

INVESTIGATING THE POSSIBILITIES OF DL-SERINE SORPTION OVER ACTIVATED NATURAL MINERAL SORBENTS

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It is a well known fact that natural sorbents in crude state possess a limited sorption capacity. Hence, in the practice a variety of physico-chemical methods are used for their activation and modification. Acid treatment of natural mineral sorbents is one of them. In the pertinent literature there are various concepts concerning the character of the reactions taking place during acid activation of natural mineral sorbents (5, 7, 9, 10). Nevertheless, thus far, the problem outlined has not been sufficiently clarified. Many authors, after studying acid activation of natural mineral sorbents, point out that the hydrogen of mineral acids is exchanged with the peripheral cations of sorbents. This is exactly the circumstance conditioning their catalytic and sorptional activity.

In the sorption technique practice, the study of organic objects has been imposed much later, and hardly in the past few years, its development has shown a more rapid progress. In a personal report, Byikov and Smirnova (4) describe the sorption of amines over natural sorbents from the USSR. Pinck (8) proves that montmorillonites, similar to ion-exchange resins, adsorb substances in various ways, and therefore recommends their use in the purification of proteins, enzymes and antibiotics.

Some of our works deal with the problem of sorption of various mixtures of DL-valine and DL-serine over a number of activated natural sorbents from North-Eastern Bulgaria (1, 2, 3.). In the present report, a more detailed study is made on the possibility of synthetic DL-serine sorption over acid activated natural mineral sorbents from North-Eastern Bulgaria. The sorbents are subjected to acid activation with HCl, H₂SO₄ and HNO₃, at concentrations 2.5, 5, 10, 15, 20 and 25 per cent. A detailed description of the activation procedure is submitted in the same works. Sorption is conducted under static conditions using two serine concentrations: 5 and 10 mM solutions. Following centrifugation at 10000 rpm, photometric serine determination is made according to a personal method at $\lambda = 530$ (3). The results obtained are illustrated in tables 1, 2, 3, 4, 5 and 6, where the sorbents are arranged in the following order: No 1 — Silistra-MC-4, No 2 — Balchik, No 3 — Silistra MC-27, No 4 — Gen. Toshevo, No 5 — Bakalovo, district of Tolbuhin, No 6 — Telerig, district of Tolbuhin and No 7 — Tolbuhin-Riltzi quarter.

It is evident from the experimental data that upon activation with HCl (15% concentration), the sorbent from the village of Telerig, district of Tolbuhin, shows the optimal sorption properties. Upon activation with sulphuric acid (2.5%), the best results are obtained with the sorbent from Gen. Toshevo. As regards activation with nitric acid, the best sorption pro-

properties are recorded with the sorbent from Silistra MC-27 (at activation with 10% HNO_3). In general outline, the optimal results are obtained at comparatively low concentrations of the activating acids which proves economically profitable.

There is no doubt that during acid activation of natural mineral sorbents a number of factors assume an important role, one of them being the nature of the acid with which activation is conducted. The basic factors include also

Table 1

**DL-Serine Sorption from 5 mM Solution over HCl Acid Activated Sorbents
in mM/g Sorbent**

HCl concentration in %	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7
0	0.95	1.2	0.6	0.85	0.80	1.20	0.40
2.5	2.20	0.60	1.55	0.80	1.10	1.20	0.80
5	1.25	2.00	1.75	2.00	1.25	1.50	1.10
10	0.75	1.35	1.85	2.45	1.65	1.75	1.55
15	0.60	1.75	2.45	0.85	0.95	2.10	1.10
20	0.15	1.20	0.95	0.85	1.40	1.05	0.65
25	0.00	0.95	0.80	1.20	0.65	1.20	0.20

Table 2

**DL-Serine Sorption from 5 mM Solution over H_2SO_4 Activated Sorbents
in mM/g Sorbent**

H_2SO_4 concentration in %	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7
0	0.95	1.20	0.60	0.85	0.80	1.20	0.40
2.5	2.00	1.75	0.60	1.40	1.55	1.25	1.85
5	1.45	1.75	1.55	1.25	1.10	1.45	1.00
10	0.95	0.75	1.35	1.20	0.95	0.70	1.40
15	0.60	1.35	1.50	1.10	2.00	1.85	1.10
20	0.45	0.50	0.45	0.95	0.95	0.80	0.80
25	0.30	0.15	0.35	0.95	0.65	0.40	0.35

