

How to Properly Maintain Permeability Testing Instruments

Abstract: permeability testing instruments is expensive in price. Operation condition of the instruments is one of the key factors affecting accuracy of test data. Therefore, proper maintenance of instrument is very essential. This article elaborates on the maintenance precautions of several permeability testers. Based on specific test methods and important components of instruments, the focus of maintenance is also discussed.

Key Words: maintenance, gas permeability, water vapor permeability, calibration

Comparing with the mechanical and the thermal properties of film, barrier property testing is more microcosmic in terms of its testing object and more complex in terms of the testing principle. In addition, permeability testing costs much higher than common testing items. Therefore, instrument maintenance becomes essential since it can prolong instrument lifespan and in turn improve the rate of instrument utilization. Although in earlier testing, many procedures are completed through manual operation. Present instruments possess high atomization. Except for the procedure of specimen attachment, the whole test including providing test data can be finished automatically. Thus instrument maintenance can be considered as the primary factor affecting accuracy of test data. For different test principles and different key components, the methods of maintenance for various permeability testing instruments also vary greatly. This article will introduce the key points of maintenance based on specific test method.

1. Permeability Testing Instruments

1.1 Differential-pressure Method

Differential-pressure test method possesses many advantages, with Non-selectivity to test gas being the most salient one. Also, sensors of such instruments are of non-consumptive type, thus having no time and quantity limit. Therefore, operation details are the focus of differential-method instrument maintenance. First, keep impurities from entering lower test chamber. Since lower test chamber directly connects to vacuum pump, impurities inside lower chamber will enter vacuum pump and cause damage there. Next, vacuum pump is required to use special oil obtained from its manufacturer. Operators should control the oil quantity within a specified range and pay close attention to the quality of oil. Thirdly, for earlier differential-pressure method instruments that employ mercury-containing vacuum pressure gauge, safety storage of mercury is of critical importance.

1.2 Equal-pressure method

Equal-pressure method instruments mainly adopt consumptive oxygen sensors, of which the effective detection elements deplete with time, when exposed in high concentration oxygen or in air, oxygen sensors are rapidly consumed and cannot be used. Because it costs high to exchange oxygen sensor, the most important thing in equal-pressure method instrument maintenance is to prolong sensor life by keeping it from exposing to environmental gases. First, make sure the specimen is properly placed so that leakage can be avoided. Next, purge the system and do not begin the transmission until internal oxygen content becomes very low. At the same time, for lower barrier materials, operators should take measures to prevent oxygen content inside oxygen sensor from being extremely high in order to reduce sensor consumption. Labthink series of Equal-pressure method instruments reduces the consumption of oxygen sensor by providing assistant devices to reduce test area of specimen and to increase flow rate of carrier gas. Empirical tests have proved that these two methods not only reduce the consumption of effective detection elements during testing, but also greatly expand test range of

instruments. Secondly, lower oxygen content inside oxygen sensor to a minimum extent after testing. If the instrument is to be used in the near future, purge test chambers with high flow carrier gas and then keep purging the chamber with carrier gas of smaller flow rate so that environmental oxygen can be prevented from entering inside. If the instrument will be left unused in a long term, make sure oxygen content of gas flow is lower enough (for example, system has been purged by high purity nitrogen gas for more than two hours), then stop air supplying by closing safety valve of oxygen sensor. Next, turn off output valve of gas source. Labthink series of equal-pressure method instruments adopts dual protective measures for oxygen sensors, thus greatly improved the sealing effect. However, since depletion of oxygen sensor directly affects accuracy of test data, equal-pressure method instrument must be calibrated periodically.

It should be noted that because equal-pressure method instruments should be purged with large quantity of carrier gas both during and after testing, the releasing amount of tail gas is rather big. Therefore, users should guide the tail gas outside by connecting outlet of tail gas with guide tube. At the same time, ventilate the lab to keep fresh air.

Thirdly, present equal-pressure method instruments generally have temperature and humidity controlling function. Humidity controlling will inevitably increase humidity of gas path and produce unnecessary matters there. The existing of moisture inside gas path is unfavorable for instrument maintenance. Thus users should remove the matters generated during humidifying testing and then purge the system with dry nitrogen gas.

2. Water Vapor Permeability Testing Instruments

2.1 Gravimetric Method

Gravimetric method is the basic method for water vapor permeability testing. It has been used since the 1950s, thus automation degree of gravimetric method instruments vary greatly. Earlier non-automatic instruments also differ from current automatic testing instruments in terms of maintenance. For the former kind, separate devices such as constant temperature and humidity box, permeable cups, and gravimetric balance are needed for combined test, for which the maintenance is also carried out separately. The importance of maintenance is to make sure that surfaces of permeable cups and gravimetric balance are clean without corrosion. While for current automatic instruments, permeable cups should be taken out from the instrument after testing. Clean internal cups and keep them clean. At the same time, to prevent instrument components from corrosion specified distilled water or agent the must used as humidizer.

2.2 Sensor Method

For infrared and electrolytic sensor methods, the water vapor sensors being employed are of consumptive type, for which the effective elements deplete with time. Water vapor sensor cost higher in price. Thus water vapor sensor becomes the focus of instrument maintenance. The transmission of water vapor should be reduced to a minimum state during test, for example, reducing test area of specimen. If the instrument will be used in the near future after test, purge instrument pipe path with high-purity nitrogen dry gas at big flow rate until next test. Otherwise, take out the humidizer inside humidifying chamber and then suck the water vapor on chamber wall with dry filter paper. Next, attach aluminum-laminated film into test chamber and keep purging the chamber with high-purity dry nitrogen gas for hours. Close protection valve of sensor to seal water vapor sensor. Finally, turn off output valve of gas source. Only when water vapor sensor works properly could the instrument provide accurate test results. Periodic calibration of the instrument is necessary to secure accuracy of test data. Also, to keep dryness of internal system, remember to treat humid gas inside the system after testing, especially when the instrument will not be used in a long term. Thirdly, these two methods need large quantity of carrier gas to purge test system, both during and after testing, which makes the releasing of tail gas large in amount. Therefore,

users should guide the tail gas outside by connecting outlet of tail gas with guide tube. At the same time, ventilate the lab to keep fresh air. Fourthly, to prevent instrument components from corrosion, specified distilled water or agent the must used as humidizer.

Since humidity sensor method adopts non-consumptive sensor, the sensor need no particular maintenance. During non-test period, users only need to keep internal chamber clean and dry. If the instrument will not be used in a long term, take out the humidizer inside humidifying chamber and then suck the water vapor on chamber wall with dry filter paper. In humidity sensor method, tail gas should also be treated. Moreover, specified distilled water or agent the must used as humidizer.

3. Conclusion

In conclusion, instrument maintenance of differential-pressure method, gravimetric method and humidity sensor method is simple and only needs regular maintaining operation. However, in equal-pressure method, infrared sensor method and electrolytic method, users must pay careful attention to aspects such as the maintenance of sensor, tail gas treatment and the removing of impurities inside test systems. At the same time, users should operate carefully to avoid sensor depletion. Allowing for the higher cost of sensor, it is very essential that users carry out special maintenance during instrument operation.