

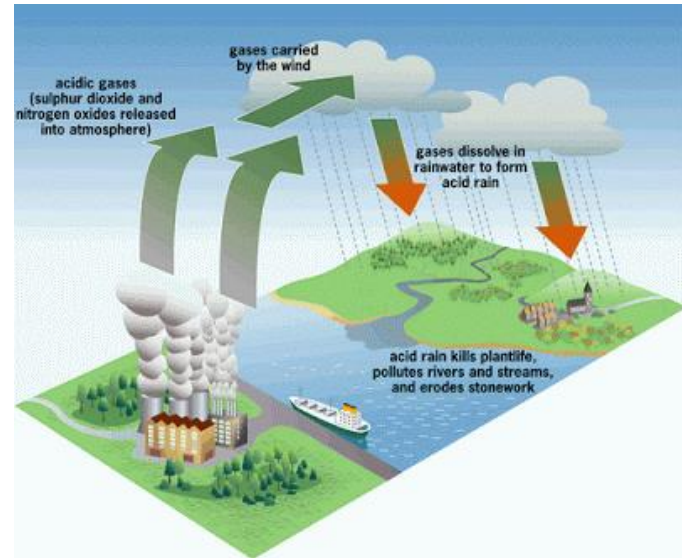


# Desulfurization of Model Fuels with Carbon Nanotube/TiO<sub>2</sub> Nanomaterial Adsorbents using Film Shear Reactor

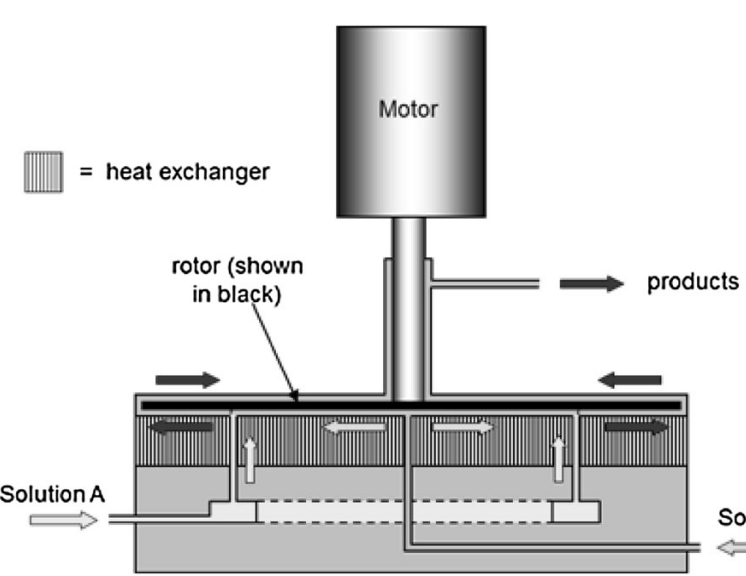
Mohammad N. Siddiqui, Tawfik A. Saleh, Munzir H. Mohammed, Chanbasha Basheer Abdurrahman A. Al-Arfaj, David R. Tyler

## Abstract

Trace levels of sulfur compounds in crude oil is one of the major problems.

