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No.571 Gas Transmission Rate Tester
(Gas Permeability Tester)

Model CT3

Measurement cell (Diameter 70mm, 30mm)

■APPLICATION

The **Gas Permeability Tester** measures gas transmission rate (gas barrier property) of packaging materials such as plastic films. Measurement of gas transmission rate of polymer films such as plastic films, etc. is important because, for example in case of packaging materials, preservation of the content of a package considerably depends on the gas barrier property of the packing material. Recently gas transmission rate measurement is being used in new fields such as functional polymer films.

■FEATURES

- An automatic valve is used to realize fully automatic measurement. (No need for conventional manual valve operation)
- Many kinds of gases can be measured. (Differential pressure method)
- Additional expansion is possible by modular design.
- Since measurement is performed while data is stored, data can be analyzed even during testing.
- Mail transmission function allows you to receive a message when an error occurs or the test ends.
- Allows analysis of diffusion coefficient and solubility coefficient (Optional)
- High sensitivity vacuum pressure gauge of reading accuracy 0.25% is employed.
- Specimen table supports two different sizes of specimen.
- Performs temperature error correction of transmission gas.

■MEASUREMENT METHOD

The Gas Transmission Rate Tester is designed according to differential pressure method. In this method, both sides of measuring cell, with the sample in between, are evacuated, as shown in Fig. 1. After that when the test gas is filled in the high pressure side, the pressure on low pressure side gradually starts increasing. Transmission rate of the test gas is calculated from the straight line gradient when the transmission curve changes linearly with regard to time. (Fig. 2) Gas transmission rate is represented by the volume of gas transmitted through unit area of sample in unit time under unit partial pressure. On the surface of polymer film, dissolution concentration difference is produced according to the partial pressure of the gas. Concentration gradient occurs when there is partial pressure in the gas separated by the film. By extending the straight line part of transmission curve of Fig. 2 to the time axis and determining the point of intersection with the time axis and delay time (q) from the origin, we can determine gas diffusion coefficient (D), gas transmission coefficient (P) and gas dissolution coefficient (S) from equations (1) and (2).

$$D = \frac{\ell^2}{6\theta} \quad \text{— (1)}$$

$$P = S \times D \quad \text{— (2)}$$

D :	Gas diffusion coefficient	(cm^2/s)
ℓ :	Thickness of sample	(cm)
θ :	Delay time	(s)
P :	Gas transmission coefficient	($cm^3.cm / cm^2.cm.s.cmHg$)
S :	Gas dissolution coefficient	(cm^3/cm^3)

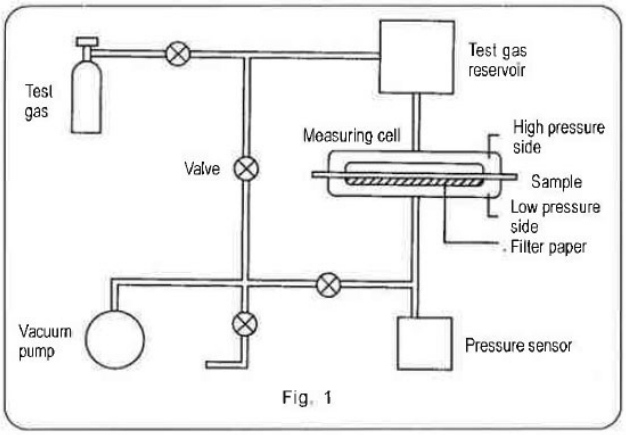
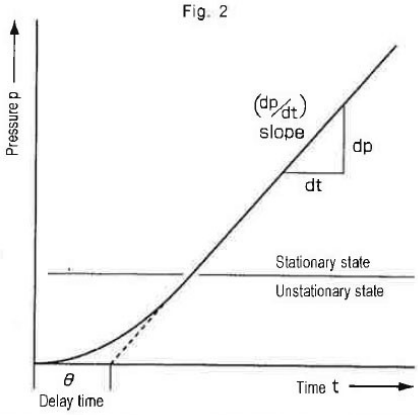

