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DERIVATOGRAPHY STUDY OF ADSORBED PHASE AT RADIOLYSIS OF PHENOL IN WATER SOLUTIONS IN THE PRESENCE OF NANO- γ Al_2O_3

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Abstract: In this work, it has been studied the kinetics of formation of exothermic effects at radiolysis of water solutions of phenol ($10^{-2}M$) in the presence of nano- γ Al_2O_3 under the influence of γ -radiation Co^{60} . It has been established that, with increasing dose of heat of formation and area of exothermic effect decrease strongly.

Keywords: Derivatography, exothermic effects.

1. Introduction

The increased interest to the study of nano-particle on radiolytic decomposition of phenol in water solutions [1-2], is related with the possibility of increase of effectiveness of the removal of phenol from water solutions under the influence of ionizing radiation.

It is known that, the radiolytic decomposition of phenol in water solutions is a multistage process [3], which leads to the formation of a quantity of intermediate organic compounds, such as dihydric phenols and other aromatics, organic acids and aldehydes.

Some of these intermediate products can be adsorbed on the surface of nano- γ Al_2O_3 . Application of derivatography can give some information about the effects of the absorbed dose to the number of adsorbed products of phenol degradation.

For this purpose, it has been studied the kinetics of formation of exothermic effects at radiolysis of water solutions of phenol ($10^{-2}M$) in the presence of nano- γ Al_2O_3 under the influence of γ -radiation Co^{60} . The dose rate, γ -radiation was 0.21 Gy/s.

2. Experimental

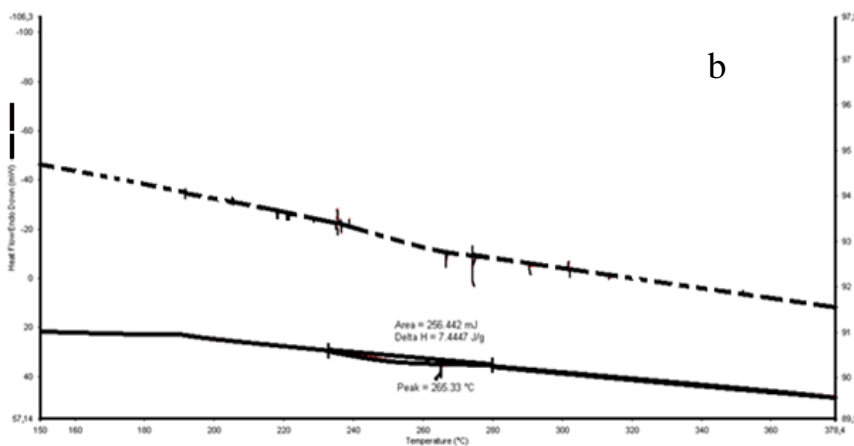
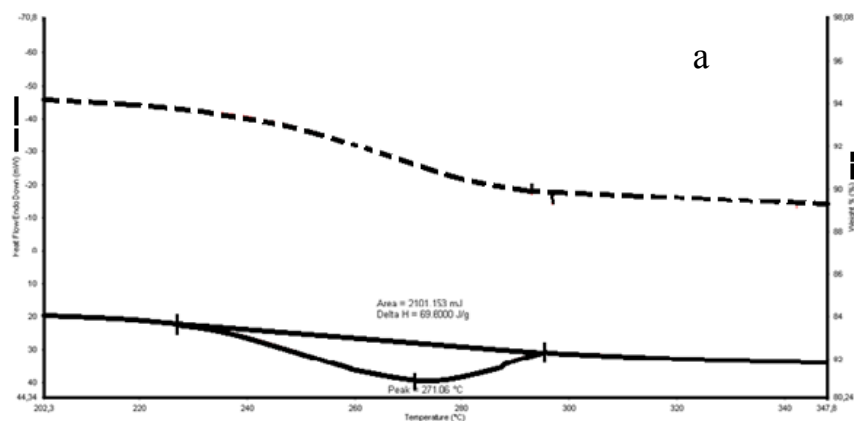
Preparation of the samples: For separation of Al_2O_3 it has been used Centrifuge 5804R of the firm "Eppendorf". Irradiated samples (1 ml) have been placed in a cylindrical cell of 50 ml centrifuge, the rotation speed was 5000 rev / min. Rotation time was 5 min. Al_2O_3 , collected at the bottom of the cell after rotation has been mechanically removed, dried in the air for one day and analyzed in Derivatograph "Perlin Elmer" STA 6000. Water has been periodic moved around the stove by cooling it 16 $^{\circ}C$ by means of the system of "digital temperature controller", with distil which added PolyScience analyser. Working relationship established between the device and computer from the "PyrisSeries-STA6000 COM-1" window in working computer, in "Pyris Manger" program. It was ensured occurrence of homogeneity during combustion which is occurs with the increase of temperature in the system and giving nitrogen gas to system with a speed of 20 ml per minute with the purpose of removing combustion products from system. The empty mass of crucible is weighted in the first "Sample info" part of PyrisSeries-STA 6000 page and the mass of this crucible is weighted with electronic scale with $10^{-6}g$ accurancy, which is placed inside of the device and it is automatically saved in program. Samples are filled in an empty crucible and placed in the device. Software automatically defines sample mass which will be analyzed by deducting empty mass of crucible from full mass of crucible. Defined mass is saved in the memory of software. Nitrogen gas which is given in the second part, is tested to be

20 ml/min by program. In the third part, the samples are heated between 30 °C -900 °C temperature with the speed of 5 degree /min. The field of endo and exothermic effects, forming from the obtained thermal curves is defined as enthalpy by calculating effect field in the area which is selected in the line of temperature by choosing “Paek Area” the from “Calculation” window.

