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INDUSTRIAL WASTE WATER RECYCLING USING NANO GRAPHENE OXIDE FILTERS

by Yuvarani P

Submission date: 26-May-2021 01:45PM (UTC+0530)
Submission ID: 1594452831
File name: Yuvarani_Paper.docx (1.93M)
Word count: 2090
Character count: 12157

INDUSTRIAL WASTE WATER RECYCLING USING NANO GRAPHENE OXIDE FILTERS

ABSTRACT

Nanomaterials plays a vital role in healthcare, electronics, manufacturing industries, bio-technology and security systems. One such material was Graphene and its oxides specifically used for recycling industrial waste water. Graphene, a single layer in honeycomb cross section, providing excellent attentions because of its significant optical, mechanical, physical and optical properties. GO was utilized to decrease the acidic or essential centralization of the mechanical wastewater into reusable water for the modern reason utilizing graphene channels. Graphene channels can be created from the pencil graphite. Graphene have the high goals of separating capacity and graphene was considered as "A definitive RO film" in light of its stronger, thinner and more chemically safe than the polymer layers. Graphene oxide layers were likewise to be used in the desalination plant in replace with the RO membrane.

Index Terms - Graphene Oxide (GO), Hummers Method, FTIR, pH Analysis

1. INTRODUCTION

Nowadays waste water coming from industries will produces major problem to surroundings as well as creates pollution to the environment. Public and government forced the industries to recycle or reduce the waste coming out to stringent standards. So many industries looking forward to implement better and portable treatment technologies. Graphene was obtained from pencils and then oxidation process was carried out in order to scatter the carbon layers with oxygen molecules, then carbon layers are completely separated into single or multilayer by means of reduction [1] , Graphene has possess extremely strong bond not only mechanically but also have high electro migration [2-4,8,13,18,26]. As well as it cannot dispersed in water or any other organic solvent [5], other admirable properties with the improvement of an reasonable, biodegradable and mass GO production, which would be highly significant [6,15] . GO-silicon bi-layer structure experimented for humidity sensing detection which exhibited outstanding humidity sensitivity [7].Graphene has promised has extended potential research applications in solar cells, corrosion prevention, fuel cells display panels, circuit boards, detection of diseases [9-10,17] and flexible films [25] . The mechanical properties of Polyurethane / Graphene Oxide/Multilayer-Graphene (PU/GO-MG) composites exhibits excellent chemical bonding [11]. Chemically reduced graphene oxide (RGO) revealed highly sensitivity to NO_2 at the room temperature of 200˚C [12]. Polypyrrole/Graphene Oxide (PPy/GO) indicate enhanced electrochemical performances because of its flexibility and electro chemical activity [14]. Liquid crystallinity nature of the graphene oxide had well demonstrated [15]. Graphene Oxide (GO) membranes clearly exhibited as excellent membrane for gas separation process, it blocks everything except water vapour [16] Graphene oxide (GO) derived via chemically has used as humidity sensitive coating deposited over quartz crystal microbalances (QCMs) to detect various Relative Humidity at room temperature[22-23]. The capacity for graphene oxide to direct electrons relies upon the measure of oxidization in the compound, just as the strategy for amalgamation. It's the oxidization in the arrangement that aggravates electrical conductivity [20], so while profoundly oxidized graphene oxide would be an extremely poor channel of power, regardless of whether graphene oxide were to be vigorously

decreased, however it would potentially have the capacity to lead power, it would in any case not execute just as high quality graphene monolayers as far as electron versatility. In any case, there are techniques that can be used to check this circumstance, and those are by a procedure frequently alluded to as functionalization, which intends to artificially change a substance in request to build up its properties to suit a particular application. The properties includes dispersibility, Toxicity, Hygroscopicity and filtering ability. The subsequent artificially adjusted graphene could then conceivably turn out to be much increasingly versatile for practically boundless applications. Functionalization of graphene oxide can be done by numerous techniques.

2. MATERIALS AND METHODS: Several methods were used for synthesis of GO such as Hummer's method, Modified Hummers method, Graphite Oxide reduction method, Graphite intercalation method, electrochemical method, organic synthesis method, carbon nano tubes conversion method, ,liquid stripping method, solvent thermal method, and arc-discharge method. One of the most commonly used method was Hummer's Method [24]. This method was highly recommended because, the GO yield was high and cost also low compared with other methods.

