PACS: 82.50.Rx

INFLUENCE OF NANO-γ- Al_2O_3 ON RADIOLYTIC DECOMPOSITION OF PHENOL IN WATER SOLUTIONS

[1]U.A. Guliyeva, [1]M.A. Gurbanov, [1]Z.I. Isgenderova, [1]S.G. Mammadov, [1]E.T. Abdullayev
[1]Institute of Radiation Problems, ANAS
ulviyegulieva13@gmail.com

Abstract: The change of pH, chemical oxygen demand (COD) and formation of CO_2 at radiolysis of water solution of phenol in presence of nano-γ-Al_2O_3 within the absorption dose range of 0-400 kGy has been studied. The existence of nano-γ- Al_2O_3 does not significantly affect the decrease in COD with the growth of adsorbed dose, but causes to reduction in concentration forming carbon dioxide. pH is strongly reduced in homogeneous system. pH changes relatively low in the presence of nano-γ- Al_2O_3.

Keywords: Adsorbed dose, nano-γ- Al_2O_3 degradation of phenol, chemical oxygen demand, pH.

1. Introduction

Despite the intensive researches of radiolytic decomposition of phenol in water solutions [1-5], heterogeneous radiolysis of the system has been studied insufficiently. Particularly the influence of nanoparticles on radiolytic decomposition of phenol in water solutions has been weakly studied [6-7].

In the work it has been studied the change in pH indicator, chemical oxygen demand (COD) and formation of CO_2 at radiolysis of water solution of phenol in presence of nano- γ Al_2O_3 within the absorption dose range of 0-400 kGy.

2. Experimental

2gr nano-γ-Al_2O_3 has been added to the samples with phenol concentration of 10^{-2} M. Nano-γ Al_2O_3 has the following characteristics.

Purite	99.99%
Form	Nanopowder, white
Particle Size D_{50} Specific Surface Area	20 nm 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

Irradiation of samples has been carried out in glass ampoules under static conditions at room temperature by the γ radiation from Co^{60}. The absorption dose rate has been 0,21 Gy/s.

After irradiation it has been prepared two types of samples. Firstly, it has been analyzed the irradiated samples on COD and pH indicator. Secondly, the samples have been placed in centrifuge and nanoparticles have been separated from the liquid phase. For separation of Al_2O_3 it has been used Centrifuge 5804R of the firm "Eppendorf". The irradiated samples (1 ml) have

been placed in cylindrical cell of centrifuge with the volume of 50 ml, rotating velocity has been 5000 turnover/min. Rotation time has been 5 min.

Obtained the liquid phase samples has been analyzed on COD and pH CO_2 has been analyzed chromatography.

3. Results and discussion.

The kinetic curves of changes of pH of the irradiated system, including radiolysis of homogeneous system of phenol-water, systems of nano-γ-Al_2O_3 with and without sample rotation is presented in figure 1.

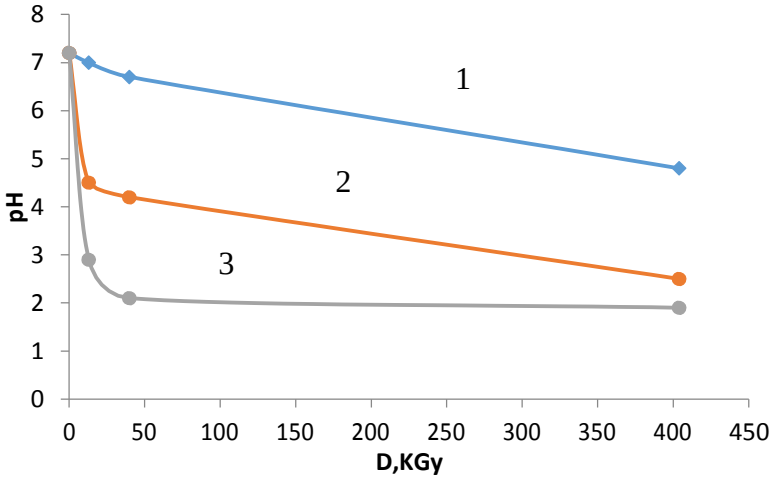

Fig.1. Dependence of pH on absorped dose, 1-after rotation, 2- before rotation, 3- without Al2O3 (homogeneous mixture)

