

Introduction to Standard GB/T 21529-2008 -- Determination of Water Vapour Transmission Rate for Plastic Film and Sheetting-----Electrolytic Detection Sensor Method

Abstract: The paper is about Plastic Film Water Vapour Transmission Rate Standard Electrolytic Detection Sensor Method.

Keywords: water vapor transmission rate , wvtr , GB 21529 , electrolytic

With WTO entrance and the acceleration of globalization, standards are becoming more and more important in promoting international trade and establishing technological trade measures. It is an inevitable demand for our national economy and social development to establish and perfect a scientific, reasonable technical standard system in line with international practices. In contrast to the rapid development of packaging industry, some testing technologies are still simplex and dated. In order to promote the production and development of packaging materials, formulating new testing standards and introducing new testing technologies are imperative. There had been the weight method as the only standard for water vapour transmission rate testing in China, and can not satisfy the rapid development of packaging industry.

Therefore, the formulation of standard for the more convenient and easy electrolytic detection sensor method has been greatly concerned. Now, the national standard GB/T 21529-2008 -- Determination of Water Vapour Transmission Rate for Plastic Film and Sheetting-----Electrolytic Detection Sensor Method has been unveiled, and will take effect on October 1, 2008.

1. Introduction to GB/T 21529

Determination of Water Vapour Transmission Rate for Plastic film and Sheetting - Electrolytic Detection Sensor Method (GB/T 21529-2008) derives from the third part of ISO 15106-3:2003, that is, Film and Sheetting - Determination of Water Vapour Transmission Rate - Part 3: Electrolytic Detection Sensor Method. It is co-drafted by China Packaging Research & Testing Center (CPRTC), State Packing Products Quality Supervision and Testing Center (Jinan) and Labthink. Proper modifications and supplements of this ISO standard based on experiences in barrier property tests, structure manufacture and data statistics are made so as to strengthen the feasibility, practicability, preciseness of the standard and data comparability. This standard was formally released on April 1st 2008, and published in May 2008 (available in Standards Press of China); and will be formally promulgated on October 1st 2008.

2. GB/T 21529 and ISO 15106-3

In order to strengthen the applicability and comprehensiveness of the new standard, some corrections on ISO 15106-3:2003 are made as revised adoption. First of all, we will introduce concept of revised adoption of international standards.

International standards are defined as those standards that have been approved and promulgated by International Organizations for Standardization (ISO) or international standard organizations; they are the basic elements and common foundations for international trade. International standard adoption refers to analysis and validation of

the contents of international standards to equate and modify as our national standards, and promulgation following national procedure of examination and approval. According to regulations in Guides for Standardization-Part2: Adoption of International Standards (GB/T 20000.2-2001), our national standard are classified into equal adoption and revised adoption by the extent of adoptions in our national standards. Equal adoption refers to those national standards are the same as international standards in contents and structures, or with slight editorial corrections in content whereas the technical contents are the same. Technical differences are allowed when adopts revised international standards, but these differences must be explicitly marked and explained. Meanwhile, structures of The original standards should be kept as far as possible.

Revisions include modification, addition, deletion or supplementation to the international standards as well as the editorial corrections under equal conditions.

GB/T 21529-2008 differs from ISO 15106-3:2003 in the following aspects:

1. Addition of introduction to testing components. Introduction of testing system in ISO 15106-3:2003 is comparatively simple. Though illustrations of the structures of test machines are given, but capability indexes of specific components are not stated clearly -- even some components are without definite introductions to their usages. This may lead to misunderstandings and make unnecessary obstacles of further popularization and application of standards. Therefore during the drafting procedure of GB/T 21529-2008, we clarify not only the usage of each component, but also the precision requirements for necessary indexes of each component to meet the testing needs. At the same time, the materials of some components are stated, such as the porous disc: it's stated clearly in GB/T 21529-2008 that 'porous disc is made of fiberglass or porous ceramics'. This may decrease possible economic losses in material selection, but prepare for future selection of new materials as well.