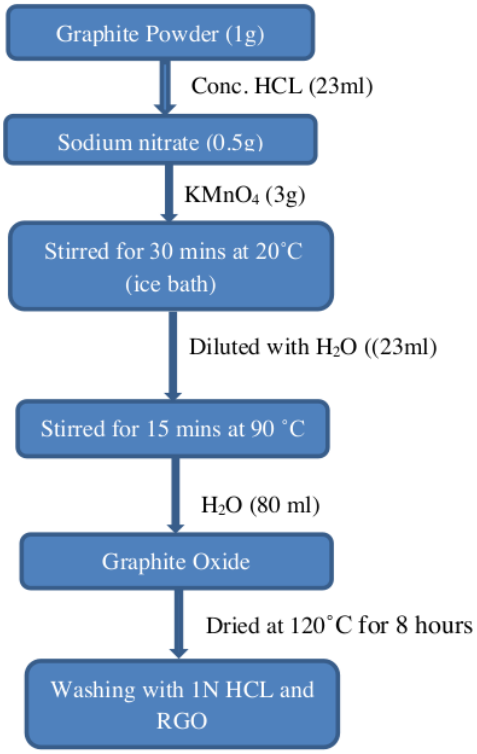

Figure 1. Flow chart of Hummer's method

2.1 Chemicals required: Graphite powder, Concentrated HCL (Hydrochloric acid), Sodium Nitrate, Potassium permanganate, Distilled water, Sulphuric acid, Hydrogen peroxide.

2.2 Hummer's Method of synthesis: Graphene oxide was synthesized by Hummer's Method through oxidation of graphite [24, 27]. The stepwise procedure was mentioned as follows:

1. Graphite powder (1g) and Conc. HCL(23ml) is taken in a beaker and kept in an ice bath at a temperature (0-5˚C)
2. Sodium Nitrate (0.5g) is added in a beaker and stirred for 30 mins at 20 ˚C and $KMnO_4$ (3g) is added into the beaker
3. After 30 mins the beaker is diluted with H_2O (23ml) and stirred for 15 mins at 90 ˚C after some time H_2O (80ml) is added to the solution
4. After stirring some time Graphite Oxide is synthesized and then is washed with the 1N HCL (Hydrochloric acid) several times
5. The washed Graphite oxide is dried at 120˚C for 8 hours and finally Reduced Graphene Oxide
6. The obtained Graphene Oxide may have some other chemical impurities, after centrifugation and further drying process the final Graphene Oxide Nano filters

GO was analysed using FT-IR analysis for atomic characteristics. The FTIR analysis proved that the sample was converted into a Graphene Oxide compound. The water samples from the industries and other impure water samples were taken and it was analysed and filtered using Graphene Oxide Nano particles. Graphene Oxide allows only the water molecules and filter out various others chemical particles and impurities in the water sample. Graphene possesed the ability to filter out the various micro-organisms, dissolved salts, and various types of impurities in the water or industrial waste water.

3. RESULTS AND DISCUSSION:

The incorporated Graphene oxide (GO) was prepared by Hummer's method and result was revealed by FTIR.

