



The PMI Advanced Combined Gas Diffusion Permeameter & DMPC

Not just products...solutions!

## **A**PPLICATIONS

(Gas Diffusion Permeameter)

Many applications of porous materials require very low gas permeability through these materials. Such applications are found in many industries including biotech, healthcare, pharmaceutical, food, packaging, environmental, power sources and chemical industries. Determination of the magnitudes of flow rates of multiple gas through materials used in these applications is important for evaluation of products.

# PRINCIPLES OF OPERATION

(Gas Diffusion Permeameter)

The basic principle is based on the laws of diffusion.

## F = -M [dp/dx]

where F is the flux across the sample, [dp/dx] is the pressure gradient across the thickness, and M is a measure of diffusivity. The instrument is designed toaccurately measure pressure and flow rate. The sample chamber is evacuated. Gas pressure maintained at a constant value on one side of the sample is measured and the increase in pressure on the other side is also measured. The data are used to compute flow rate of gas per unit area of the sample per unit time as a function of pressure gradient. The gas flow rate is computed using the following relation:





Gas chromatograph is used to find the ratio of differrent gases coming through

# **S**PECIFICATIONS

(Gas Diffusion Permeameter)

- Permeability Rang<mark>e: from 1 to 10<sup>-10</sup> darcies</mark>
- Sample Size: 1.75" 2.5" diameter
- Pressure Transducer Range: High Pressure Side: 0 - 100 psi Low Pressure Side: 0 - 10 Torr Accuracy (both): 0.15% of reading Resolution: 1 in 60,000



Flow of different gases through membrane

- Pressure Range: 100 psi maximum differential pressure
- Pressurizing Gas mixture: multiple non-corrosive gas
- Vacuum Pumping System: Vacuum to 0.002 Torr
- Stock Tank: Built in, Low Pressure Sample Cell Size: 50 100 cc (specific to machine)
- Weight : 500 lbs (specific to machine)
- Power Requirements : 220 VAC, 50/60 Hz (Others available)



- Accuracy of pressure measurement is 0.15% of reading
- The sample chamber is maintained at a constant temperature for yielding reliable & reproducible data.

### **A**PPLICATIONS

(Dynamic Moisture Permeation Analyzer)

The PMI's Dynamic Moisture Permeation Analyzer is capable of measuring water vapor transmission through porous media such as textiles, leathers, man made materials, membranes, nonwovens, and fabrics used in numerous high technology components and consumer products manufactured by a variety of industries. The instrument has the unique ability to measure vapor transmission rate over a wide range of humidity, temperature, and pressure under gradients of humidity, temperature, and pressure encountered in application environments.



## **PRINCIPLES OF OPERATION**

(Dynamic Moisture Permeation Analyzer)

Two independent gas streams are maintained on the two sides of a sample at the desired temperature. Humidity and gas flow rates are measured. The transmission rate through the sample is computed using mass balance.

#### $(dn/dt) + [(p_{e'i}\Phi_i/P_i)M_i] = [(p_{e'o}\Phi_o/P_o)M_o]$

- Where, i = inlet t = time n = moles P = total pressure
- o = outlet
- M = flow rate
- $\Phi$  = humidity
- p = equilibrium vapor pressure



## **S**PECIFICATIONS

(Gas Diffusion Permeameter)

- Humidity (φ) measurement
   Range: 5 95%
   Accuracy: ± 2%
- Differential pressure transducers Range: 10 torr (10 mm Hg) Accuracy: 0.015%
- Temperature Range: 10 ° - 40 °C Accuracy: 0.4 °C (low φ) - 0.8 °C (high φ) at 0 °C Control: ± 2%
- Mass Flow Transducers Range: 8 L/min Accuracy: 1%
- Humidity (φ) control Range: 5 - 95% Accuracy: ± 1.5% (φ = 0.5) ± 5% (high & low φ)
- Mass Flow Meter Range: 8000 cc/min Accuracy: 1%
- Mass Flow Controller Range: 2000 cc/min Accuracy: 1%

### FEATURES

(Gas Diffusion Permeameter)

