ADSORBENT REGENERATION BY ELECTRIC DISCHARGE INFLUENCE

A.M. GASHIMOV, K.M. GURBANOV, I.G. ZAKIYEVA, N.M. HOSSEINAHLI
Institute of Physics of Azerbaijan National Academy of Sciences
H.Javid ave., 131, AZ-1143, Baku, Azerbaijan
E-mail: arif@physics.ab.az, magerram-hasanov@rambler.ru

The adsorbent regeneration processes by electric gas discharge influence have been studied. The thermally stimulated relaxation method (TSR) widely used at study of electric charge relaxation in polymer films and other dielectric materials is used for revealing of charged state in natural adsorbents of benthonic clay. The influence of electric fields and discharges on natural adsorbent – bentonite leads to its additional regeneration and simultaneously to appearance of charged state in it.

Keywords: natural adsorbent, regeneration, torch discharge, monomer.
PACS: 52.25-b; 52.80. He; 52.00.00

INTRODUCTION

The main regularities taking place in the system "adsorbent – adsorbate – strong electric field" is necessary to reveal in the connection with big perceptivity of electric control of adsorption processes in problems of purification and liquid separation. The appearance of electric charges of different signs on the surface and in the adsorbent volume is the one of the essential physical factors defining the substance properties [1-4].

It is known that the influence of electric discharge on adsorbents changes their adsorptive capacity [5-7].

The adsorbents are treated by activating influences of different types for increase of efficiency: chemical, radiation, electric and etc. The influences by electric fields and discharges significantly changing the adsorptive capacity of adsorbents are the most effective ones.

The polarization processes in electric field or electric charge introduction directly on the surface or in material volume take place in the result of electric influences on adsorbents in them. The given processes lead to appearance of bound electric charges, i.e. the charged state in material forms [5-8]. As it is mentioned by authors of the given works, the electric charges introduced in adsorbent can be the centers of high adsorption from liquid of different impurities because of the Van-der-Waals force activity in system adsorbent – impurity particle.

The study of different mechanism changes in natural adsorbents treated by electric influences is necessary for solving of task of sorption process intensification with the help of electric discharges.

EXPERIMENT TECHNIQUE AND DISCUSSION OF OBTAINED RESULTS

The investigations of adsorbent regeneration process by influence of electric gas discharge have been carried out in the given paper.

Adsorbent-bentonite is treated by regeneration process in vacuum condition at 180ºC temperature; later the sample is divided into two parts each by 1300mg. Further, 350mg hydrocarbon composition monomer is added in ampoule with bentonite by height 1300mg and 82mg monomer is added in other one and both systems are endured during 24 hours.

The results characterizing the monomer adsorption process are presented in tables 1 and 2.

Table 1.

Monomer, 350 mg	
t, h	m, mg
1	340+1310
2	335+1315
5	330+1320
8	330+1320
24	330+1320

Table 2.

Monomer, 82 mg	
t, h	m, mg
1	72+1310
2	70+1312
5	66+1316
8	66+1316
24	66+1316

From tables 1 and 2 it is seen that adsorbent absorbs the insignificant monomer quantity and total saturation is observed during 5 hours. In further experiments the adsorbents saturated by monomer are treated by regeneration by the way of torch discharge influence in them. The principal electric scheme of material treatment by electric discharge of torch type is presented on fig.1.

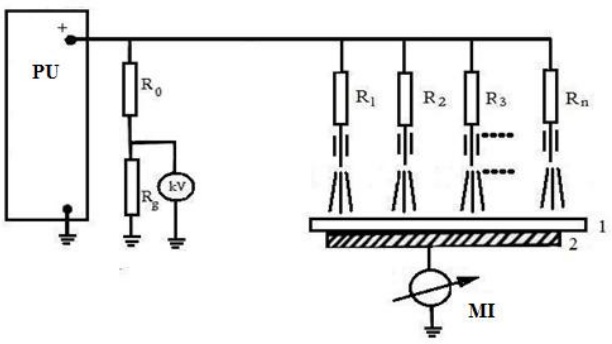

Fig.1. Principal electric scheme:
PU is power unit, kV is kilovolt-meter, R_0, R_g is resistance divisor, $R_1,R\ldots R_n$ are limiting resistors, MI is measuring instrument, 1 is metallic substrate, 2 is electrode.

131 H.Javid ave, AZ-1143, Baku
ANAS, G.M.Abdullayev Institute of Physics
E-mail: jophphysics@gmail.com

Further, the adsorption process is carried out again in previous conditions. The given process results are presented in tables 3 and 4.

The method of thermostimulated relaxation (TSR) widely used at study of electric charge relaxation in polymer films and other dielectric materials is used for revealing of charged state in natural adsorbents of bentonite clay [9].

The experiment of TSR method is carried out by the way of sample heating from room temperature up to 450ºC with constant velocity 2º/min with simultaneous record of relaxation current curve in temperature function (and time) on two-coordinate recorder with amplifier. The heating linearity is supplied by special electron device.

The thermostimulated current curve is shown on fig. 2. The presence of two high-temperature peaks (300ºC, 430ºC) proves the relaxation of electric charges in samples.

The square taken under current curve TSR in time function corresponds to sum charge relaxed in the sample. The charge quantity corresponded to peaks is: Q_1=1,8·10^{-7} coulomb; Q_2=2,8·10^{-7} coulomb.

Table 3.

