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Main Testing Items of BOPP Films

Abstract: the properties of cigarette packaging materials are the key factors affecting the storage period in relation to the different storing environments. This article analyzes the testing demands of BOPP film (bi-axially oriented polypropylene film), and introduces the tests for several properties of BOPP film, including water vapor transmission rate , flavor protection, coefficient of friction, heat shrinkage and thickness, etc.
Key Words: BOPP, bi-axially oriented polypropylene film, cigarette film, flavor protection, coefficient of friction, heat shrinkage, thickness

During manufacturing process, several organic and inorganic substances are added to the tobacco, which may generate microorganisms and mould with the changing of the storing environment. When smoking, various microorganisms and mould may change into toxins by the high temperature burning, and put threats to human health. Thus, the storage period of cigarette depends heavily on the environment: two to three year's storage period in suitable environment, and less than one year in inferior environment. We must take cigarette packaging and storing environment into consideration, so as to prolong shelf-life period and to reduce cigarette deterioration.

1. The Analysis of Testing Demands

Temperature and humidity are the two vital factors affecting cigarette storage. Since cut tobacco would absorb moisture in high humidity environment, and would occur over-drying in low humidity environment, it's normally required to store the cigarette in low temperature environment with proper humidity. Therefore, moistening and moldiness are the main factors affecting the quality guarantee period; and flavor protection is of vital importance, especially for high-end cigarettes. At the same time, cut tobacco is apt to absorb other aromas around which would lead to inferior cigarette flavors.

Different from other consuming products, even the retail package of cigarette has several layers, including the inner aluminum-foil paper, flexible/rigid paper packaging, and the outer transparent plastic film packaging. Every layer has its respective function, and the whole package barrier property is the key factor relating to moldiness, moistening, and flavor protection. The outer transparent film, i.e., cigarette film is of the highest barrier property among all the packaging materials, which has the closest relationship with the cigarette quality. Now, BOPP (bi-axially oriented polypropylene) film has been widely applied as the cigarette film. Though inferior in barrier performance against oxygen, BOPP film is superior in flavor protection and barrier property against moisture. Yet, with the higher requirements from the high-end cigarette packaging, the barrier performance of BOPP cigarette film, especially flavor protection performance can not meet the demands completely. Thus, high barrier film with PVDC coating has been gradually used in cigarette packaging. Besides, cigarette film should be suitable for high-speed packaging line; and a set of index requirements for coefficient of friction, thickness, shrinkage, heat seal, anti-static electricity and mechanical performances, should be achieved.

2. Testing Items for Cigarette Film

Barrier property is the key testing item for cigarette film. Relevant tests include water vapor transmission rate testing, oxygen transmission rate testing and organic gas transmission rate testing, all of which directly relate to the moistening, moldiness and flavor protection effect of the cigarette. Meanwhile, in order to meet the requirements for high speed packaging line and packaging speed with excellent performances, the film should meet the requirements for the following indexes, namely, coefficient of friction, thickness, shrinkage, heat seal,

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anti-static electricity and mechanical properties, etc. Furthermore, as to the artistic and beautiful packaging demand, transparency, stiffness and haze should satisfy high standards. For this purpose, tests for coefficient of friction, heat shrinkage and thickness are of key importance.

2.1 Water Vapor Transmission Rate Testing

In order to avoid deterioration caused by moistening, higher barrier property against water vapor is required for cigarette packaging. Currently, weighing method and sensor method (including humidity sensor method, Infrared sensor method and electrolytic sensor method) are the two testing methods for water vapor transmission rate testing. Both of those two methods can meet the testing demands for cigarette films. As to testing efficiency, sensor method, especially the electrolytic sensor method, is better.

2.2 Flavor Protection Testing

Oxygen transmission rate testing is one of the common testing items for BOPP cigarette film. However, oxygen doesn't have the influence as important as water vapor on cigarette quality. Generally, a comprehensive set of tests both for oxygen and water vapor transmission rates can help determine the flavor protection performance. It's known that flavor is composed of organic gases. So, the flavor protection properties of different packaging materials should be evaluated based on the organic gas transmission rate testing. Yet, the test is still at its primary stage worldwide.

