

# Adsorption properties of carbon dioxide on several activated carbons



**Jung-Sik Choi, Won-Jin Son, and Wha-Seung Ahn\***

*Department of Chemical Engineering, Inha University, Incheon 402-751, Korea*

# INTRODUCTION

- **Physical adsorption on activated carbon and carbonaceous adsorbents is widely used for the separation and purification of gases. In recent years, high-pressure adsorption has often been applied in industrial adsorption processes.**
- **The development of such a system of adsorption-based processes requires basic adsorption equilibrium data across a wide range of pressure and temperature. There have been several studies on the adsorption of gases by adsorbents.**

# INTRODUCTION

**Key commercial applications of activated carbons in the gas separation and purification industry**

---

**Goal**

**Process**

---

**Trace impurity removal**

**TSA**

**Solvent vapor removal and recovery**

**TSA**

**Air separation**

**PSA**

**Carbon dioxide-methane separation from landfill and  
Biogases**

**PSA**

**Removal of CO, from flue gas**

**PSA**

**Hydrogen and carbon dioxide recovery from steam-methane  
(SMR) reformer off gas, coke oven gas, ethylene off gas**

**PSA**

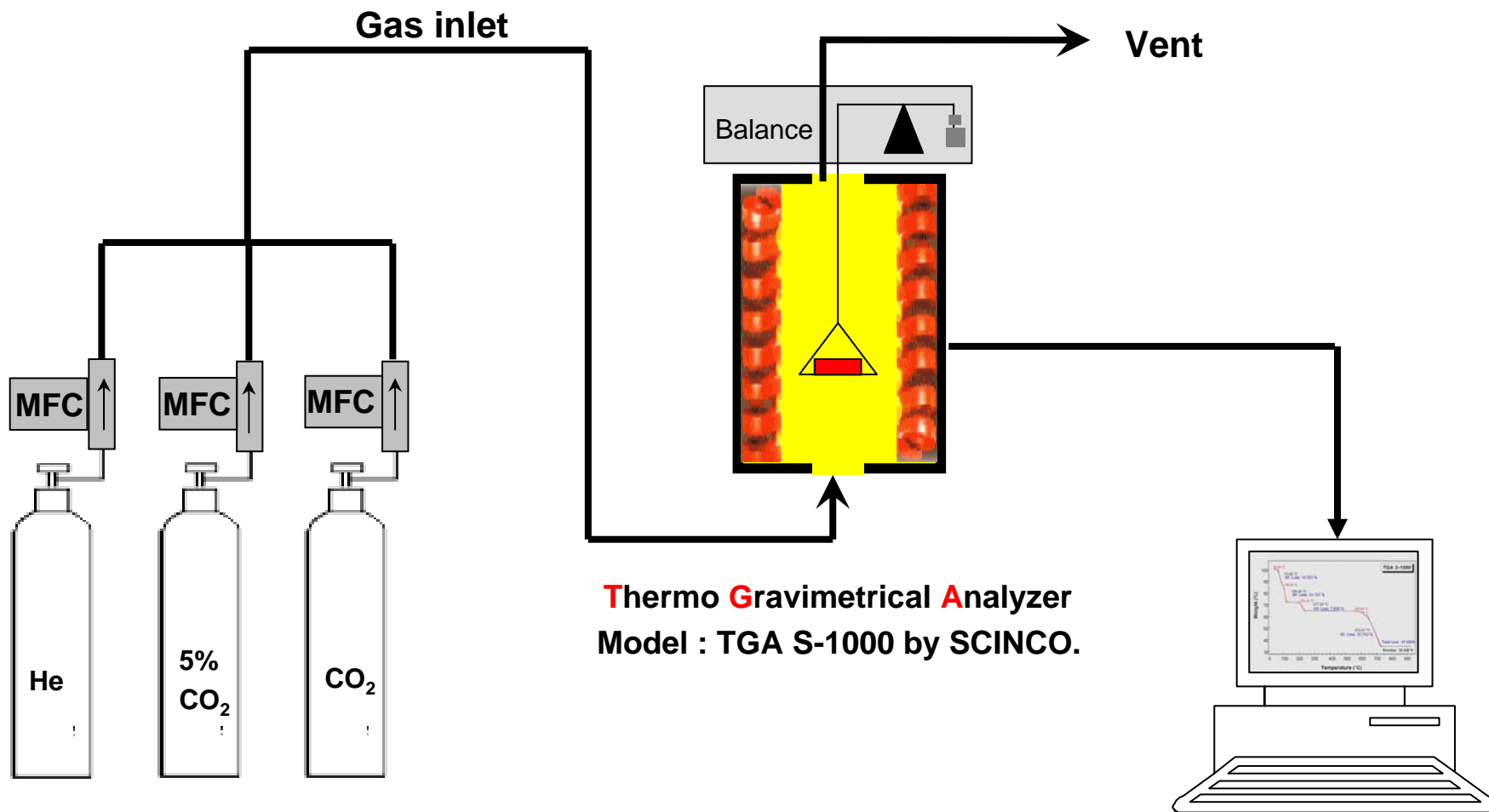
---

# Textural property of activated carbons

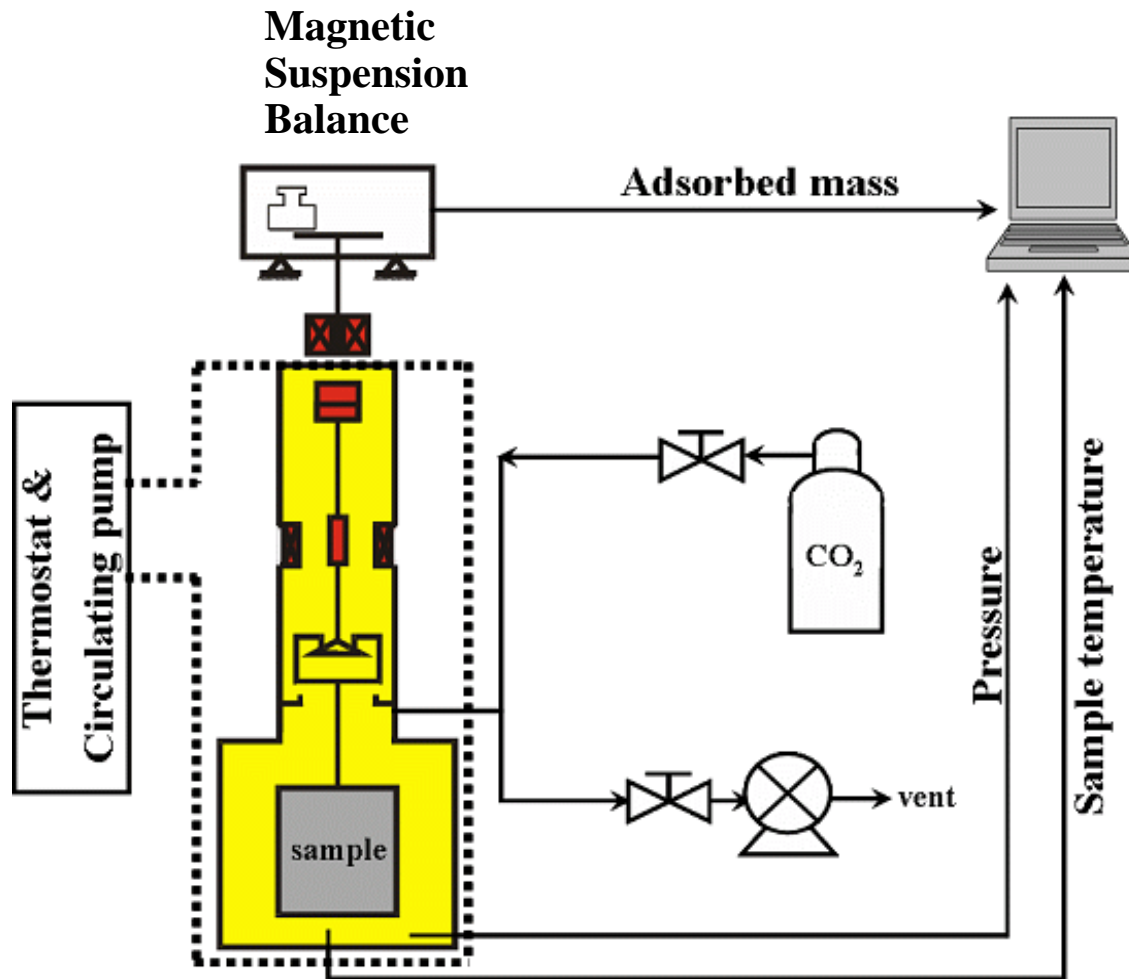
<b>Activated Carbons</b>		
<b>sample</b>	<b>BET surface area (m<sup>2</sup>/g)</b>	<b>Pore volume (cm<sup>3</sup>/g)</b>
<b>MSC30</b> (Coal 계)	<b>3226</b>	<b>1.7</b>
<b>MSP20</b> (Phenol 계)	<b>2413</b>	<b>1.0</b>
<b>BA-15</b> (목질계)	<b>2227</b>	<b>1.2</b>

Degas : 350 °C, 18 h under vacuum

# Equipment (Breakthrough)



# Equipment (High-pressure)



- 흡착등온선 (1-40 기압 , 상온)
- 흡탈착 재생성 (Pressure Swing sorption).
- TGA 기능을 이용한 흡착제의 재생성 분석 (Temperature Swing Analysis).
- 흡/탈착 속도 측정.