As it is seen, pH is strongly reduced in homogeneous system. pH changes relatively low in the presence of nano-γ Al_2O_3 in the system. Apparently, part of acidic liquid products is adsorbed on the surface of nano-γ Al_2O_3. Unexpected change in pH is observed in the case of sample rotation. In this case decrease in pH is less than above mentioned two cases. The obtained results show the additional adsorption of acids on the surface of nano-γ Al_2O_3 at rotation in centrifuge.

In fig.2 it is shown the kinetic curves of the changes in COD of the irradiated systems, including radiolysis of homogeneous system of phenol-water, systems of nano-γ Al_2O_3 with and without sample rotation.

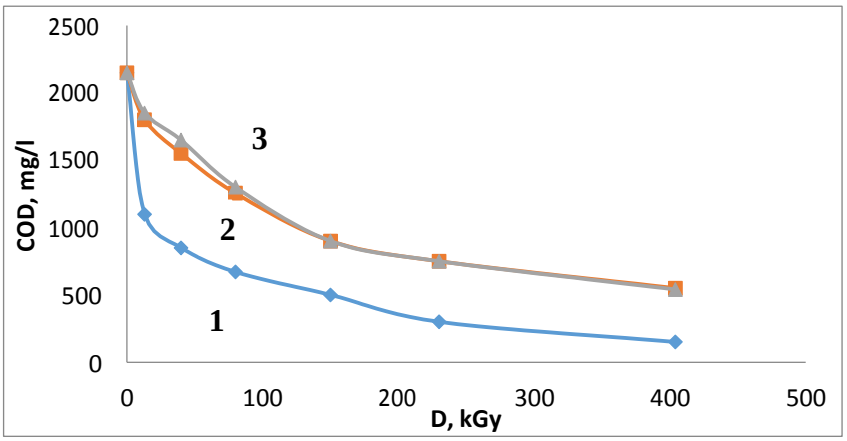

Fig.2. Dependence of COD indicator on absorption dose, 1-after rotation, 2-before rotation, 3-without Al_2O_3 (homogeneous mixture)

As it is seen, the existence of nano-γ Al_2O_3 does not significantly affect the decrease in COD with the growth of adsorbed dose. The difference is observed in the case of sample rotation in centrifuge. In this case there is a strong reduction in COD with increasing dose. This pattern also confirms the adsorption of acidic liquid products on the surface of nano-γ Al_2O_3 at rotation in centrifuge.

In fig.3 it is shown the kinetic of change in concentration of carbon dioxide at radiolysis of homogeneous and heterogeneous systems.

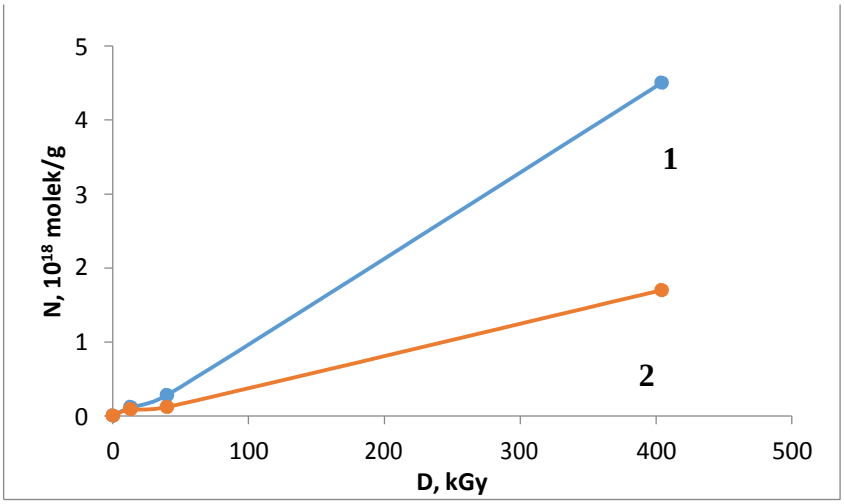

Fig.3. Kinetic of CO_2 formation at radiolysis, 1-homogeneous system Ph+water, 2-systems Ph+Al_2O_3+H_2O

