neotron
Part of the Cotecna Group

Gas Permeability Tests on Plastic Films and Packages

Today it is important to evaluate the properties of the gas barrier (oxygen, water vapor and carbon dioxide) to characterize the performance of plastic films and containers to preserve the quality and safety of the product.

For example, oxygen adversely affects the shelf life of many foods by causing oxidation, bacteria growth and quality changes. To protect the quality of the product, oxygen barrier packaging materials are used. As a result, accurate measurement of oxygen transmission rate (OTR) is important when selecting packaging materials.
Sensor technology is critical to achieve accurate, repeatable and reliable OTR results from which important commercial and quality control decisions are taken.[1]

Neotron Proposal

Neotron test methods covers a procedure for determination of the steady-state rate of transmission of various gas (Oxygen, Steam water and Carbon Dioxide) through plastics materials in the form of film, sheeting, laminates, plastic-coated papers or fabrics and shaped materials (caps/ bowls/bottles). These methods are performed accordingly to the most recent regulations:

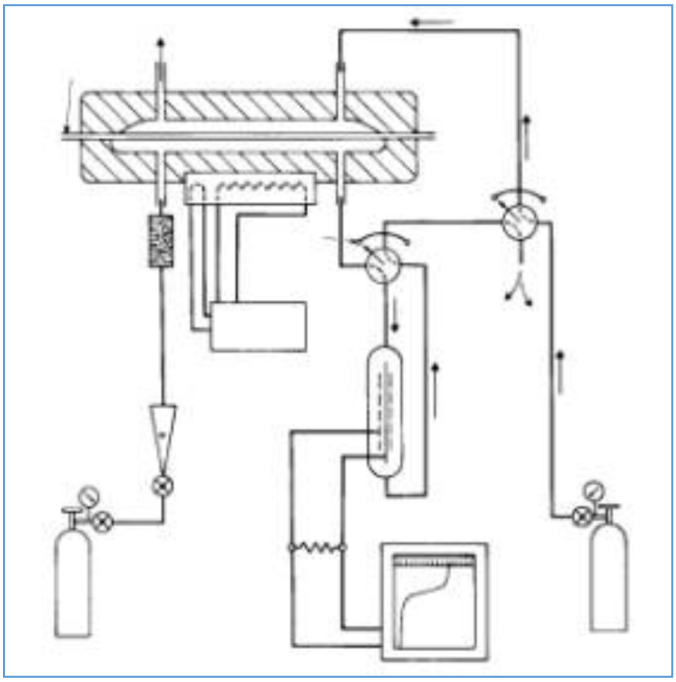
Oxygen permeability on film according to ASTM F2622-20 (ACCREDIA)
Steam water permeability on film according to ASTM F1249-20 (ACCREDIA)
Carbon Dioxide permeability on film according to ASTM F2476-20
Gas transmission rate on packaging (Reference: DIN 53380-3)

Instruments Characteristics

	Measuring range		Relative humidity range	
	Plastic Films	Packages	Plastic Films	Packages
O_2	0.05-25000 ml/m^2 24h bar^{-1}	0.003-200 ml/pkg 24h bar^{-1} air	0-90%	0-70%
H_2O	0.002-500 g/m^2 24h bar^{-1}	0.003-500 g/pkg 24h bar^{-1}	0-90%	0-70%
CO_2	1-200000 ml/m^2 24h bar^{-1}	0.5-200000 ml/pkg 24h bar^{-1}	0-90%	0-70%

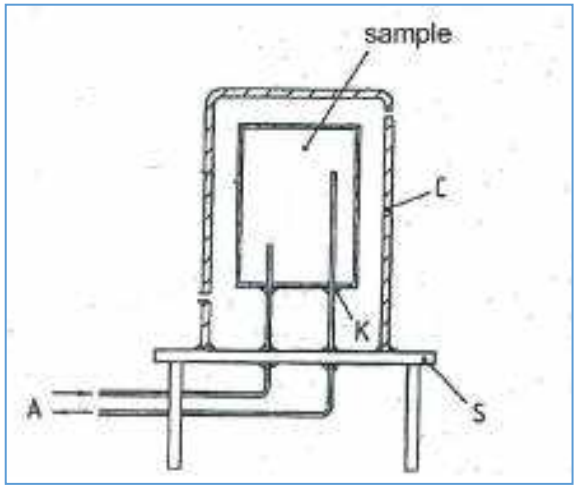
The instrumental uncertainty associated to measurements is calculated according to the measurements carried out and corresponding ranges.

Testing Method



Concerning the method applied for plastic films, the sample is placed between two different pressure chambers and sealed so as to prevent lateral leakage.
The thin film to be analysed consists in a separator between two half-cells. In the early stages, referred to as "conditioning", a flow of anhydrous nitrogen electronically controlled is circulated both on the upper half-cell and in the lower one, where the actual measurement of permeability will be made in order to remove residual oxygen, moisture or carbon dioxide left over during the loading and inside the sample.
When the concentration level of oxygen, humidity and carbon dioxide proves to be at constant value over time, the nitrogen flow in the lower half cell (carrier) is reduced to work value.
This entails an increase of the concentration value until a new steady value. The measurement phase begins, which lasts until the achievement of a constant level of oxygen, humidity or carbon dioxide concentration.
The film permeability value is then detected by the instrument and the measurement ends.
All the operations described above are performed while maintaining the cell at a constant temperature, set by the user with a long-term stability better than 0,1°C. The monitoring of relative humidity, of flows and variables that could alter permeability – such as the atmospheric pressure – is also carried out.

Gas transmission rate on packaging



A. Carrier gas inlet and outlet **C**. Plastic cylinder
K. Adhesive seal **S**. Baseplate

The determination of the permeability of shaped materials is carried out using the same instruments mentioned above, equipped with a dedicated modular accessory (Pack-Perm) that allows to make measurements on shaped containers such as bottles, bowls, caps etc.
This accessory consists of an adaptor on which the sample to be tested is placed and sealed and which is later isolated from the external environment thanks to a cylinder in acrylic material.
The phase of the actual measurement, which is differential, is preceded by a conditioning during which a controlled flow of high purity nitrogen is circulated inside the sample in order to remove any trace of oxygen, humidity or carbon dioxide. At a later stage, the surrounding environment is saturated with oxygen, humidity or carbon dioxide.
Then, the concentration of oxygen, humidity or carbon dioxide detected inside the sample will be determined by an electrochemical/semicoulometric detector with stabilized temperature (± 0,1°C) which will correspond to the permeability of the sample (pkg) analysed.[2]

For more information contact us @www.neotron.it

References:

1-ASTM D3985 vs. ASTM F2622: Which Method Is Better for Your Application (packageintegrity.com)
2-DIN 53380-3