# 3D OXIDIZED GRAPHENE FRAMEWORK-BASED CONTINUOUS FIXED BED FILTRATION FOR DYE REMOVAL

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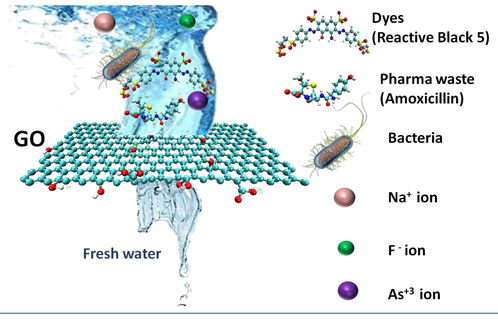
## Abstract

With the expansion of the economy and population, there has been an increase in textile industries and production capacity, which has resulted in an increase in effluent discharge into water bodies containing organic and inorganic pollutants. The major constituents of these pollutants are dyes and organic molecules, which are difficult to degrade in the environment and thus harmful to both the environment and living beings. We present a novel method for producing large quantities of 3D oxidized graphene frameworks (3D OGFs) using agro waste suitable for dye removal due to its high porosity and thin layers of oxidized graphene on the walls of micro holes. At the pilot scale, a three-column continuous bed filtration system with a length (L) of 120 cm and a diameter (d) of 10.16 cm is developed. The device is very effective at removing dyes from effluents and has been thoroughly tested for 1500 L of dye at a specific concentration. This type of system can be installed in textile mills to treat effluent.

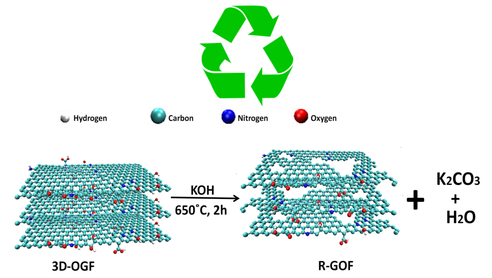
## Introduction

- Modern industrialization and rapid population growth lead to global crisis for fresh water.
- The discovery of graphene and graphene oxide (GO), plays an important role for water remediation.
- GO is hydrophilic and can be functionalized with different groups, this property helps in application of GO for various pollutants.
- Discharge of textile effluents in surface water is a major concern.
- Textile effluents contain unused dyes and some of these organic compounds are carcinogenic in nature.
- These dyes also reduce the aesthetics of lakes and rivers. Thus removal of these dyes is an important challenge

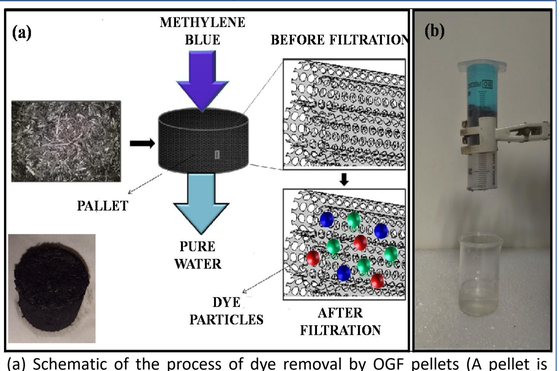



## Material Preparation

- Agro waste has been used for preparation of 3D-oxidized graphene frameworks (3D-OGFs)
- These 3D-OGFs are further reduced with KOH to form Reduced graphene oxide frameworks (R-GOFs)

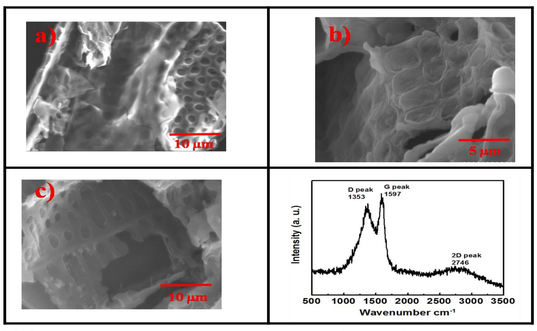



## Experiment

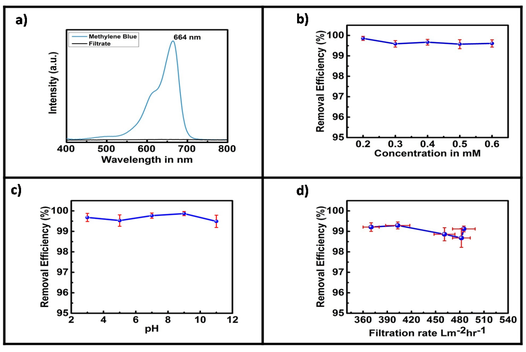



(a) Schematic of the process of dye removal by OGF pellets (A pellet is shown at the inset) and (b) Experimental setup for Degradation study of Methylene Blue aqueous solution (marked by Blue Arrow)

## Characterization




SEM micrographs of a) processed agro waste b) after adsorbing dyes c) after desorption of dye d) Signature of graphene oxide, confirmed by peaks at 1353 (D band), 1597 (G band) and 2746 (2D band) in Raman spectroscopy.




a) UV-Vis spectra of 0.4 mM methylene blue dye has peak at 664 nm, which is completely removed in filtrate. b)-d) Shows the effect of different parameters such as concentration, pH of dye solution and filtration rate on dye degradation efficiency

## Continuous Fixed Bed Filtration System

## Results

- 99% efficiency for removing 1100 liters of Methylene Blue dye 0.4mM concentration in lab
- Removal of suspended macro particles via sand column (1st)
- Removal of chemicals (dyes) via 2nd and 3rd column.
- Flow rate: 1 lit/min
- Removal of Phenol: 169 mg/g
- Removal of amoxicillin: 145 mg/g

## Conclusions

- The Oxidized Graphene Framework present in the processed agro waste was efficient in removing Methylene Blue Dye from its 0.4 mM aqueous solution up to 1500 ml using only 2.5gms of the material
- Dye Removal Efficiency was > 99% under different conditions.
- This filter can be used for filtering the dye by chemisorbing the dye molecules on surface.

## Contact

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