Table 3. Kinetics of Au^{+3} sorption on CAS-2 sorbent in 0.1 N HCl solution.

Concentration of Au^{+3}, mg l^{-1}	W		$\tau_{½}$, min	K_s, $s^{-1}\cdot g^{-1}$
	W_a, mg s^{-1}	W_{sp}, mg $s^{-1}\cdot g^{-1}$		
8.87	$3.4\cdot10^{-3}$	$1.6\cdot10^{-2}$	1.15	$4.3\cdot10^{-2}$
17.75	$5.9\cdot10^{-3}$	$2.9\cdot10^{-2}$	1.17	$3.9\cdot10^{-2}$
35.50	$10.3\cdot10^{-3}$	$5.1\cdot10^{-2}$	1.25	$4.0\cdot10^{-2}$
Average value				$(4.1\cdot10^{-2})$ $s^{-1}\cdot g^{-1}$

kinetics obeys the first-order equation in the studied range of gold (III) ions concentration, i.e.:

$$K_S = \frac{2.3}{\tau}\cdot\frac{\lg C_0}{C} \quad (3)$$

where τ is the semi sorption time (min), C_0 is the initial concentration of gold (III) ions (mg l^{-1}), while C is the gold (III) ions concentration in the solution (mg l^{-1}),.

Table 3 presents the rate constants found by plotting lg C vs.τ graphs [33].

The rate of sorption depends on the concentration of gold (III) ions in the solution, the sorbent mass and the diameter of the particles. The rate increases with an increase of the concentration and the mass and the decrease of the sorbent particles diameter. The dependence of the rate on these factors can be described by the equation:

$$W_{eff} = k\cdot C^n\cdot M^y\cdot d^z \quad (4)$$

where k is the rate constant, C is the concentration (mg l^{-1}) of gold (III) ions in the solution, M is the sorbent mass (g), d is the particle diameter (mm) of the sorbent, while n, y, z stand for the reaction order in respect to the concentration, the mass and the diameter, respectively.

The processing of these table data by the method described above (the Van't Hoff method) shows that the reaction order with respect to the sorbent mass is equal to unity (1), while the reaction order with respect to the sorbent particles diameter is minus one (-1). The sorption rate of gold (III) ions on CAS-2 amounts to $2.6\cdot10^{-3}$ mg $s^{-1}\cdot g^{-1}$ (Table 4) in case the rate is referred to an unit mass of the sorbent (d). It is equal to $1.4\cdot10^{-2}$ mg ·mm $s^{-1}\cdot g^{-1}$ (Table 5) when the rate is referred to an the unit size of CAS-2 particles. Thus, the sorption rate of gold (III) ions on CAS-2 obeys the equation:

$$W = k\cdot C\cdot M\cdot d^{-1} \quad (5)$$

It follows from this equation that in case of an identical concentration of gold (III) ions, their rate of sorption can be changed in one direction or another (more or less) by changing the product $M\cdot d^{-1}$. Therefore, the latter is the sorption efficiency factor, while the rate per an unit mass of the sorbent and an unit of the particle size is the effective rate. The effect of the hydrochloric acid medium acidity on the sorption of gold (III) ions on CAS-2 is outlined. The acidity varies within the range of 0.1 N - 5 N hydrochloric acid. The results of these experiments are presented in Table 6.

Table 4. Kinetics of gold (III) ions sorption at various amounts of CAS-2 in 0.1 N HCl solution. The concentration of the ions is 17.75 mg l^{-1}, while the diameter of sorbent particles is 0.5 mm.

Sorbent mass, g	$\tau_{½}$, min	W_a, mg s^{-1}	W_{sp}, mg $s^{-1}\cdot g^{-1}$
0.2	1.20	$5.4\cdot10^{-3}$	$2.7\cdot10^{-2}$
0.4	0.45	$1.1\cdot10^{-2}$	$2.7\cdot10^{-2}$
0.6	0.35	$1.5\cdot10^{-2}$	$2.5\cdot10^{-2}$
Average value			$2.6\cdot10^{-2}$

Table 5. Kinetics of gold (III) ions sorption at various sorbent sizes in 0.1 N HCl solution. The concentration of the ions is 17.75 mg l^{-1}, whle the sorbent mass is 0.2 g.

d, mm	$\tau_{½}$, min	W_a, mg s^{-1}	W_{sp}, mg $s^{-1}\cdot g^{-1}$	W_{eff}, mg·mm $s^{-1}\cdot g^{-1}$
0.1	0.15	$2.5\cdot10^{-2}$	$1.3\cdot10^{-1}$	$1.3\cdot10^{-2}$
0.4	0.2	$7.4\cdot10^{-3}$	$3.7\cdot10^{-2}$	$1.5\cdot10^{-2}$
0.5	1.2	$5.4\cdot10^{-3}$	$2.7\cdot10^{-2}$	$1.4\cdot10^{-2}$
Average value				$1.4\cdot10^{-2}$

An effect of metal ions impurities

Gold (III) ions are adsorbed quantitatively (97 % - 98 %) in a wide acidity (0.1N-5N) range of HCl. The sorption is completed (100 %) in solutions of up to 2N HCl within 8 min, but in a solution of 5N HCl it amounts