Monomer, 350 mg	
t, h	m, mg
1	20+1630
2	12+1638
5	8+1642
8	6+1644
24	2+1648

Table 4.

Monomer, 82 mg	
t, h	m, mg
1	18+1364
2	12+1370
5	10+1372
8	8+1374
24	4+1378

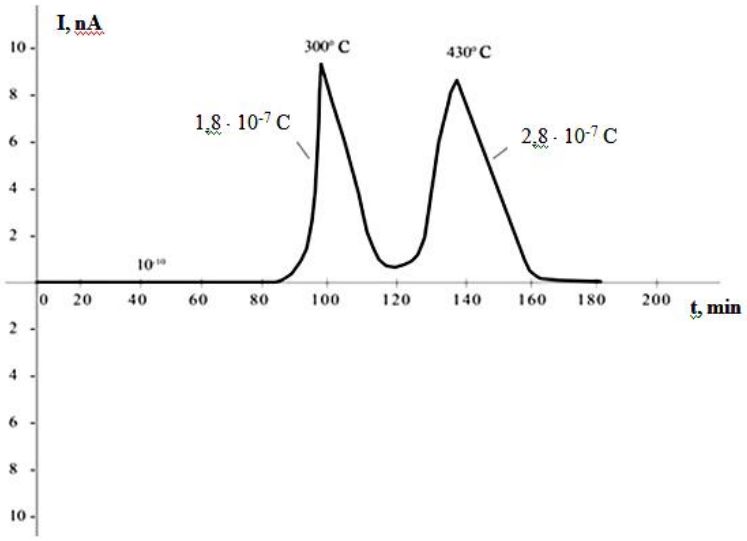

Fig. 2. The curve of thermostimulated current.

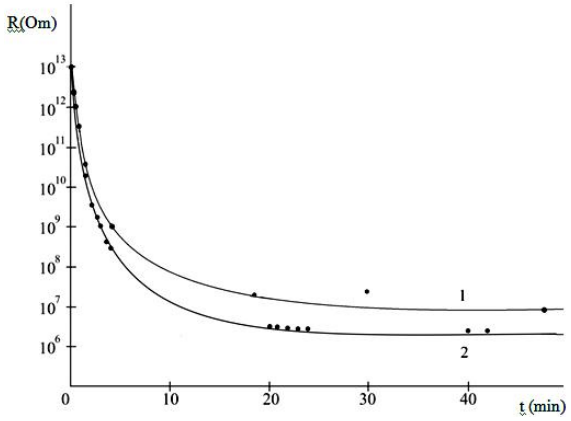

Fig.3. The dependence of bentonite electric resistance on degree of its saturation by steams before and after treatment by torch discharge:
1 is adsorbent nontreated by electric discharge
2 is adsorbent treated by electric discharge

The results of carried investigations show that the adsorption ability of adsorbents increases in many times at their regeneration with torch discharge influence. The fact of increase of bentonite adsorption ability is proved again in further experiments. The bentonite treated by the influence of torch discharge is used in bentonite. The change of adsorbent resistance *fig.3) in dependence on humidification degree before and after treatment is investigated.

The bentonite humidification is carried out by two methods: by the way of water barbotage and also by aging of bentonite portion in atmosphere with humidity 50%. Moreover, the mass change and sample electric resistance are mentioned in definite time periods. The quantity of absorbed water is defined by mass change.

The bentonite intensively adsorbs the steams and in time (approximately after 40 hours) the process transforms into saturation region in initial stages. The measurement of electric resistance through the definite time intervals correspondent to definite humidification degrees allows us to reveal the dependence character of specific resistance change on humidity time (fig.3).

CONCLUSION

Thus, it is shown that the influence of electric fields and discharges on natural adsorbent-bentonite leads to its additional regeneration. This is connected with the fact that the bound water in adsorbent transforms into dissolved state under influence of electric discharge on adsorbent and it easily desorbs. The electro-treatment of adsorbents makes wider the bentonite application in different technological processes.

[1] *M.A. Yegorov.* Voda: ximiya I ekoloqiya. 2008, n.4, s. 41-43. (in Russian).
[2] *Sh. Wang, Y. Peng.* Chemical Engineering Journal. 2010, vol. 156, Issue 1, 11-24.
[3] *A.S. Shilina, V.K. Milinchuk*. Sorbtsionnie i khromatograficheskie protsessi, 2010, t.10, vip. 2, s. 237-245.
[4] *E.S. Klimov, M.V. Buzayeva*. Prirodnie sorbenti i kompleksoni v ochistke stochnikh vod. Ulyanovsk Ul GTU, 2011. 201 s.
[5] *A.M. Gashimov, V.A. Aliyev, K.B. Gurbanov, M.A. Gasanov.* Fizika i khimiya obrabotki materialov, Moskva, 2005, n. 2, s. 86-89.
[6] *M.A. Gasanov.* Fizika i khimiya obrabotki materialov, Moskva, 2006, n. 5, s.88-91.
[7] *A.M. Gashimov, M.A. Gasanov.* Elektronnaya obrabotka materialov. 2008, n. 6, s. 46-51.
[8] *A.M. Gashimov, M.A. Gasanov.* Jurnal Fizicheskoy khimii, 2009, t. 83, n.7, s. 1352-1355.
[9] *G. Sesler.* Elektreti. M.: Mir, 1983, 488 s.

Received: 14.07.2016

131 H.Javid ave, AZ-1143, Baku
ANAS, G.M.Abdullayev Institute of Physics
E-mail: jophphysics@gmail.com