initial part of the kinetic curve is used in accordance with this method. The time interval considered refers to a sorbent surface almost free from reaction products, i.e. the latter mass is insignificantly small and hence no reaction with their participation is possible. The sorption rate (W) is calculated by the formulas:

$$W_a = \frac{\Delta C \cdot V}{\Delta t \cdot 1000} \quad (1)$$

$$W_{sp} = \frac{\Delta C \cdot V}{\Delta t \cdot M \cdot 1000} \quad (2)$$

where $W_a$ is the absolute rate (mg $s^{-1}$) at a specific mass and particle size of the sorbent, $W_{sp}$ is the rate (mg $s^{-1}g^{-1}$) at a specific particle size of the sorbent referred to one gram of the sorbent, ΔC is the change of the amount (mg $l^{-1}$) of gold (III) ions which pass from the solution to the sorbent during the time interval Δt (s), V is the volume (ml) of gold (III) ions in the solution, Δt is the time interval during which ΔC takes place, M is the mass (g) of the sorbent, while 1000 is the conversion factor from a liter to milliliters.

The initial rate is found on the ground of a tangent line drawin to the initial section of the kinetic curve. It cuts off the value of Δt on the x-axis. Fig. 3 shows the kinetic sorption curves of gold ions on sorbents CAS-1, CAS-2 and CAS-3 in 0.1N HCl solution. They are obtained by the electrochemical method used to study the adsorption considered. Fig. 3 shows that CAS-2 provides the highest sorption rate of $Au^{+3}$. An almost complete

Table 2. Kinetics of Au (III) sorption on different sorbents in 0.1 N HCl solution.

| Sorbent | $W_a$, mg $s^{-1}$ | $W_{sp}$, mg $s^{-1}\cdot g^{-1}$ | $\tau_{½}$, min | $K_s$, $s^{-1}\cdot g^{-1}$ (sorbent) |
|---|---|---|---|---|
| CAS-1 | $2.29\cdot10^{-3}$ | $1.1\cdot10^{-2}$ | 1.75 | $3.7\cdot10^{-2}$ |
| CAS-2 | $5.9\cdot10^{-3}$ | $2.9\cdot10^{-2}$ | 1.35 | $4.6\cdot10^{-2}$ |
| CAS-3 | $0.99\cdot10^{-3}$ | $0.49\cdot10^{-2}$ | 3.65 | $2.5\cdot10^{-2}$ |

sorption of $Au^{+3}$ proceeds within 8 min. The time of the complete $Au^{+3}$ sorption on CAS-1 is 11 min, while that referring to CAS-3 equals 16 min. The numerical values of the rate and the rate constant of gold ions sorption are summarized in Table 2.

Table 2 shows that the sorption rate of gold (III) ions decreases in the series of CAS-2 > CAS-1 > CAS-3 (Fig. 3). Based on this data, the further studies are carried out with sorbent CAS-2.

**Effects of $Au^{+3}$ concentration and hydrochloric acid medium acidity**

Fig. 4 shows the kinetic curves of $Au^{+3}$ sorption at different ions concentrations on CAS-2. Within the studied concentrations (8.88 mg $l^{-1}$ - 35.5 mg $l^{-1}$) the complete sorption of gold (III) ions proceeds within 8 min. The value of the slope of I vs. t curves of gold (III) ions loss in the solution and, consequently their sorption increases with the increase of the ions concentration.

The half sorption time, $\tau_{1/2}$, does not depend on the initial concentration of gold (III) ions (it is found equal to 1.2 min). This fact indicates that the sorption process

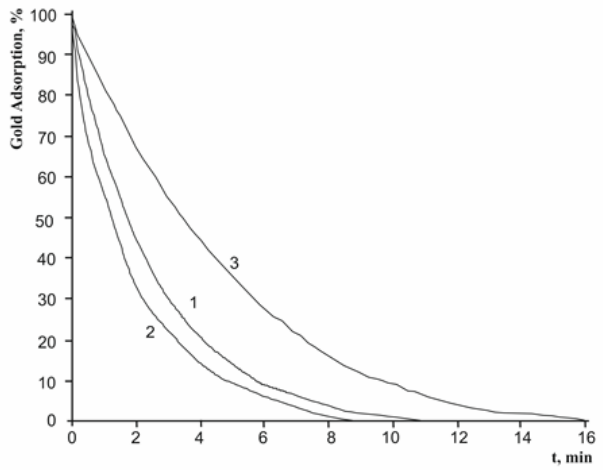


Fig. 3. Kinetic curves of $Au^{+3}$ sorption on different sorbents in 0.1 N HCl solution: 1 - CAS-1; 2 - CAS-2; 3 - CAS-3.

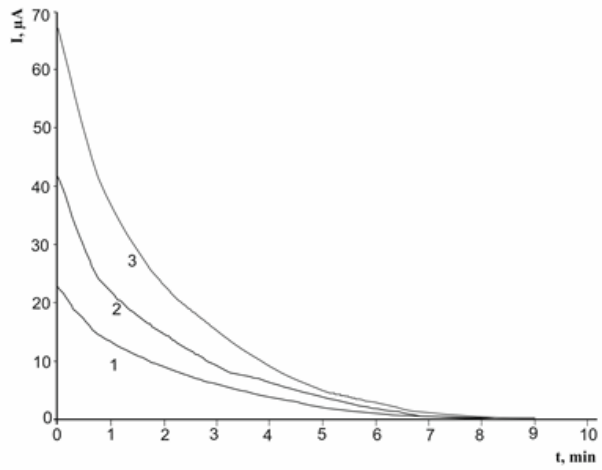


Fig. 4. Kinetic curves of $Au^{+3}$ sorption on CAS-2 in 0.1 N HCl solution. $Au^{+3}$ concentration of : 1 - 8.88 mg $l^{-1}$; 2 - 17.75 mg $l^{-1}$; 3 - 35.5 mg $l^{-1}$.