SYNTHESIS, CHARACTERIZATION AND ADSORPTION PROPERTIES OF SUGAR BASED GRAPHENE OXIDE: REMOVAL OF U(VI) FROM AQUEOUS SOLUTIONS (SUGAR BASED GRAPHENE OXIDE FOR THE REMOVAL OF U(VI)

[1]YU-LIM CHOI, [2]LAKSHMI PRASANNA LINGAMDINNE, [3]JANARDHAN REDDY KODURU, [4]JAE-KYU YANG, [5]YOON-YOUNG CHANG

[1,2,5]Department of Environmental Engineering, Kwangwoon University, Seoul, 139-701, Republic of Korea
[3]Graduate School of Environmental Studies, Kwangwoon University, Seoul, 139-701, Republic of Korea
[4]Division of General Education, Kwangwoon University, Seoul, 139-701, Republic of Korea
E-mail: ychang@kw.ac.kr

Abstract- The present study has been described about synthesis of graphene oxide from sugar using an eco-friendly method. It is a simple and efficient method for graphene oxide preparation without using any chemical. A suitable methodology was introduced to preparation of graphene oxide without any chemicals. FT-IR confirmed that the material is indeed graphenic in nature. It effectively removes contaminants from water. Here, we use U(VI) for this application. The spectroscopic and microscopic analyses coupled with adsorption experiments revealed that chemical adsorption plays a dominant role in the adsorption process. Isotherm data in batch experiments show an adsorption capacity of 63.69 mg/g, which are superior to that of activated carbon. The adsorbent was eco-friendly, cost-effective technique for the commercial water tenement.

Keywords- graphene, composites, adsorption, water purification, nanotechnology, environmental remediation

I. INTRODUCTION

Carbon has been the most suitable material for waste water purification [1, 2]. Nowadays very often used material for water purification is activated carbon [3]. Carbon has high surface area and high adsorption capacities [4]. Among the simplest of natural sources of carbon are sugars [5], which upon dehydrogenation get converted completely to elemental carbon, leaving only water to escape. New additions into the carbon family are Graphene. Graphene, a single two-dimensional (2D) layer of carbon atoms and its oxide form, graphene oxide (GO), have large specific surface areas and good biocompatibility. The amorphous nature of graphene oxide generated by the chemical fabrication method, understanding the atomic structure and its effects on the oxidation process is still a big problem. Recently, many studies have dealt with the oxidation of graphene by ozone and O ions [6-12]. In this present study, synthesized graphene from sugar and in-situ oxidation using ozone gas produced by ozone generator in order to prepare GO. After well characterization of the prepared GO was successfully applied for the removal of radio active U(VI) from aqueous solutions

II. METHODS

As shown in the Fig.1, GO was prepared by programmed thermal heating of sugar at N_2 atmosphere for 5 h. At first the sugar was kept in silica crucible and heats it up to 200°C with in 30min and then kept for 1h, after that increased temperature from 200 to 750°C within 30 min and held that temperature for 3h to get sugar based graphene. The prepared graphene at pH 1.0 was exposed to ozone gas which is generated by ozone generator as shown in Fig.1. After ozonation, the product, GO was collected by filtration and dried in hot oven at 65°C.

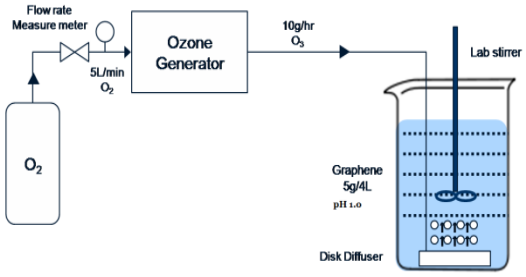


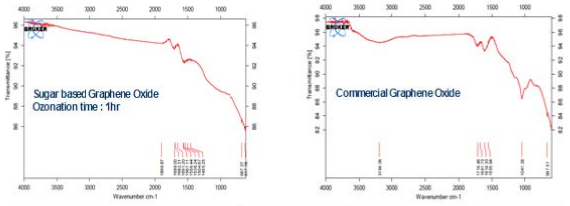
Fig.1. Schematic representations of preparation GO from Sugar.

The mechanism during converstion derived sugar is shown followed formula.

$C_{12}H_{22}O_{11}$(Sugar) $\quad\quad$ $12C + 11H_2O$

III. RESULTS AND DISCUSSION

The prepared sugar based graphene oxide confirmed by characterizing using FT-IR shown in Fig.2. From FT-IR spectrum of GO it was clearly observed the presence of -OH, C-O , C=O along with C=C-H functions were confirmed the formation of GO. It was also comparable with FT-IR spectrum of commercial GO. The BET results (Fig.2) were indicated the high surface area GO (655.94 m^2/g) which is more favorable for adsorption. XRD, and XPS spectroscopy techniques were also confirmed the formation of GO from sugar. The morphology and surface composition was evaluated by SEM and SEM-EDS where clearly observed the pours surface morphology.



	cm-1	Characteristic
1	500-900	-OH
2	800-1000	C=C-H
3	1000-1250	C-O
4	1700-1750	C=O
5	3000-3700	-OH

Material	BET surface area, m^2/g	Particle size by BET, nm
Graphene	674.593	8.894
Graphene Oxide	655.894	9.1478

Fig.2. FT-IR and BET characterization and comparison of suagr based GO with commercial GO.

The prepared GO surface properties was tested by batch adsorption of U(VI) from aqueous solution. In this order to evaluate sorption characteristics of sugar based GO, the factors affected on the sorption of (UVI) was tested. The sorption of U(VI) is plotted in as a function of contact time ranging from 5 min to 24 h at pH 4.0, initial concentration of U(VI)10mg/L and 0.6g/L dosage . It can be seen that the sorption was rapid and a contact time of 45min is enough to reach equilibrium(Fig .3). The adsorption kinetics results concluded that 99% removal of U(VI) and it addressing the rate limiting pseudo second order on heterogeneous surface of GO.

In order to evaluate sorption capacities of sugar based GO for U(VI), applied Langmuir and Freundlich isotherm models to the sorption data. Adsorption isotherm results (Table 1) concluded that the correlation coefficients value of 0.99 for uranium that the Langmuir equation fits the experimental data better than the Freundlich model. The maximum adsorption capacities (Q_{max}) of U(VI) ions on GO at 298K are 63.69 mg g-1 was achieved in the present study .The data also indicate a monolayer adsorption occurred at binding sites on the surface of the adsorbent.

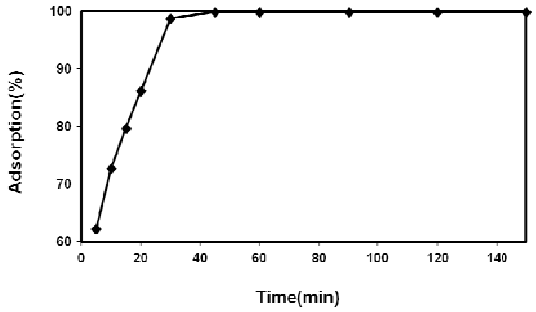


Fig.3. Adsorption kinetics of U(VI) on to sugar based GO

TABLE 1. U(VI) isotherms with sugar based graphene oxide.

Langmuir			Freundlich		
q_{max}, $mg\,g^{-1}$	K_L, Lmg^{-1}	R^2	K_F, mgg^{-1} $(Lmg^{-1})^{1/n}$	n	R^2
63.69	3.75	0.993	37.65	1.84	0.951

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