Table 1 Nano- γ Al_2O_3 has the following characteristics:

Purite	99.99%
Form	Nanopowder, white
Particle Size D_{50}	20 nm
Specific Surface Area	262.09 m^2/g
Content of γ phase	99.32%
Content of water	0.317%
Impurities	Ca: 8.25 ppm Fe: 7.967 ppm K: 6.3 ppm Na: 4.707 ppm Si: 9.71 ppm

In Fig.1 it has been submitted the curve of changes of weight, ΔH and the area of exothermic effect. As it is seen, the decrease of weight of samples is observed at $t=228-295^{\circ}C$. The exothermic effect occurs with maximum, depending on the absorbed dose.



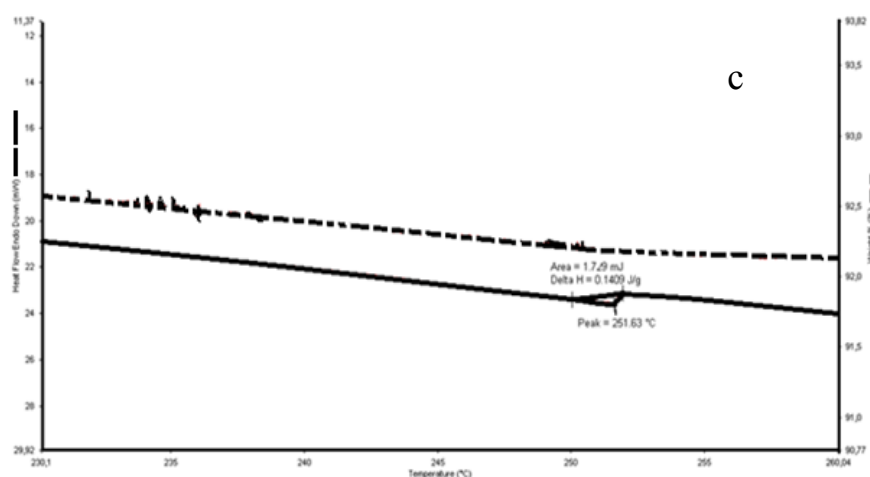


Fig.1 Derivatograms of samples at a- $t=0$, b- $t_{irr}=17h$, c- $t_{irr}=51h$

The results are shown in the Table 2.

Table 2. Characteristics of exothermic effect

t	S, mJ	ΔH , J/g	t_{Max}
0	2101.153	69.600	275.06
17h	256.442	256.442	265.33
51h	1.729	0.1409	251.63
510h	~0	~0	—

As it is seen, with increasing dose of heat of formation and area of exothermic effect decrease strongly, that is connected with decomposition of phenol and products of its conversion at higher doses. There is also observed t_{Max} shifted to the direction of low temperature at high dose. The observed patterns demonstrate the effective participation of active particles, being formed on the surface of nano- γ Al_2O_3 in the processes of phenol decomposition and organic part of its conversion products at radiolysis of the water - nano- γ Al_2O_3 – phenol system.

References

1. S.Seino, T.A.Yamamoto, K.Hashimoto, S.Okudo, N.Chitose, S.Ueta and K.Okitsu, Gamma-ray irradiation effect on aqueous phenol solutions dispersing TiO_2 , or Al_2O_3 nanoparticles, Rev.Adv.Mater.Sci. 4, pp.70-74, 2003.
2. I.M.Piskarev, Phenol oxidation with OH, H, O and O_3 particles, being formed at electric discharge, Kinetics and catalysis, vol. 40, №4, pp.505-511,1999.
3. E.A.Podzorova, Combined radiation methods of water purification and sewage treatment, doctoral dissertation, M. 2001

ДЕРИВАТОГРАФИЧЕСКОЕ ИССЛЕДОВАНИЕ АДсорбированных фаз
ПРИ РАДИОЛИЗЕ ВОДНЫХ РАСТВОРОВ ФЕНОЛА В ПРИСУТСТВИИ
НАНО- γ -Al₂O₃

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Резюме: Изучена кинетика экзотермических эффектов при радиолизе водных растворов фенола (10^{-2} М) в присутствии нано- γ -Al₂O₃ под действием излучения Co⁶⁰. Было установлено, что экзотермический эффект в зависимости от дозы имеет максимальное значение. При больших дозах площадь экзотермического эффекта и теплота образования сильно уменьшаются.

Ключевые слова: Дериватография, экзотермические эффекты.

NANO- γ -Al₂O₃ ŞT RAKINDA FENOLUN SUDA MƏHLULUNUN RAD OL Z
ZAMANI ADSORBS YA FAZASININ DER VOTOQRAF K TƏDQ Q

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Xülasə: Nano- γ -Al₂O₃ iştirakında fenolun suda məhlulunun (10^{-2} М) Co⁶⁰ izotopunun şüalanmasının təsiri ilə radiolizi zamanı ekzotermik effektlərin əmələgəlmə kinetikasi öyrənilmişdir. Müəyyən edilmişdir ki, ekzotermik effekt dozadan asılı olaraq maksimum qiymətini alır. Udulan dozanın artması ilə əmələgəlmə istiliyi və ekzotermik effektin sahəsi kəskin azalır.

Açar sözlər: Derivotaqrafiya, ekzotermik effekt.