**EXERCISE 2**

**SURFACE PHENOMENA**

**Theoretical topics**

adhesion, cohesion, adsorption, catalysis, monolayer isotherm, Langmuir isotherm, surface tension, surfactants, chemisorption, physical adsorption, Gibbs surface excess equation, differential heat of adsorption, capillary phenomena

**Experimental Part**

**Topic:**  
Adsorption from solutions.

**Objective:**  
Determination of the adsorption isotherm of acetic acid from an aqueous solution on activated carbon.

**Apparatus:**  
250 cm³ volumetric flasks, Erlenmeyer flasks, analytical funnels, 50 cm³ burette, technical balance, filter paper

**Reagents:**  
0.1 M CH₃COOH, activated carbon, 0.01 M NaOH, distilled water

**Procedure:**

1. Transfer the following amounts (cm³) of 0.1 M acetic acid to 250 cm³ volumetric flasks: 20, 40, 80, and fill up to the mark with distilled water.
2. Transfer 100 cm³ of solution from each volumetric flask to lower Erlenmeyer flasks with a wide opening.
3. Weigh 3 g of activated carbon on a technical balance and record the exact weight in the table.
4. Add the weighed amount of activated carbon to the Erlenmeyer flasks with acetic acid, place them on a shaker, and shake for 10 minutes (speed 5).
5. After shaking, filter the solutions using funnels and larger Erlenmeyer flasks. Prepare filters, place them on the funnels, and filter the solutions with activated carbon into the Erlenmeyer flasks, being careful not to let carbon into the filtrate. If this happens, re-filter the obtained filtrate to ensure the solution is clear.
6. Determine the initial concentration of acetic acid (from volumetric flasks) by titration with 0.01 M NaOH. For this purpose, take 2 samples of 3 cm³ from each solution, dilute with distilled water to approximately 100 cm³, add phenolphthalein (3 drops), and titrate with NaOH solution. Record the results in the table (column "before adsorption"). **NOTE:** To streamline work, determine the initial concentration of the acid while filtering.
7. Determine the concentration of acetic acid in the filtrate by titration with 0.01 M NaOH. For this purpose, take 2 samples of 8 cm³ from each solution, dilute with distilled water to approximately 100 cm³, add phenolphthalein (3 drops), and titrate with NaOH solution. Record the results in the table (column "after adsorption").
8. Use the average values of the two measurements for calculations.

**Report:**

1. Summarize the obtained measurement results in Table 1.
2. Calculate the following values:
   * concentration of acetic acid before adsorption *cp* ​and the number of moles of acid before adsorption
   * concentration of acetic acid after adsorption *ck* and the number of moles of acid after adsorption
   * the difference in the number of moles of acetic acid before and after adsorption
   * the amount of adsorbed substance *a* [mol/g]
   * summarize the obtained values in Table 2
3. Plot the linear forms of the Freundlich isotherm (*log a=f(logc)*) and Langmuir isotherm (*c/a=f(c)*).
4. Calculate the constants from the equations of both isotherms based on the linear equations of the lines.
5. Plot the Freundlich and Langmuir isotherms (*a=f(c)*, values of *a* calculated based on the constants of both isotherms) and, based on the R2 coefficient for the trend line, indicate which isotherm better describes the adsorption of acetic acid on activated carbon.
6. Provide conclusions for the performed experiment.