Water Treatment by Mechanical Methods

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***Abstract*— In today`s era, tossing of exhaut gasses is one of the major ecological problem. These gases also have detrimental effects on water resorces. According to the investigations, we determined that, applying of graphen oxide and zeolite as mechanical treater can be solution to the treatment of water sources which are contaminated with exhaust gases. According to the obtained results, graphene oxide has better results than zeolite.**

Keywords—graphene oxide, zeolite, water treatment, SEM

I. Introduction

In a world of gradually developing technologies the demand for new new scientific breakthroughs in order to improve these technologies becomes more indispensable. The synthesis of multifunctional compounds and drugs is considered as one of the possible solutions to this issue. Such kind of compound is the graphene oxide, as nowadays it's derivatives and their chemical production issue become more relevant among the the chemists and also characterization of the products require novel analytical methods which in order creates a new research possibilities [1-4]. And the question is, in which way the synthetic chemistry could take a part in graphene and graphene oxide topic and could it push this area further by any new developments? In last 20 years we observed the inordinate improvement in chemical characterization, reactivity principles, application properties and complex formation with other various compounds of synthetic allotropes of carbon, like fullerenes and carbon nanotubes.

Rapid growth of world population and industrial development aggravates the problem of clean water scarcity and as an result, enhancing the demand for highly beneficial and eco-friendly water treatment technologies. The main research goal of this direction is preparation of semipermeable nanostructurized membranes and graphene oxide with ensembles derived from it posses a great potential for replacing the polymer membranes due to their relative accessibility and mechanical and chemical durability.

The current research strategy in this area is the synthesis of more efficient graphene oxide membranes for water treatment by modifying carbon oxygen ratio and analyzing the functional groups [5-7]. The main goal of our laboratory work is to obtain new derivatives of graphene oxide and analyze their efficacy in water treatment. The experiment will be carried out by Hummers method, and obtained graphene oxide ensemble will be applied in filtering of water in order to measure the amount of ions in filtered water [8-11].

II. Experimental part

The experiment first was carried out at room temperature and then was heated to higher temperatures(90 °C). The used equipment is listed below:
Filter paper; 250 ml cylindrical flask; cold bath, electric heater;
The measurement of the a mount of reactants by titration is depicted in image below:

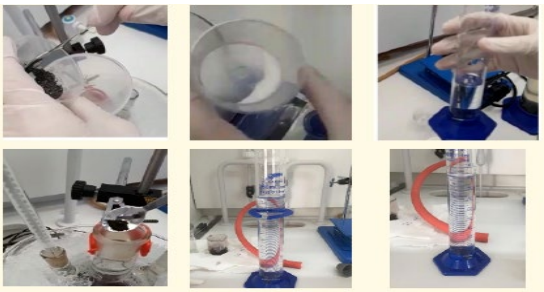

Fig. 1. Laboratory equipment used in the synthesis of graphene oxide

In recent years modified and improved Hummers method become widespread and the most beneficial and our experiment was based on that method in order to obtain more better results. The step-by-step sequence of procedures during our laboratory work was proceeded according to NCR documentation [23] due to its efficiency in our other research projects. As reactants we took 2gr of graphite, 1gr of $NaNO_3$ and 6gr of $KMnO_4$. 46 ml of 95-98% sulfuric acid were prepared in advance. During reaction cold bath was used to keep temperature low as required. According to theoretical part it advisable to carry out reaction twice. After preparing the samples three and two necked thermometers were chosen. Then graphite, $NaNO_3$ and H_2SO_4 were added to flask and the obtained mixture was stirred for a some period. After, during 20 minutes the temperature was plummeted till 200 °C. By heating again till 20 °C, $KMnO_4$ was added gradually for 2 hours. As the reaction was exothermic we retained the temperature around 20-25 °C using cold bath. Then we heated it up to 35 °C stirred it for 30 minutes. After we put the mixture again into the cold bath, added to the sample 92 ml of distilled water and temperature rised to the 90°C, followed by decrease to the 70 °C. Then we used electric heater to keep temperature at 70-70 °C for 15 minutes. After we poured the reaction mixture into 1 L Erlenmeyer flask and washed it with distilled water to enhance dispersion and decrease the loss of adduct. For this reason 500 ml of 3% percent H_2O_2 solution was prepared. After keeping adduct at temperature for 12 hours, we washed it with distilled water by filtration method. For the complete removal the sulfuric acid we washed the adduct again with NaCl solution with 12 gr/l concentration. Then, in the Buncher system we added 100 ml of thickened water into our newly obtained composition.