As it is seen, the existence of nano-γ Al_2O_3 leads to reduction of carbon dioxide in concentration. The obtained results demonstrate the suppression of oxidation of organic acids – products of deep oxidation of phenol in this case The observed tendency in kinetic of CO_2 formation has also been observed in the [6], in which it has been carried out researches on the influence of nano-γ Al_2O_3 on radiolytic decomposition of phenol in water solutions.

References

1. Hashimoto, A., Miyata, T., Washino, M., Kawakami W., 1979. A liquid chromatographic study on the radiolysis of phenol in aqueous solution. Envirin. Sci. Technol. 13, 71-75.
2. Hashimoto, A., Miyata, T., Kawakami W., 1980. Radiation – induced decomposition of phenol in flow system. Radiat. Phys. Chem. 16, 59-65
3. Sato. K, Takimoto, K., Tsuda, S., 1978. Degradation of aqueous phenol solution by gamma irradiation. Environ. Sei. Technol. 12, 1043-1046
4. R.M.Quint, H.R.Park, P.Krajnik, Solar, N.Getoff and K.Sehested //Radiat. Phys. Chem, 47 (1996) 835
5. E.A.Podzorova, Combined radiation methods of water purification and sewage treatment, doctoral dissertation, M.2001
6. 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(2003) 70-74.
7. Norihia Chitose, Shinzo Ueta, Satoshi Seino, Takao A.Yamamoto, Phenol degradation and TOC removal in solutions containing TiO_2 induced by UV, γ-ray and electron beams, Chemosphere 50 (2003) 1007-1013.

ВЛИЯНИЕ НАНО- γ- Al_2O_3 НА РАДИОЛИТИЧЕСКОЕ РАЗЛОЖЕНИЕ ФЕНОЛА В ВОДНЫХ РАСТВОРАХ

У.А. Кулиева, М.А. Курбанов, З.И. Искендерова, С.Г. Мамедов, Э.Т. Абдуллаев

Резюме: Изменения ХПК, pH и концентрации CO_2 при радиолизе фенола в водных растворах в присутствии нано- γ Al_2O_3 в интервале 0-400 кГр поглощенных доз были изучены. Наличие нано-γ-Al_2O_3 существенно не влияет на уменьшение ХПК с ростом дозы, но приводит к уменьшению концентрации образовавшийся углекислого газа. pH сильно уменьшается в случае гомогенной системы. При облучении системы в присутствии нано-γ Al_2O_3 pH среды изменяется относительно слабо.

Ключевые слова: Поглощенная доза, нано-γ-Al_2O_3 , деградация фенола, Химическая Потребность в Кислороде, pH.

FENOLUN SUDA MƏHLULUNUN RADİOLİTİK PARÇALANMASINA NANO- γ- Al_2O_3-ÜN TƏSİRİ

Ü.A. Quliyeva, M.Ə. Qurbanov, Z.İ. İskəndərova, S.Q. Məmmədov, E.T. Abdullayev

Xülasə: Fenolun suda məhlulunun 0-400 kQr udulma dozası intervalında nano- γ-Al_2O_3-ün iştirakı ilə radiolitik parçalanma prosesində OKT və pH göstəricisinin dəyişilməsi, CO_2-nin əmələ gəlməsi öyrənilmişdir. Nano- γ-Al_2O_3-ün iştirakı udulan dozadan asılı olaraq OKT-in dəyişməsinə əhəmiyyətli dərəcədə təsir etmir, lakin əmələ gələn karbon qazının qatılığının azalmasına səbəb olur. Nano- γ-Al_2O_3 olan halda radioliz zamanı homogen sistemdə pH güclü azalır.

Açar sözlər: Udulma dozası, nano- γ-Al_2O_3,fenolun parçalanmsı, Oksigenə Kimyəvi Tələbat, pH.