- Humidity on any side can be maintained between 5 and 95%
- Any desired pressure gradient can be maintained between 0 -10 Torr
- Any desired test temperature can be achieved between 10° – 40°C
- Simultaneous pressure and humidity gradients can be maintained
- Flat samples in a wide range of sizes can be accommodated
- It is used for measuement of comfort of medical gowns and other medical textiles.
- Completely automated
  - Test execution
    - Data acquisition
- Data storage
- Data reduction

	Sensor. Differental Pressure:	Counts: 2000	Value: 0.00 Pa
	Flow 1(Wet): Flow Flow 2 (Dry): Flo	w controllers	0.0 SCCM 0.0 SCCM
	Flow 4 (Dry): and	meters	0.0 SCCM
	Flow 6: Flow 6:	2000 2000	0.0 SCCM 0.0 SCCM
P1 INCEL P5 INVESTIGATION	Inlet Top Humidity: Inlet Btm Humidity: Outlet Top Humidity: Outlet Btm Humidity:	umidity Sens	0.00 %rh 01500 %rh 0.00 %rh 0.00 %rh
Flow 4: 0 counts	Intel Top Air Temperature	2000	40.000 C
Flow 3:0 counts	Intel Bim Air Temperature Outlet Top Air Temperature Outlet Bim Air Temperature	Temperature	-40.000 C -40.000 C -40.000 C
Flow 2: 0 counts	Top Controller Set Point		0.0 C
Slide to activate	Btm Controller Set Point. Bottom cabinet		30.0 C 0.1
	Master Ground: Master Reference	2000	0.0000 volts 0.0000 volts
Test Gas Regulator: 0 counts	Stave Ground: Stave Reference:	2000 2000	0.0000 volts 0.0000 volts
tor Valve Control	Top sample chamber: Bottom samplechamber Chiller 1		0.2
coor varve 1: Motor Varve 2 cc c 1 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Chiller 2		0.5
nperature Controls:	Sample Chamber Contro		
		_	

## NSTRUMENT

(Dynamic Moisture Permeation Analyzer)

The sample is enclosed in a sample chamber. A part of the gas flowing through each independent stream is allowed to go through bubblers while the other part bypasses the bubblers and mixes with the gas passing through the bubblers. For maintaining constant humidity in the inlet gas stream, the flow rate in each part of the gas stream is controlled. The gas pressure is controlled by the valve at the end of each gas flow line. The valves automatically control and maintain either zero differential pressure or a finite definite pressure difference. Absolute pressure remains close to the standard pressure. The inlet and outlet flow rates and humidity are measured. The water vapor transmission rate through the sample is computed using the following relation.

#### $(dn/dt) = [(p_e/P)\Phi_o^{-}(p_e/P)\Phi_i]M_o/[1-(p_e/P)\Phi_i]$

9																					
en Raw Data File																					
ve Report to File							Material Information:					Test Parameters									
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play Graphs			_	San	ipie iD.		PUP 00		_					Topr	low Rate	(scen).	2000.0		-		
t Sta	ndard: 2298-03			Sample Area (cm^2):		16.0				Bottom Flow Rate (SCCM):					2000.0						
20 Dutchmill Rd Iti	20 Dutchmill Rd Ithaca - NY		Sample Properties:		MESH DOWN				Differential Pressures (Pa):					0,-25.0,0.0,25.0,50.0,75.0,100.0,150.0							
					SINGLE LAYER				Top Humidity (rH%):					47.0							
Phone: 607-257-554	44		_									Pattern Hamidity (HTM)					64.0				
												Bottom Humidity (rH%):		01.3							
													Number Data Points:		100	100					
										Data Point Interval (Sec):				5							
										Water Vapor Resistence (s/m):				0.01							
0.00 Water Vapor Transmi	24.0 ission Rate:		22.359			47.0			51.2			42.6			56.2			2068.1			
Differential Pressu	re (Pa)	SCOMIN		SCC4H2-Min		GMP2-Hour				GMP2-Day			KGMP2-Sec			KG/M2-Day					
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