Test gas
Test gas reservoir
Measuring cell
High pressure side
Valve
Sample
Low pressure side
Filter paper
Vacuum pump
Pressure sensor
Fig. 1

Fig. 2


Pressure p
(dp/dt) slope
dp
dt
Stationary state
Unstationary state
θ
Delay time
Time t

■SPECIFICATIONS

Model	CR1	CR3	CT1	CT3
Number of specimens	1	3	1	3
Temperature range	Room temperature		10ºC to 90°C (Hot water circulation)	
Dimensions of specimen	■ 50 x 50mm (Measuring cell: Ø30mm, Transmission area: 707mm^2) ■ 90 x 90mm (Measuring cell: Ø70mm, Transmission area: 3848mm^2)			
GTR measurement range ***To be selected Type A or B upon order***	■ Type A: 4.5 x 10^{-15} to 4.5 x 10^{-12} mol/(m^2・s・Pa) (0.1 to 100fm/Pa・s) ■ Type B: 4.5 x 10^{-14} to 4.5 x 10^{-11} mol/(m^2・s・Pa) (1 to 1000fm/Pa・s (Vacuum pressure gauge: Accuracy 0.25% of reading)			
Test gas	■ Oxygen ■ Nitrogen ■ Carbon dioxide ■ Air etc.			
Test gas pressure	0 to 200kPa			
Measurement items	■ Gas transmission rate ■ Gas transmission coefficient ■ Diffusion coefficient, Dissolution coefficient (Optional)			
Data processing & control	Personal computer			
Dimensions	Main unit (CR1, CT1): W550 x D560 x H470mm Main unit (CR3, CT3): W800 x D560 x H470mm			
Weight	Main unit (CR1, CT1): Approx. 50kg Main unit (CR3, CT3): Approx. 70kg			
Power requirement	■ Main unit: Single-phase, AC100V, 50Hz or 60Hz, 0.5kVA ■ Vacuum pump: Single-phase, AC100V 50Hz or 60Hz, 0.6kvA ■ Warm water circulation bath (CT1, CT3): Single-phase, AC100V, 50Hz or 60Hz, 1.5kVA			
Compressed air requirement	0.4MPa			
Related standards	JIS K 7126-1 JIS K 6275-1 JIS K 6404-10 ISO 15105-1 ISO 2556 ASTM D 1434			

■OPTIONS

	Name	Model
1	Additional measurement module, Room temperature model	MCR1
2	Additional measurement module, Temperature control model	MCT1
3	Diffusion coefficient measurement device	

Gas transmission coefficient (P), diffusion coefficient (D) and dissolution coefficient (S) of polymer film

Polymer film	Temp. (°C)	Gas transmission coefficient, diffusion coefficient, dissolution coefficient				
			He	Co2	O^2	N^2
Polydimethylsiloxane	20	$Px10^{10}$	216	1120	352	181
		$Dx10^{7}$	600	189	189	123
		$Sx10^{3}$	0.36	5.93	1.86	1.47
Natural rubber	25	$Px10^{10}$	31.2	131	23.3	8.05
		$Dx10^{7}$	223	11.1	15.9	11.2
		$Sx10^{3}$	0.14	11.8	1.47	0.72
Low density polyethylene	25	$Px10^{10}$	4.93	12.6	2.89	0.97
		$Dx10^{7}$	68	3.72	4.6	3.20
		$Sx10^{3}$	0.073	3.39	0.62	0.30
PVC (plastic)	25	$Px10^{10}$	2.05	0.157	0.0453	0.0118
		$Dx10^{7}$	28.0	0.025	0.118	0.0378
		$Sx10^{3}$	0.073	6.27	0.384	0.312

P: $cm^3(STP)\cdot cm/cm^2\cdot s\cdot cmHg$ D: cm^2/s S:$cm^3(STP)/cm^3(polymer)$

Note:

Note:

Specifications are subject to change without notice.

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