Fig. 2. Mixture at Ice-bath at below 2°c for about 1 hour

Fig. 3 Nano particles settled down after 8 hours

Figure 4.centrifugation at 1500 rpm for 20 minutes

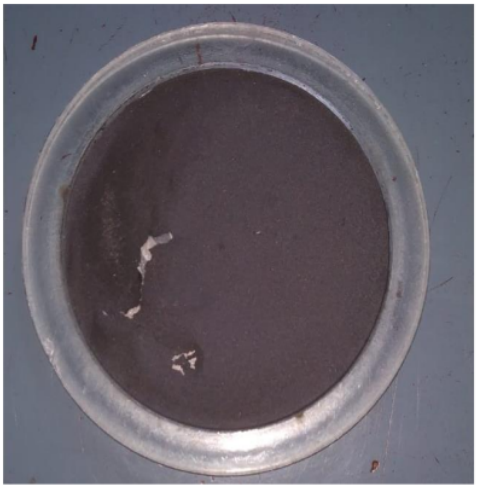

Figure 5. Dried at 120°C for 8 hours

3.1 Fourier Transform Infrared Spectrum Analysis

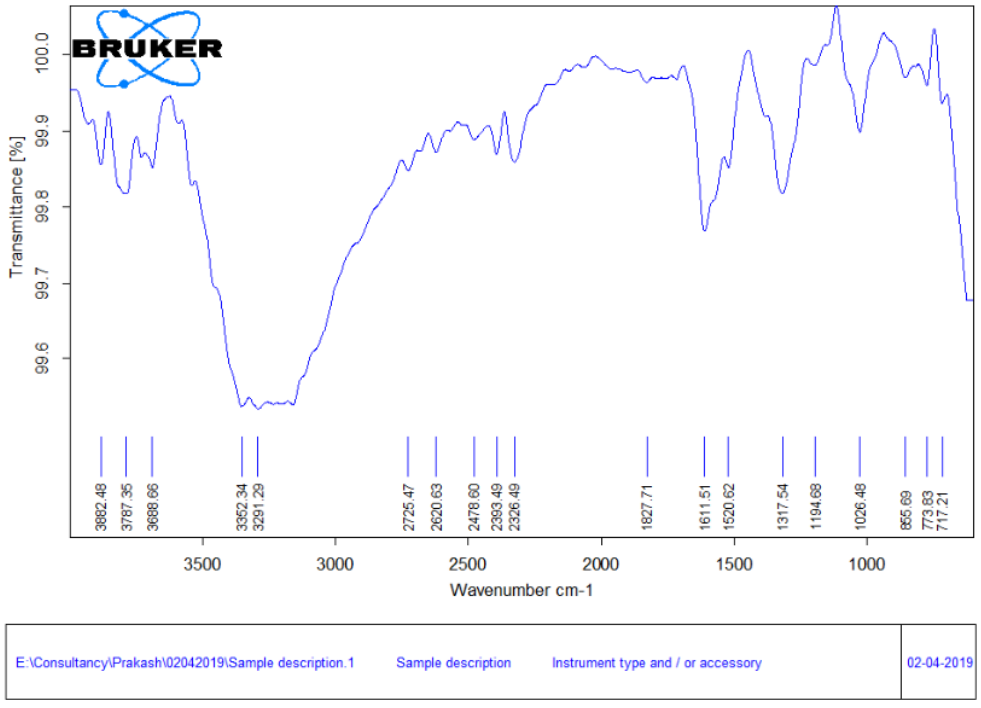

Figure 6. Fourier transform infrared spectra of GO

Fourier transform infrared spectroscopy used to examine the bonding structure. It is a framework grasped to get an infrared scope of maintenance, transmission, and photoconductivity of a solid, gas or liquid. It expects the powers of the pinnacles are specifically identified with the sum of test present [19]. The incorporated GO has a crest at 1081 cm-1 which is ascribed to the C-O bond, affirming the nearness of oxide useful gatherings after the oxidation procedure. The crests in the scope of 1630 cm-1 to 1650 cm-1 demonstrate that the C=C security still stayed previously what's more, after the oxidation procedure. The ingested water in GO is appeared a wide top at 2885 cm-1 to 3715 cm-1, contributed by the O-H extend of H_2O particles.

3.2 pH Analysis

Figure 7. Sample Solution pH value

Figure 8. Filter using GO Nano Particles

The sample solution containing some impurities and acidic content was first analysed and pH of that sample solution is measured. Then synthesized GO nano particles was placed over the filter paper and the sample solution to be tested poured over the filter paper.

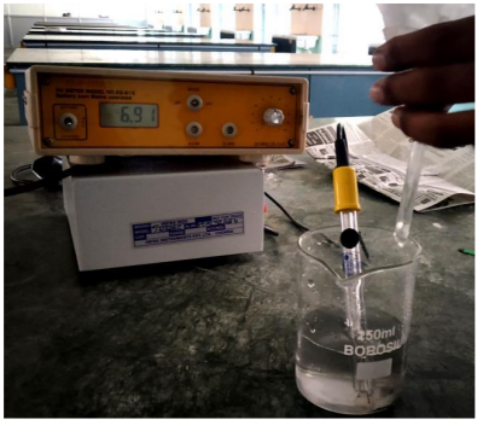

Figure 9. pH value after filtration

GO was produced from pencil graphite so it may have some impurities and it reduces the pH level. On further filtration with the purified GO nano particles layer or paper it will give better reduction in the pH value to around neutral level.

4. CONCLUSION

Nano Graphene Oxide filter paper was obtained by Hummers method. Fourier Transform Infrared Spectrum revealed the presence of C-O and C=C bonds. The graphene Oxide Nano filters is capable of filtering out the impurities and also ability to reduce the pH level of the industrial waste water into a reusable form. Apart from this filtering ability, Graphene Oxide also capable of gas sensing, energy storing ability and current and voltage characteristics. Thus, Graphene was one of the important and future of electronics, electrical and various other important technologies around the world.

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