

Advantages of Gas Permeability Test Using Equal-pressure Method - from empirical research experiences

Abstract: based on Labthink's empirical research and its long term operating of equal-pressure method gas permeability testers, this article introduces advantages of equal-pressure method gas permeability testing in some special fields.

Key Words: equal-pressure method, differential-pressure method, package, contact lenses

Equal-pressure method was gradually developed in the 1970s to determine oxygen permeability of packaging materials. Although equal-pressure method has limitation in its actual application and still needs improvement to challenge the fundamental position of differential-pressure method in gas permeability testing, it possesses test advantages of its own, which expand the application fields of equal-pressure method.

1 . The Research and Development of Equal-pressure Method Instrument in Labthink

Since the application of package oxygen permeability testing, differential-pressure method has always been the most fundamental and most widely used test method. However, equal-pressure method is a newly developed method in North America in the 1970s. These two methods are based on completely different test principles using different units. That is why test results obtained using these two methods cannot be compared directly. Since equal-pressure method possesses test merits of its own, sometimes it forms effective complementation with differential-pressure method. For this reason, Labthink began to develop equal-pressure method gas permeability testers since 2004.

Before its research and development of equal-pressure instruments, Labthink has accumulated much research experience to develop gas permeability testing instruments in aspects of sealing, processing of test cells, designing pipeline and etc. Because domestic micro oxygen probing technology has a short development period and the expanding and application of sophisticated high precision products are not commonly seen, there are some difficulties in the initial research period of such instruments. After Labthink's unremitting efforts of more than two years and through its cooperation with top ranking international micro oxygen probing corporations, Labthink has made breakthrough development in micro oxygen probing technology. It now has manufactured oxygen permeability test instruments using equal-pressure method completely meeting ISO international standards.

2 . Advantages of Equal-pressure Method

The theoretical basis of equal-pressure method is not as profound as that of differential-pressure method instruments. It still needs improvement in terms of the richness of test indexes and conveniences of actual application. For example, equal-pressure method can only test the self-property of specimen, i.e., oxygen (or carbon dioxide) permeance. It is unable to test diffusion coefficient and solubility coefficient. Moreover, there are others problems existing such as the unicity of test gas and higher cost of instrument operation. However, the unique characteristics of equal-pressure method give it some incomparable advantages in some special testing fields.

2.1 Container Packaging Testing

Oxygen permeability testing of container packaging can be considered as the salient merit of equal-pressure method. Oxygen permeance of package was previously estimated by testing oxygen permeance of packaging

sheeting. However, container package is not uniform in thickness and the property of materials has changed during production. Therefore, the estimated results and actual test results vary very much. In equal-pressure method, pressures on both sides of specimen are standard pressure, so the two sides have equal pressure, in which case package breakage can be avoided resulting from too big pressure difference on two sides of specimen. Therefore, equal-pressure method can test oxygen permeability of the whole package. Due to the rapid development of equal-pressure method, ASTM F 1307 is introduced and further accelerates the research and expanding of equal-pressure method package oxygen permeability testing instruments. The application of this standard makes the test results more scientific and accurate, improving previous situation of chaotic test and lower credibility of test data. At present, equal-pressure method test instruments can realize oxygen and carbon dioxide permeability testing. Container packaging can take forms of bottle, bag, box, capsule and bubble cap package. Therefore, almost all forms of container packaging in current market can realize integral testing, avoiding the error caused by estimation of sheet material. Equal-pressure method offers powerful test basis to those container packaging manufactures who substitute plastics for glass and metal.

2.2 Lower the Demand on Stability of Power Supply

According to the requirements of some standards, either differential-pressure method or equal-pressure method takes several, more than ten or even longer hours. For this reason, gas permeability testing has certain demand on the stability of power supply system. Temporary or even instant power shortage will make previous testing of several hours in vain. That is why stability of power supply has always been a main external factor affecting efficiency of gas permeability testing. In some areas of our country, stability of power supply cannot be secured. When there is a surge of electricity demand, some places only have timing power supply, the period of which may not be enough to finish gas permeability testing of one time. Under these circumstances, those instruments that require no satiability of power supply win high favor of market. Empirical research experience shows that differential-pressure instrument can hardly do without power supply. Power failure will destroy any stage of test process (evacuation stage or permeation stage).

Labthink's creative development of TOY-C1 and TOY-C2 equal-pressure method film/package oxygen permeability tester have greatly lowered the demand on power supply and can maintain previous test state when there is power failure. Although the sensor is not able to output electrical signal on power shortage, accurate test data can be obtained from operation panel when power supply comes again. At the same time, test principle of equal-pressure method can guarantee that the test will not fail for over range operation of sensor due to extremely long period of transmission process

2.3 The Application of Equal-pressure Method in Newly Rising Testing Fields

Equal-pressure method was initially developed as a new test method for flexible packaging materials. After its development of about three years, its application does not confine to gas permeability testing of flexible packaging any more. Equal-pressure method has got some new application in other fields, such as the oxygen permeability testing of contact lenses. Oxygen permeability of contact lenses, directly influencing the wearing comfort of users and in turn affecting distribution of the lenses, is one of the important indexes in evaluating contact lenses. That is why oxygen permeability attracts particular attention of lens manufacturers. ISO has issued special test standards for contact lenses. Among these standards, test principle and test instruments of ISO 9913-2 is very close to the equal-pressure method used for oxygen permeability testing of flexible packaging materials.

3 . Conclusion

Equal-pressure method has prominent advantage in special testing environments such as container

packaging testing and in cases of unstable power supply. Moreover, its actual application has already been expanded, not limited to the testing of packaging materials any more. However, due to its limitations in terms of test principle, equal-pressure method is still inferior to differential-pressure method in the variety of test gases and is unable to meet test requirements for gas permeability testing of special gases.