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Data System Unification for Barrier Capability Testing

Abstract: The problem of data inconsistency among barrier property tests still exists. Minor differences can lead to significant economical losses, even safety problems of products. This paper mainly talks about the methods of unifying barrier property testing data system and the demands in choosing standard film.

Key word: barrier property, oxygen transmission rate, water vapor transmission rate, calibration, standard film

From the laboratory capability validation of “barrier property of plastic packaging material test，testing of oxygen penetration amount and vapor penetration amount”, we can see that the inconsistency among different testing methods really exists. Minor differences can lead to significant economical losses, even safety problems of products. After the capability validation, experts in the relative fields began to pay attention to barrier property testing unification. We will further discuss the probability of realization and method of implementation.

1. Analysis of the available methods of unifying barrier property testing data

There are difficulties in unifying barrier property testing data system because of the differences in testing theories of barrier property testing. For example, pressure difference method in air penetration test compute testing data by measuring the changes in testing cavities, and isopiestic method get testing data by inspecting oxygen content in airflow. Likewise, as for moisture permeability test, parameters also vary greatly, weighting method use weight, while electrolysis sensor method and infrared sensor method use gas content in airflow, and humidity sensor method choose times. So the direct calibrating methods adopt by those barrier property tests are different, such as isopiestic method using standard air in calibration while pressure difference method using manometers.

But those direct calibration methods can not be used to unify data system of barrier property test. First, these calibration methods only calibrate key test parameters but other parameters are also calculated in testing result. Second, calibrate objects differ in different calibration methods and these methods can not be used in other situations. So we must find a current and reliable method to satisfy the need.

After studying calibration methods in other test indexes, in order to unify data system of barrier property test, we must find a kind of substance that can calibrate test data of barrier property test instruments, just as using standard blocks which calibrate the thickness of instruments, to complement the calibrate of different thickness

gauges. And as for barrier property testing, the standard substance appears to be standard films which have acknowledgeable, robust barrier properties. User can find out whether the experimental data is within the promising range by comparing the barrier property data of film and testing data of instrument. Generally speaking, the standard film calibration method which has been widely used is the first consideration to unify data system of barrier property testing.

2. Standard Film and Selection

2.1 Introduction to Standard Film calibration

Standard film calibration is the most commonly used calibrating method in barrier property testing. The calibrating which deal with testing data instead of experimental parameters, could be used to calibrate instruments in air penetration test, moisture permeability test and organic compounds permeability test, the focus.

There are many advantages in standard film calibration. First, it is easy to use, the standard substance is the only need. Second, it conforms accuracy and consistency of testing data. Other calibrating methods calibrate one testing parameter only and can not eliminate the effects of other factors. Third, it can be used in frequent operating and periodical calibrating. Multi-cavity testing instrument need not to break its normal testing work when determining if the instrument is working in condition.

2.2 Testing Items of Standard Film

Standard film calibration has been widely used. The property testing needs to be strengthened to qualify to the unification of data system of barrier property. It is important to make sure that errors would not happen when testing the same index using the same instrument under the same experimental condition. The focus is whether film is stable and keeps its barrier property after a certain period of storage, transportation and so on. So the barrier property of film includes good uniformity and stability.

2.3 Standard Film Selection

First, select films of good uniformity and stability.

Second, uniform is the first consideration. Uniform films such as standard film published by NIST and used in air penetration instrument testing. The more kinds of materials involve in films, the more factors that affect the uniformity and stability of testing data.

Third, the universality of testing data of selected material, the data should not too close to the limit of testing

instruments. A data of mid-level is fairly receivable. For if the testing data is too close to the limit of testing instruments, other factors such as environment would have more influences on the testing data.

Forth, materials that keep good barrier property after strength enforcement is the priority choice. Although uniformity and stability of barrier property is keystone in material selection, other factors in material transportation should also be considered. So, materials with good barrier property are the prior chooses on the basis of satisfying uniformity and stability.

In fact, there many materials that meet the demands of standard film selection, such as PET. PET is the most commonly used material in flexible packaging with moderate barrier property and stability. The specimen that used in laboratory capability validation of “barrier property of plastic packaging material test，testing of oxygen penetration amount and vapor penetration amount” , are PET with slight differences in thickness and have a barrier property of good uniformity and stability. We can see from list1 that it keeps good barrier property after enforced on external forces in kneading experiment by labthink, counteracting the effect of external forces in transportation.

	thickness	WVTR [1, 2] before kneading experiment	WVTR[1, 2] after kneading experiment with pattern D	WVTR[1, 2] after kneading experiment with mode C	WVTR[1, 2] after kneading experiment with pattern B
VMPET	12μm	1.248	18.352	22.112	30.363
PET	20μm	15.64	16.654	16.321	26.012
PE/EVOH/PE	76μm	5.09	5.523	5.556	5.083

List1. Data list of kneading experiment

ps：1. The unit of WVTR is：$g/m^2 \cdot 24h$.

2. Average testing value.

3. Summary

Relevant institutes of our nation are trying to unify testing data of barrier property, for example, the national test standards of pressure difference method and weighing method have already been instituted, we can manage the testing data system by controlling testing methods. However, with the development of national barrier property testing, we have isopiestic method and electrolysis sensor method later and non-standard instruments are also used sometimes. We can not control the stability of testing data system by controlling testing methods, so it is urgent to find a new way to unify data system of barrier property testing. Standard film calibration that has been commonly used is competent for unifying data system of barrier property and getting rid of obstacles in data

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comparison of different testing methods.