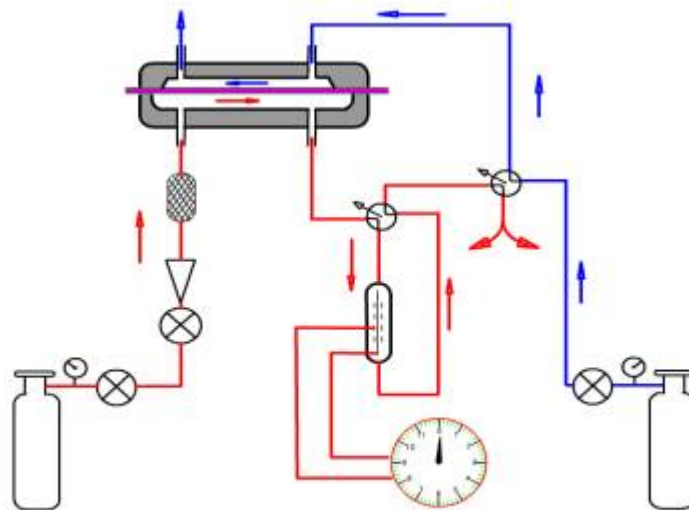


Fig.2. Testing Process of Equal Pressure Method

After testing, close oxygen gas source to stop supplying oxygen to the upper cavity and adjust the system to purging condition (nitrogen gas to lower cavity bypass the sensor). If the instrument will be use for testing in the near future, in order to prevent the air from backward permeating 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 rather widely in the world. Some manufacturers of package testing instrument has 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 provide a brief introduction taking Labthink TOY-C1as an example: specimen diameter is ϕ 140mm. If specimen thickness is bigger than 1mm, corresponding accessories are needed in specimen placement. It can perform three-chamber testing. Seal specimen edge with vacuum grease in the process of specimen placement. Pay attention not to contaminate testing area. Testing process is just the same as stated before.



Fig.3. TOY-C1Package/Film Oxygen Permeability Tester which has fitted with the sample in film type

5. Prospects

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

Labthink is the first domestic manufacturer in independent research and development of oxygen permeability tester. The introducing 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. For domestic package enterprises, permeability testing instruments of equal pressure method can no doubt provide perfect technical support to them.