

Plastic Material Barrier Property Document: Significance of Proficiency Testing of Plastic Packaging Material Barrier Property 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 Words: barrier property, oxygen transmission rate, water vapor transmission rate, calibration, standard film

At present, the development of material barrier property test in China is not balanced: the testing quality levels are varied, testing data is inconsistent. But, to improve the condition and promote testing proficiency, we must know the general condition of China's barrier property tests objectively and accurately at first. We have investigated barrier property testing in China and gained tremendous achievement through laboratories proficiency testing 'Barrier Property Test of Plastic Packaging Material——Determination of Oxygen and Water Vapor Transmission Rate'.

1. Appropriate evaluation of barrier property testing level in China

In the past, we knew and evaluated the barrier property testing level in China via indirect ways. For example, analyzing the percentage of each testing method in China by market domination rate of testing instruments of various companies, and then estimated the condition of general barrier property testing by analyzing and comparing each testing method and capability index of instruments. As a result, the conclusions and evaluations do not possess high accuracy. Further, the statistical data are often of little truthfulness due to indirect evaluation methods and the lack of official authority. There have been instances of 'prettified' statistical data owing to commercial purposes.

As class A project of proficiency testing program of CNCA in 2007, the labs of plastic packaging material barrier property testing include production quality test centers nationwide, inspection institutes at provincial levels (including deputy provincial level city and city directly under state planning), government-controlled technical centers (labs) of Administrations for Entry-Exit Inspection and Quarantine, all laboratories processing the barrier property testing items in relevant ministries and commissions and production quality inspection centers. Company laboratories and other laboratories can also participate in the testing. Totally, 69 laboratories participated in oxygen transmission rate testing, 67 laboratories participated in water vapor transmission rate testing. It covers most of the Quality testing institutes and relevant authoritative laboratories in China. This proficiency testing is unprecedented in scale, barrier property testing level and authoritative of organizers. Therefore, we can evaluate barrier property testing level of China authoritatively, objectively and accurately. The statistical data affirmed the unshakeable reputation of weighing method and differential-pressure method. System errors of weighing method and differential-pressure method are within the range of accreditation; and laboratories with neither of these testing methods provide outlying testing data.

2. Testing procedure Regulation

Barrier property testing is a new testing field in China, and many testing institutes and laboratories begin to carry out this testing item in recent years. Degree of familiarity of the testing method and understanding of the testing index of laboratory assistants are not exactly the same. Laboratory assistants have different understandings on testing principal, specimen preparation, choosing of experimental environment, effects of temperature changes on the testing data, similarities and differences among testing standards, and notices of kinds of testing instruments, etc. Laboratory assistants would get deep understanding of many details in operating through the proficiency testing so as to avoid future effects of many detailed issues in barrier property testing. At the same time, the applications of package material barrier property testing was popularized and emphasized.

3. Guidance to data comparison process

Comparisons of data among laboratories and barrier property testing methods had been executed in the past. But the comparison process was not standard. The commonly phenomenon is that the specimen selection for comparison and statistical processing of testing data were simple and not strict. Through the proficiency testing, we get a clear knowledge of the strict procedure of the whole proficiency testing, and the consistency of compared specimen and scientific nature of data statistical analysis which have a direct influence on the accuracy of proficiency testing so as to affect the success of the project. Therefore, organizers should test the homogeneity and stability of the proficiency testing specimen according to CNAS-GL03 《**Guidance on Evaluating the Homogeneity and Stability of Samples Used for Proficiency Testing**》, to avoid the dissatisfied results from the inherent variability of specimen. Statistical processing on the testing result should be carried out according to CNAS-GL02 《**Guidance on Statistic Treatment of Proficiency Testing Results and Performance Evaluation**》, and evaluate testing capability of laboratories by those statistical data. These evaluation methods have been used for many years and have profound theoretical basis. They can act as theoretical basis for the future comparison of various kinds of data and a guide to the comparison test.

4. Provide references to barrier property testing instrument choosing

There are many testing methods for each barrier property testing. In fact, other testing methods besides weighing method and differential-pressure method are also used in China (despite the lack of supports from international standards). Therefore the organizer, National Package Product Quality Supervision & Testing Center (Jinan), suggested GB/T1037-1988 《**Test Method for Water Vapor Transmission of Plastic Film and Sheet – Cup Method**》 and GB/T1038-2000 《**Plastics - Film and Sheeting – Determination of Gas Transmission - Differential-Pressure Method**》 as the experimental method. Other experimental testing methods are also allowed. Thus, this proficiency testing provides a scientific and equal platform for different testing methods.

The proficiency testing takes the automation level of instruments into the account of comparison, which was not concerned in the past.

In fact, the convenience of instrument operation has direct link with affects of artificial error in experimental data; and especially for microcosmic indexes as barrier property, the inaccuracy arisen from artificial error is far greater than effects of testing method itself. Taking the automation level of instruments into account, we acquired many valuable conclusions in this proficiency testing. For example, automatic weighing method

instrument and non-automatic weighing method instrument performed differently in proficiency testing of water vapor transmission rate -- data from only 3 laboratories with automatic weighing method instrument was considered to be suspicious; whereas more than half of the laboratories with non-automatic weighing method instrument were considered to be suspicious or outlying. Experts are not surprised to this result: the shortages of non-automatic weighing method had been mentioned several times before, and some disloyal sayings often confuse the artificial errors from low automation level with errors of different experimental methods. This proficiency testing gives us a clearer understanding of advantages and disadvantages of different testing methods, but provides valuable information for permeability instrument selection of the testing institutes and laboratories at all levels.

5. Making preparation for unifying data system of China barrier property testing

From the proficiency testing, we can see that the inconsistency between different barrier property testing methods really exists. Though data difference is slight, it could lead to tremendous economic losses and even safety problems of products, especially for food and medicine packages. So, the data differences from different methods on permeability testing have been focused on widely. Since the scale of data comparison in the past was smaller and the procedure was not regular, it is hard to get an accurate and effective analysis by data comparison; and to unify testing data systems is far more impossible. This proficiency testing is the first largest barrier property testing in the world. Not only the testing environments and specimen are guaranteed, but the reliability and truthfulness are also guaranteed by the status and strength of the participated laboratories. Therefore, the statistical data of this proficiency testing could be the foundation and realization for unifying data system of barrier property testing.

6. Summary

In summary, the achievement of proficiency testing project is remarkable. We not only get the general status of barrier property testing of China, but also accomplished the first and largest systematic comparison of different barrier property testing methods in the world. We get a clearer recognition of the existing problems in barrier property testing fields, and lay the foundation for unification of data systems of barrier property testing in the future.