In further proceedings we applied the zeolite nanoparticles and graphene oxide which we obtained from our experiment in order to studed their exact roles in water treatment. We used clinoptilolite as the zeolite nanoparticles. Elements within the clinoptilolite were given in the table below:

- Table 1. Components of clinoptilotite zeolite

Na_2O	MgO	Al_2O_3	SiO_2	K_2O	CaO	FeO	MnO	Fe_2O_3
1.37	0.99	12.13	65.95	1.95	3.63	0.07	0.02	1.22

Table 2. Components of clinoptilolite zeolite

Element	Mass %	Number of atoms %	Consistency %	Formula
Na	3.09	2.78	4.17	Na_2O
Mg	2.03	1.72	3.37	MgO
Al	7.61	5.82	14.38	Al_2O_3
Si	33.41	24.55	71.48	SiO_2
K	2.39	1.26	2.88	K_2O
Ca	0.65	0.34	0.91	CaO
Fe	2.18	0.81	2.81	FeO
O	48.63	62.72		
Sum	100			

After all these processes we applied the FTIR spectrophotometer for characterizing the functional groups in the powder samples of hybrid nanostructures. As a spectrum we picked the interval of 4000 - 400 cm^{-1}.

III. Conclusion

After experiments, we revealed the some amount of Cl ions by titration method at central Azersu laboratory. For determining the effect of obtained graphene oxide on the amount of Cl^- during water treatment we passed the simple water through filter consist of graphene oxide and then analyzed it for the number of Cl^- ions.

As a consequence of the research, the number of Cl ions was considerably reduced by ~20% using a filter that consisting of GO. According to the obtained results number of Cl^- ions before the filteration was 7472, but this amount reduced to 5958 after filteration. If water purification membranes and other devices could be used during the experiment, the indicators could be even better. Experiments on the investigation of functional groups in the produced graphene oxide are now underway.

REFERENCES

[1]. K. S. Novoselov, A. K. Geim, S. V. Morozov, D. Jiang, Y. Zhang, S. V. Bubonos, I. V. Grigorieva, A. A. Firsov, Science 2004, 306, 666;

[2]. D. R. Dreyer, R. S. Ruoff, C. W. Bielawski, Angew. Chem. 2010, 122, 9524

[3]. K. S. Novoselov, A. K. Geim, S. V. Morozov, D. Jiang, M. I. Katsnelson, I. V. Grigorieva, S. V. Dubonos, A. A. Firsov, Nature 2005, 438, 197;

[4]. R. S. Edwards, K. S. Coleman, Nanoscale 2013, 5, 38;

[5]. A. Hirsch, M. Brettreich, Fullerenes, Chemistry and Reactions, Wiley-VCH, Weinheim, Germany, 2005

[6]. S. Eigler, Y. Hu, Y. Ishii, A. Hirsch, Nanoscale 2013, 5, 12136.

[7]. You S.; Yu J.; Sundqvist B.; Belyaeva, L. A.; Avramenko, N. V.; Korobov, M. V.; Talyzin, A. V. (2013). "Selective Intercalation of Graphine Oxide by Methanol in Water/Methanol Mixtures". The Journal of Physical Chemistry C. 117 (4): 1963. doi:10.1021/jp312756w

[8]. Nonlinear optical properties of graphene oxide in nanosecond and picosecond regimes". Zhibo Liu. January 12, 2009. doi:10.1063/1.3068498.

[9]. Zheng, Xiaorui; Jia, Baohua; Chen, Xi; Gu, Min (May 7, 2014). "In Situ Third-Order Non-linear Responses During Laser Reduction of Graphene Oxide Thin Films Towards On-Chip Non-linear Photonic Devices". Xiaorui Zheng. 26 (17): 2699 2703 . doi:10.1002/adma.201304681.

[10]. Gómez-Navarro, C.; Weitz, R. T.; Bittner, A. M.; Scolari, M.; Mews, A.; Burghard, M.; Kern, K. (2007). "Electronic Transport Properties of Individual Chemically Reduced Graphene Oxide Sheets". Nano Letters. 7 (11): 3499–3503

[11]. Jung, Inhwa (November 1, 2008). "Tunable Electrical Conductivity of Individual Graphene Oxide Sheets Reduced at "Low" Temperatures". Nano Letters. 8 (12): 4283–4287. doi:10.1021/nl8019938. PMID 19367929.