

Plastic Film Reference Material Gas Permeability Document: Reference Material Used in the Calibration of Gas Permeability Test

Abstract: this paper discuss and elaborates on the elaborates on the source, the requirements and the application of reference material being employed in the calibration of gas permeability test, based on the classification and requirements of standard materials as well as the NIST introduction to standard film material.

Since standard material or standard measuring device is essential for calibration, how to calibrate permeability testing instruments was once a factor impeding the development of permeability testing. Calibration methods have now become very mature. Instrument can be calibrated with reference material, standard gas or standard devices such as manometer, and standard weights.

Key Words: equal-pressure method, calibration, reference material, standard material

Reference material is the kind of film with known permeable parameters such gas permeability, the permeability of which does not change dramatically within a certain period through a series of testing. Moreover, reference material is stable in its own properties. It is a special kind of standard material used for calibration of permeability testing, and is rarely used in other fields. This article deals with reference material in terms of its uses, conditions and actual applications, etc.

1. Functions of Reference Material

First, the basic needs for the application of reference materials lies in the unification of data systems so as to make the testing data obtained from different methods comparable. As is well known, there are more than one test methods for each kind of permeability testing. For example, there are equal-pressure method and differential-pressure method for gas permeability testing. There are gravimetric method, infrared method and electrolytic method, etc., for water vapor permeability testing. Particularly for gas permeability testing of materials, differential-pressure method and equal-pressure method vary greatly in terms of testing environment and testing principle, which imposes direct influence on test data of the two methods. Therefore, test data of different methods are difficult to compare. However, reference material can unify test data of various methods and increase the comparability of test methods.

Secondly, a broader application need for reference material lies in the instrument status, calibration of instrument data systems and prolonging the effective life time of equal-pressure method sensor. For example, oxygen sensor in equal-pressure method will be depleted with time. It is subjective and unreliable to decide the depletion of oxygen sensor only by personal experience. Reference material has obtained good reputation during actual application since its test data can be used to compare with standard value so as to evaluate working conditions of instruments. Moreover, when oxygen sensor is depleted to a certain extent and affects test data obviously, the use of reference material can calibrate data system of instrument and prolong lifespan of sensor.

2. How to Select Reference Material

Since the manufacturing process of film is rather complex, there are many factors affecting the stability of permeable parameters. Generally speaking, institutions of standard material should carry out systematic tests to films on stability of physical properties, repeatability of testing data and valid preservation period. The film cannot

be used to evaluate testing stability and data calibration of permeability instruments unless all the aspects meet the requirements.

It has been proved that ASTM D 3985, equal-pressure method oxygen permeability test standard, specifies the standard material for calibration is SRM 1470, issued by NIST: POLYESTER FILM FOR OXYGEN GAS TRANSMISSION MEASUREMENTS.

3. Introduction to Reference Material

3.1 SRM 1470

Issued by NIST, SRM1470 takes the form of 23 μ m thick sheets of PET film. It can maintain a stable O₂GTR value. The testing result under one atmospheric pressure is 63.8cm³(STP)/(m²·d·atm). Computer-controlled manometric permeation measurement facility is employed for data collection.

NIST official website has such description of SRM 1470: the known permeability values of nitrogen gas, oxygen gas, and carbon dioxide gas are compared with values obtained through common technologies such as differential-pressure method, volumetric method and coulometric method. SRM standard reference material is used in the measurement of gas transmission rate of thin films using manometric, volumetric, or coulometric methods.

3.2 Labthink PC Film

Labthink PC film is 125 μ m thick sheets of polycarbonate film. Its oxygen permeability amount under standard test condition (one atmospheric pressure, 23 $^{\circ}$ C) is 430.206 cm³/m²·24h·0.1MPa. Long term tests have proved that barrier property of this material is rather stable.

Labthink Barrier Laboratory has conducted a two-year research on the stability of the material property. Some of the data are listed below:

Date	Times	Test temperature (°C)	Average Oxygen Permeability (cm ³ /m ² ·24h·0.1MPa)
2005-7-6~8	3	40	635.512
2005-7-14~16	3	40	624.805
2005-7-25~27	3	40	635.463
2005-8-11~12	3	40	632.385
2005-11-18~22	3	40	617.000

PC films adopted in this group of tests are obtained from the same batch. The data shows that barrier property of the material does not change with time. Other mechanical tests have showed that such material possess excellent physical stability. In 2006 and 2007, Labthink also tested this material under different temperature (10 $^{\circ}$ C~50 $^{\circ}$ C) and different pressure (0.03 MPa~0.15MPa); data stability and repeatability are very good.

4. Conclusion

For gas permeability testing, the inconsistency of test data between differential-pressure method and equal-pressure method as well as the depletion happened during application makes calibration the chief factor to decide accuracy of testing data. Films are the standard materials adopted in reference material calibration. Therefore, only when stable and effective reference material is employed can users obtain effective calibration

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