2. The addition of regulations on adopting standard film calibration equipments (item 7.3). This makes the data comparability with other testing methods and standards. Due to loss of sensors or testing accuracy, electrolytic detection sensor instruments need to be calibrated with weighing method regularly, which requires standard film in calibrating. Though standard films have been commonly used in international barrier property tests, it is the first time to use in barrier property testing standard in our county.

Standard data always comes with standard film. We did not pay attention to this issue since we only have GB/T 1037-1988, the water vapour testing standard, in use; and the weighing method (weight method) only ensure the accuracy and reliability of the weighing system before GB/T 21529-2008. When drafting GB/T 1037-1988, weighing method is always the first choice for its basic status. However, weighing method is different from electrolytic detection sensor method and infrared sensor method in testing method; this may lead to differences in testing data. Therefore, it is important to decide which will be the standard data system. Weighing method, as the foundation of water transmission test, is regarded as the basic data system of water transmission test when drafting out standards internationally and domestically. Standard films that have been used in other testing methods are all calibrated by weighing method. The relevant introductions are explicitly stated in ASTM E 398-03 and other standards. There have been careful demonstrations about calibration when drafting GB/T 21529-2008; and the conclusion is 'using standard films in calibration; standard films can be films with known water vapor transmission rates, or films with water vapor transmission rates via weighing method.' Adoption of standard films is a breakthrough of GB/T 21529-2008, which is in line with international practice, and further strengthens the

traceability of testing data. Calibration of standard films can guarantee the data consistency of electrolytic detection sensor method and infrared sensor method to weighing method.

Some readers may be puzzled that there is no standard film worldwide; each country has its own standard film for calibration of the barrier property equipments. Does this mean that electrolytic detection sensor method or testing data from GB/T 21529-2008 is not consistent with testing data by electrolytic detection sensor method equipments in other countries, or other standards of electrolytic detection sensor method? Actually, this will never happen -- weighing method uses standard poise to calibrate the weighing system, the accuracy of data is the key point. Furthermore, standard poise world-wide are by the same standard, and can guarantee the uniform and stable data of standard poise of the same level. Testing data of weighing method is in consistency world-wide. Furthermore, this guarantees the global consistency of the testing data of electrolytic detection sensor method to that of weighing method.

3. Regulations on the conditions for water vapour transmission in stable state. The procedure of water vapor transmission begins with unbalanced mode (unstable transmission) and ends with balanced mode (stable transmission). However, parameters of water transmission have to be obtained in the balanced mode. Therefore, estimating balanced mode is the key of accurate testing data.

To regulate balanced qualifications of water transmission as those of weighing method is very necessary, that is, this standard adopts 'proportion estimation' method: 'measure the changes of electrolytic current at intervals. If the fluctuation ranges of electrolytic current are no more than 5% for the consistent three times, electrolytic current can be regarded as constant, and water vapor transmission in stabilization.'

Proportion estimation method can improve the stability and accuracy of data, but also, integrated with advanced computer control techniques to effectively reduce invalid loss of electrolytic cell and testing costs.

4. It also regulated that deviations between testing data of each specimen and average of whole specimen should not exceed 10%. This item can be used to judge the effectiveness of testing conditions so as to avoid enlisting ineffective data into testing results as a result of operation, sampling and other problems.

5. The addition of appendix B. Relative humidity data of different salt saturation solution are adopted in appendix B according to ASTM E 104:2002 Standard Practice for Maintaining Constant Relative Humidity by Means of Aqueous Solutions, and DIN 53122.2:1982, **Testing of Plastic Films, Rubber Films, Paper, Board and Other Sheet Materials; Determination of Water Vapour Transmission, Electrolysis Method**. Operators would feel more convenient in practical practices, since ISO 15106-3:2003 only provides method of getting pre-determined relative humidity through vitriol solution. But safe usage of vitriol should be considered in practical operations. What's more, humidity is limited only with vitriol solution. With the addition of appendix B, range ability of relative humidity has been extended from 15 humidity values in 0%RH~80%RH to most of humidity values in 0%RH~98.5%RH, this provides more ways to implement relative humidity.