Table 3

**DL-SERINE Sorption from 5 mM Solution over HNO_3 Activated Sorbents
in mM/g Sorbent**

HNO_3 concentration in %	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7
0	0.95	1.20	0.60	0.85	0.80	1.20	0.40
2.5	0.95	0.95	0.60	1.40	0.85	1.20	0.40
5	1.00	1.10	1.20	1.20	0.95	0.85	0.40
10	1.20	1.35	1.75	0.95	0.80	1.40	0.60
15	0.60	1.55	1.20	2.95	0.95	0.95	0.85
20	0.20	1.75	0.95	1.85	0.60	1.10	0.45
25	0.20	0.95	0.20	1.40	0.45	1.35	0.20

Table 4

DL-Serine Sorption from 10 mM Solution over HCL Activated Sorbents
in mM/g Sorbent

HCl concentration in %	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7
0	5.00	4.75	2.30	1.85	2.60	4.75	2.90
2.5	6.60	2.70	3.90	4.45	4.20	5.45	5.60
5	5.60	5.15	4.75	6.40	5.15	6.00	5.60
10	2.50	5.95	5.00	6.40	6.40	6.25	6.20
15	2.10	6.20	5.80	5.80	3.30	6.75	4.35
20	1.20	5.95	1.85	4.55	3.90	5.35	1.50
25	0.60	5.80	1.50	5.60	2.45	3.90	0.90

Table 5

DL-Serine Sorption from 10 mM Solution over H₂SO₄ Activated Sorbents
in mM/g Sorbent

H ₂ SO ₄ concentration in %	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7
0	5.00	4.75	2.30	1.85	2.60	4.75	2.90
2.5	5.25	5.80	5.15	6.75	6.25	5.15	5.35
5	4.25	5.95	6.55	6.20	5.35	5.95	5.60
10	3.70	1.85	2.70	5.60	4.75	2.50	6.40
15	2.90	5.15	4.75	5.25	5.95	6.35	5.85
20	1.60	3.70	2.30	5.25	3.50	5.80	4.55
25	1.25	1.10	1.10	4.50	1.85	1.10	2.05

Table 6

DL-Serine Sorption from 10 mM Solution over HNO₃ Activated
Sorbents in mM/g Sorbent

HNO ₃ concentration in %	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7
0	5.00	4.75	2.30	1.85	2.60	4.75	2.90
2.5	2.30	3.50	1.80	5.25	6.20	5.00	4.15
5	3.50	4.75	5.65	4.20	6.25	3.50	4.35
10	4.75	5.25	5.75	2.30	5.00	5.15	5.15
15	3.00	5.80	5.95	6.55	5.65	3.10	5.95
20	1.80	5.96	5.95	5.35	5.15	4.30	3.25
25	1.05	1.70	5.15	3.85	3.50	5.25	2.05

the nature of the sorbent, its structure, temperature, duration of the activation process and the like. From economical point of view, it should be accepted that in larger scales it is rather expedient to perform activation with sulphuric acid for those of the sorbents, displaying a good sorptional capacity upon activation with this particular acid. Using nitric acid in the latter case would entail a number of technical difficulties owing to the peculiar nature of this acid.

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**ИЗУЧЕНИЕ ВОЗМОЖНОСТЕЙ СОРБЦИИ DL-СЕРИНА
НА АКТИВИРОВАННЫЕ ПРИРОДНЫЕ
МИНЕРАЛЬНЫЕ СОРБЕНТЫ**

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РЕЗЮМЕ

Исследована возможность сорбции синтетического DL-серина на кислотно активированные природные сорбенты из Северовосточной Болгарии. Исследованы природные минеральные сорбенты из города Силистры — моторные зонды № 4 и 27, города Балчика, города Ген. Тошево, села Бакалово — Толбухинского округа, села Телериг — Толбухенского округа и города Тулбухин, кв. Рилци. Сорбенты активированы HCl, H₂SO₄ и HNO₃, в концентрациях 2, 5, 10, 15, 20 и 25%.

Сорбция проведена при статических условиях 5 и 10 миллимоллярными растворами DL-серина. Количество серина определено — фотометрически по собственной методике при $\lambda=530$ м. Полученные результаты отражены в шести таблицах.

Установлено, что лучшие результаты получены при использовании сорбента из с. Телериг — Толбухинского округа, после активирования 1,5% HCl, из города Ген. Тошево — после активирования 2,5% H₂SO₄ и из города Силистры МС-27 — после активирования 10% HNO₃. Считается, что с экономической точки зрения следует предпочитать активирование H₂SO₄. Технически более выгодной является азотная кислота, а соляная кислота занимает промежуточное положение.