A lack of testing method and instruments has led to the above-mentioned comprehensive test set as a common practice to compare the flavor protection capabilities between materials. Owing to the characteristics of organic gases, including transmission characteristics, which are different remarkably from the inorganic gases, such comparison is lack in accuracy: first, swelling would occur when organic gases transmit through high polymers, and would lead to great changes to barrier properties. Second, size and characteristics of organic gases differ greatly from inorganic gases. The testing methods for organic gases have remarkable differences for those for inorganic gases, among which the biggest difference is that an organic gas generator should be preinstalled inside the instrument for low gas concentration and other characteristics of organic gases. Generally, the influence of swelling towards barrier property can be neglected if the testing gas concentration at the high concentration side is no higher than 100ppm.

There have been growing testing demands for organic gases in spite of the testing difficulties. Since 2007, Labthink Instruments has been researching on the equilibrium method for organic gas testing. Now, the professional equilibrium method organic transmission rate tester, Labthink PERME OR2/410 Organic Gas Transmission Rate Testing System has been developed successfully. This instrument is highly automatic, and convenient to operate. It meets the testing demands for flavor protection, and provides technical support for the drafting of relevant national standards.

2.3 Coefficient of Friction Testing

In order to achieve stable and smooth operation, as well as good packaging effects for BOPP film on the cigarette packaging machine, the film should possess proper coefficient of friction. First, the side in direct contact with machine should have low coefficient of friction against metal, and the side in contact with the cigarette paper packaging should have a high coefficient of friction, so as to realize different slide capabilities between the two sides for good positioning of the cigarette packaging on the forming wheel, as well as to improve folding performance and to achieve compact packaging effect. In manufacturing process, film would slide on the film input channel, forming wheel, folding panel, welding iron, slide way and other metal parts operating in the high temperature of around 50 degree, much higher than the common testing temperature for coefficient of friction, i.e.,

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23 degree. Testing data indicates that, with the temperature increase, the coefficient of friction for films would increase, and even stick-slip would occur. Therefore, coefficient of friction testing in ambient temperature and its data is of little practicability for BOPP cigarette film, and the data at 60 degree is usually the necessity.

2.4 Heat Shrinkage Testing

BOPP cigarette film is usually classified into two types: standard type and heat shrinkage type. As to the standard type BOPP film, the heat shrinkage performance is not so good. The relevant heat shrinkage rate is 3%-7%. Thus, standard BOPP film is commonly used for the retailing package and bar package. On the other hand, the heat shrinkage rate of heat shrinkage BOPP film is usually greater than 8%. The cigarette package with such material can perform compact and smooth packaging effect in the long term. Heat shrinkage rate is mainly applied to evaluate the thermal stability of BOPP cigarette film in its size caused by varied conditions or factors. At present, ASTM D2732 and GB/T 13519 are the main references for this item; and heat shrinkage tester is the corresponding testing apparatus. Moreover, relevant parameters can be changed according to actual application, so as to obtain better testing results.

2.5 Thickness Testing

Thickness is a key index for BOPP cigarette film manufacturing, testing and application. If thickness can not be well controlled, flaws of outward appearance and problems for application would occur. Thicker film can have better performance in the packaging machine with better stiffness and superior package outline. However, costs would increase for such thicker films. In order to lower the packaging costs, the best parameters for excellent packaging effects with less packaging costs is under research. Yet, the practicality of the most favorable parameter is determined by the film smoothness. Furthermore, BOPP film has certain elasticity, and the mechanical determination method is more suitable for thickness testing.

3. Conclusions

The properties of cigarette packaging materials are the key factors affecting the storage period in relation to the different storing environments. According to analysis, flavor protection and water vapor barrier property are the key factors affecting cigarette storage. Now, testing technologies for water vapor and inorganic gas transmission rate have become mature; yet, the testing technologies for organic gas transmission rate relating to flavor protection is still at the development stage. It’s pleased that the domestic testing technologies for organic gas transmission rate have become world leading, and have contributed to the industrial progress.