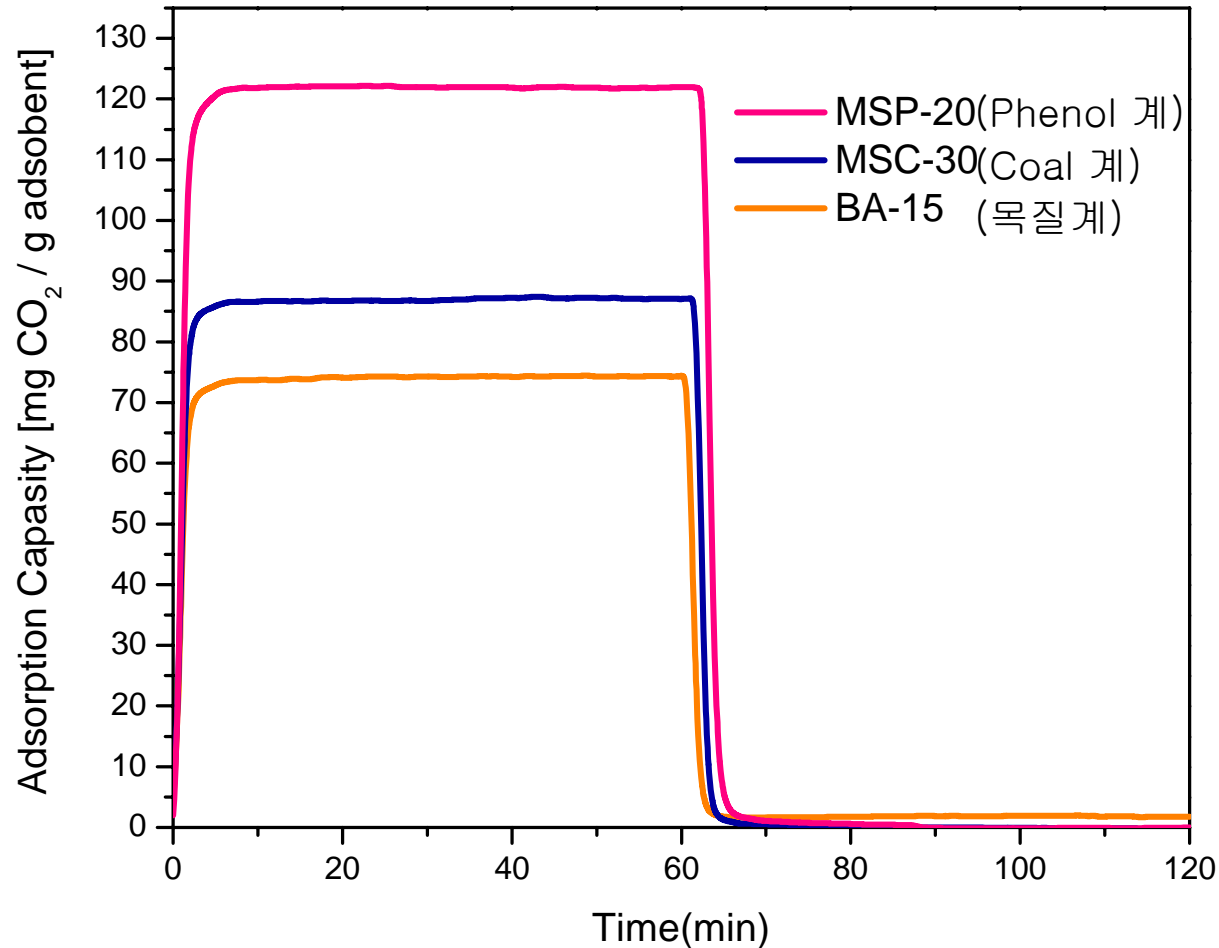
Rubotherm

Magnetic Suspension Balance

- Resolution :  $10^{-5}$  g

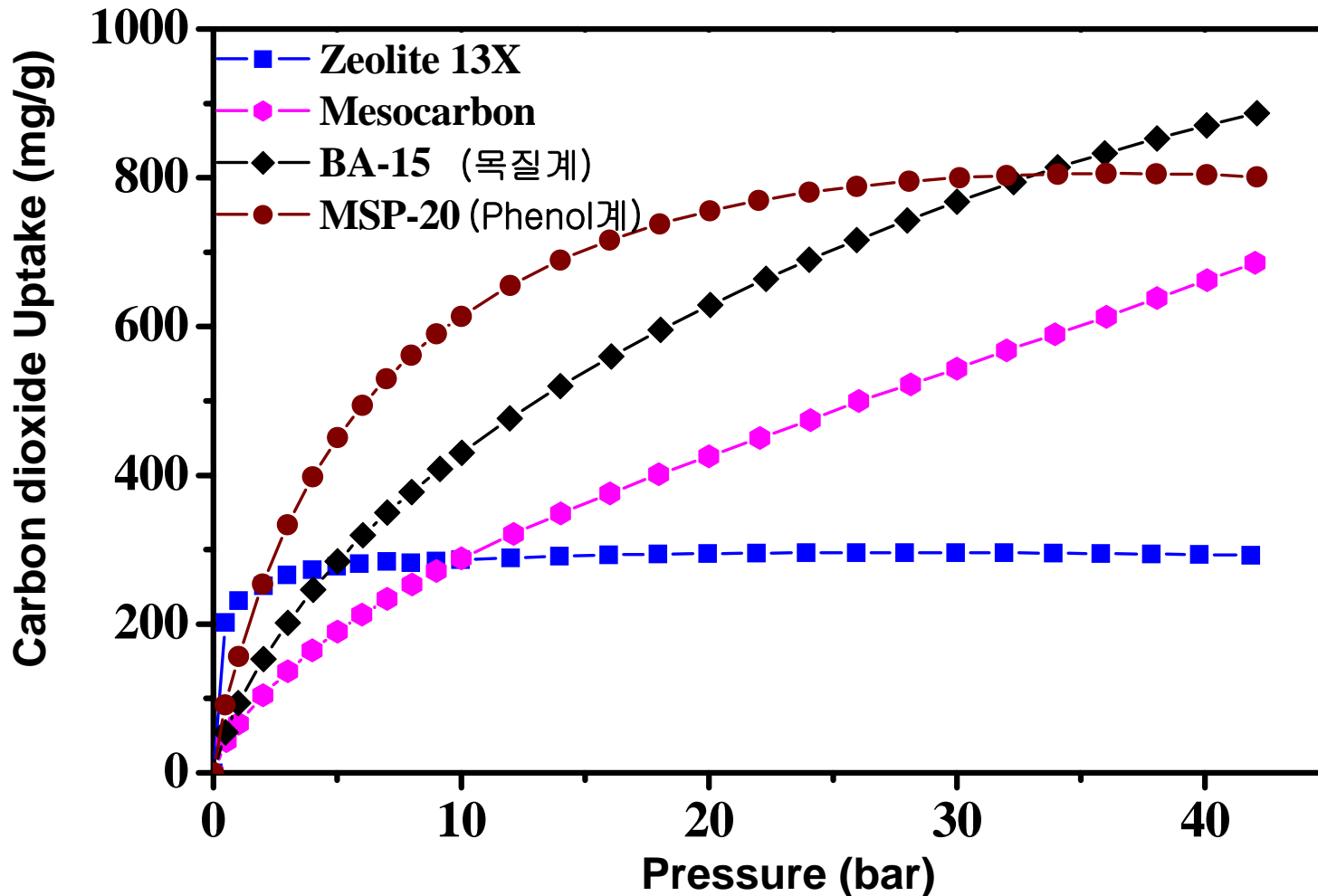
- Max. Weight : 80 g

# Breakthrough curve



Pretreatment : 200 °C, 60 min, Ad/desorption : 25/25 °C, 60/60 min, 1 bar  
Adsorbed gas = CO<sub>2</sub> (100%)

# High-pressure Adsorption



- CO<sub>2</sub> Storage capacity was measured based on gravimetric, Storage gas: 100% CO<sub>2</sub>, Condition gas : 100% He



# Conclusions

- 25 °C, 1 bar 에서의 Activated carbon의 이산화탄소 흡착능은 phenol계 activated carbon이 122 mg CO<sub>2</sub>/g 흡착제로 가장 우수하였고, coal 계는 87 mg CO<sub>2</sub>/g 흡착제, 목질계는 74 mg CO<sub>2</sub>/g 흡착제의 성능을 보여 주었다.
- 또한, 완전 가역적이고 빠른 흡/탈착 경향이 나타났다.
- 이산화탄소의 고압흡착능은 세공부피가 잘 발달된 BA-15(목질계)의 흡착능이 우수하였다.

# References

- Yang, R. T. *Gas Separation by Adsorption Processes*; Butterworths: Boston, 1987.
- Ruthven, D. M. *Principles of Adsorption and Adsorption Processes*; John Wiley & Sons: New York, 1984.
- Sircar, S.; Golden, T. C.; Rao, M. B. Activated Carbon for Gas Separation and Storage. *Carbon* **1996**, *34*, 1-12.
- Himeno, S.; Komatsu, T.; Fujita, S. High-Pressure Adsorption Equilibria of Methane and Carbon Dioxide on Several Activated Carbons. *J. Chem. Eng. Data* **2005**, *50*, 369-376