MASTER CHIMIE VERTE & ECO-INNOVATIONS

SCIENCES ET MONTAGNE
UNIVERSITÉ SAVOIE MONT BLANC

SPEC902 a – Exercices n°1, year 2024

1) <u>Adsorption, application of the BET method to measure the specific surface area</u>

The adsorption (and desorption) isotherm for nitrogen (N_2) from an activated carbon at 77 K is shown in Figure 1 (adsorbed volume in cm^3 STP/g versus P/P_0 relative pressure).
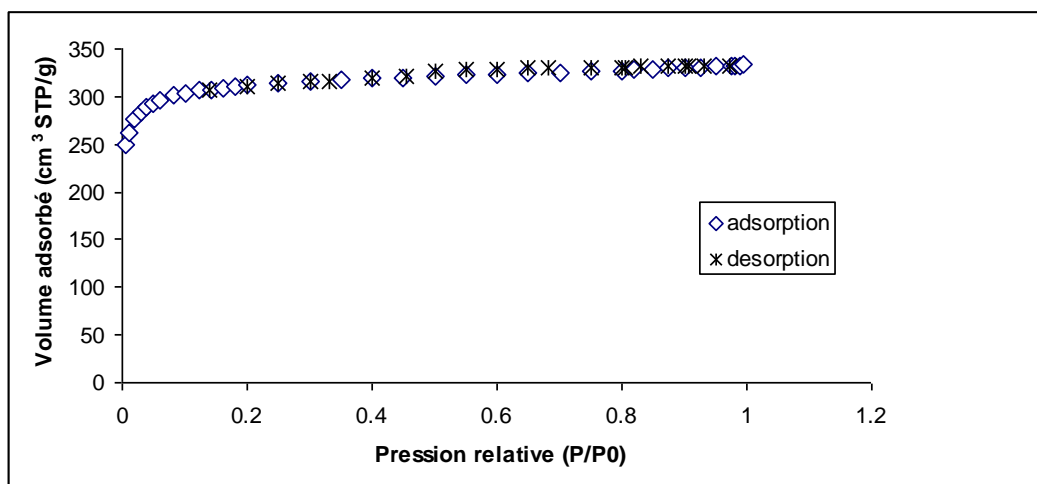

Figure 1

- What type of isotherm is used?

- Is it physisorption or chemisorption?

- What information can we obtain about activated carbon from this isotherm?

- Assuming that liquid nitrogen occupies the pore volume of the material (at saturation vapour pressure). Determine the total pore volume of the activated carbon.

Table 1 gives the volume of nitrogen adsorbed (in cm^3 STP/g) as a function of the relative pressure P/P_0 at 77 K. Deduce the B.E.T. surface area (in m^2/g) of the activated carbon obtained by adsorption of N_2.

P/P_0	V (cm^3 STP /g)
0.01005406	262.759287
0.02041868	276.668179
0.02903427	283.528682
0.03829813	288.656001
0.04947417	293.130085

Tableau 1

Table2 gives the volume of carbon dioxide adsorbed (in cm^3 STP/g) as a function of the relative pressure P/P_0 at 273 K. Deduce the B.E.T. surface area (in m^2/g) of the activated carbon obtained by adsorption of CO_2.

P/P_0	n (mmol/g)
0.01015983	4.08453952
0.02017185	6.02879156
0.02514073	6.79071045
0.03000805	7.46800456
0.03491634	8.07566693

Tableau 2

Why are the two B.E.T. surfaces obtained by adsorption of N_2 and CO_2 different?

Données :

- Density of liquid nitrogen at 77 K : 0,807 $g.cm^{-3}$
- Cross-sectional area of the N_2 molecule : $0.162.10^{-18}$ m^2
- Cross-sectional area of the CO_2 molecule: $0.210.10^{-18}$ m^2
- Avogadro number : 6.02 10^{23} molecules/mole
- M(N)= 14 $g.mol^{-1}$

2) Isotherm of Langmuir

Table 3 gives the volume (STP - at standard conditions of temperature and pressure) of nitrogen adsorbed on the mica surface at 90 K. The adsorption isotherm shows that a monolayer is formed. Check that Langmuir's law is satisfied. Determine the specific surface area of the mica (in m^2/g of mica).

P (atm)	2.8	3.4	4.0	6.0	9.4	17.1	23.5
V STP (10^{-6} m^3/g)	12.0	13.4	15.1	17.0	23.9	28.2	30.8

Table 3

Data :

- Cross-sectional area of the N_2 molecule : $0.162.10^{-18}$ m^2
- Molar volume for perfect gases under STP conditions : 22414 $cm^3.mol^{-1}$
- Avogadro number : $6,02$ 10^{23} molecules/mole