6. Addition of Appendix C. Appendix C, which follows derivation process of instrument constant of DIN 53122.2:1982, makes a detailed introduction of the computation of instrument constant. Instrument constant appeared in ISO 15106-3:2003 abruptly; and there is no explanation of its original, as many readers can not understand the purpose and significance of adding it in Appendix C. Thus, this instrument constant receives low recognition. However, GB/T 21529-2008 explains the instrument constant clearly under the principles of

completeness and integrity. Instrument constant actually is not a constant of instrument (it may be misleading as a calibration constant which is unique to each instrument), but a method constant of electrolytic detection sensor method. The name 'instrument constant' is just the continuation of that in ISO 15106-3:2003

7. Deletion of items which are uncertain and have no substantial content in ISO 15106-3:2003.

8. Other corrections done on the basis of strengthening practicability, eliminating limitation and clarifying vague explanation. First, lower the usage of some restrictive conditions. For example, no regulations on the working voltage of electrolytic detection sensor method are stated in the standard; and requirements on selections of range ability of flow meter and area of transmission are broadened. Second, broadening restrictions on component and material selections of some instrumental components which can strengthens the practicability of this standard. These measures are helpful for the applications of new materials and new designs; and makes necessary foreshadowing for the future technical compliance of this standard.

In GB/T 21529-2008, corrections are made to ISO 15106-3:2003; but these corrections do not include basic theory of testing. Their only purpose is to achieve more convenient applications based on sufficient reasons for each correction. This perfects the deficiencies in ISO 15106-3:2003, but also foreshadows technological development in future.

3. GB/T 21529 and GB/T 1037

There had only been GB/T 1037-1988 in application in China before GB/T 21529-2008; therefore it is wide concerned on the comparison and relationship between the new and the old standards. However, owing to different testing methods, it is incomparable in instrument structure and components. Thus, we compare the two standards in definitions, qualifications, balance judgments and practicability only.

1. GB/T 21529-2008 combines many water vapour transmission rate testing standards, and defines the transmission amount of water vapor under specified conditions of unit area and time as Water Vapour Transmission Rate (WVTR), not the 'water vapor transmission rate' in GB/T 1037-1988. But, essentially speaking, the implied meanings of water transmission rate in GB/T 21529-2008 and GB/T 1037-1988 are the same, and the same unit of $\text{g/m}^2 \cdot 24\text{h}$.

2. GB/T 21529-2008 added three choice testing conditions on the basis of GB/T 1037-1988, so as to broaden the range of testing qualifications.

3. GB/T 21529-2008 is the same as GB/T 1037-1988 in balanced judgment and data choice.

4. GB/T 21529-2008 is superior in practicability and convenience. First, moisture absorption ability of desiccant is limited in GB/T 1037-1988; test can not run automatically without interventions of the operators to maintain the persistence and consistency of pressure difference between the two sides. However electrolytic detection sensor method can run automatically without interventions of operators to keep humidity difference between the two sides of specimen. Second, uncertain factors brought by wax sealing of water vapor transmission cups are eliminated in specimen preparation with electrolytic detection sensor method. It strengthens convenience of loading specimen and effectiveness of testing data. Third, testing efficiency of electrolytic detection sensor method is greatly increased which can better meet the demand of faster testing of packaging industry.

4. Conclusion

The formulation of GB/T 21529-2008 is not only the importation of advanced methods, but emphasized evaluation on accuracy and practicability of the method, so as to fit the practical application of our country. It's believed that the promulgation of this water vapour transmission rate testing standard on Oct. 1, will provide more convenience for the development of our packaging industry as well as satisfy the demands of the rapid developing packaging industry.