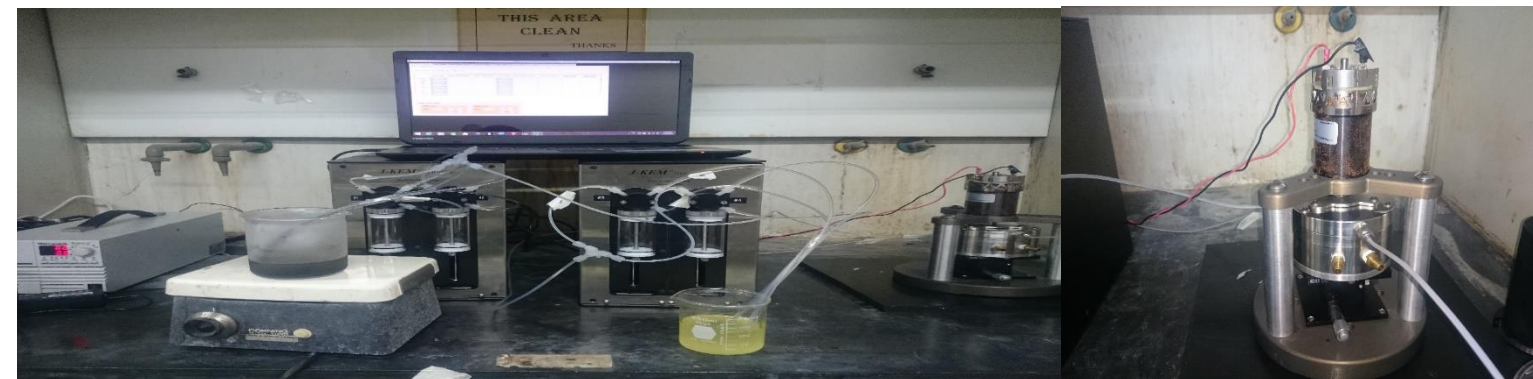


- In this work film shear reactor was used for the removal of sulfur contaminant from model fuel.
- The parameters of the removal were optimized and this method showed excellent removal efficiency from 70 – 80%.

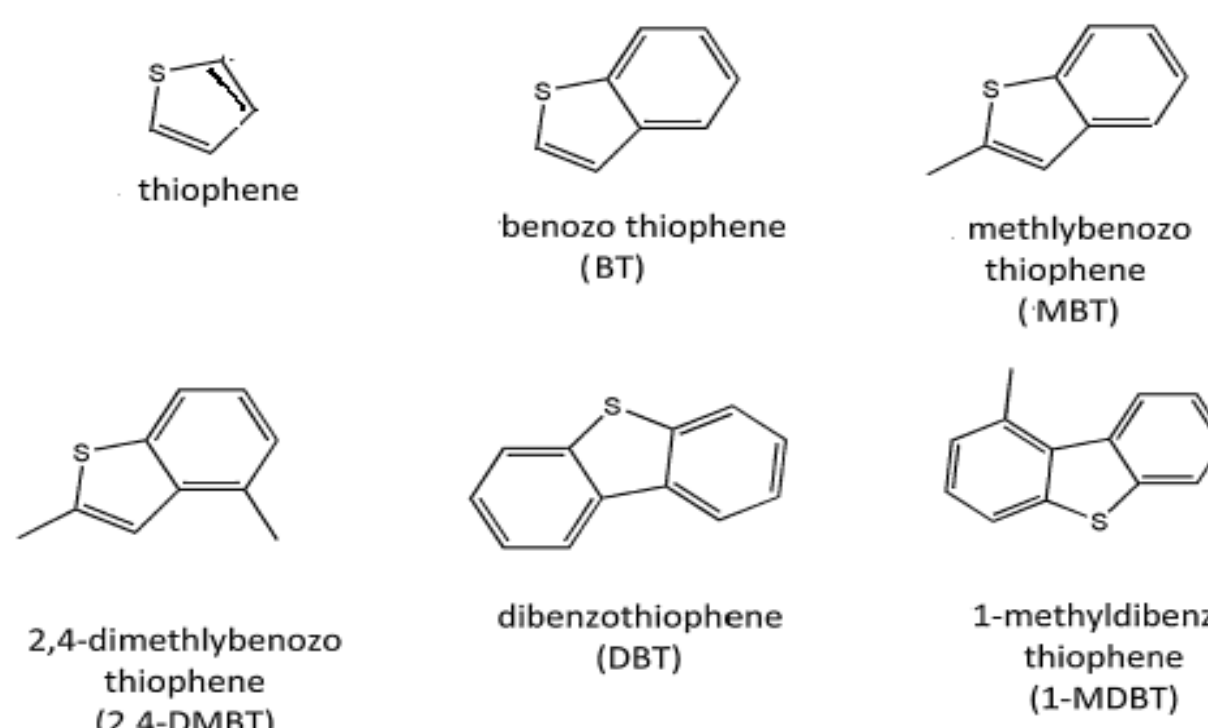


## Methods and Materials

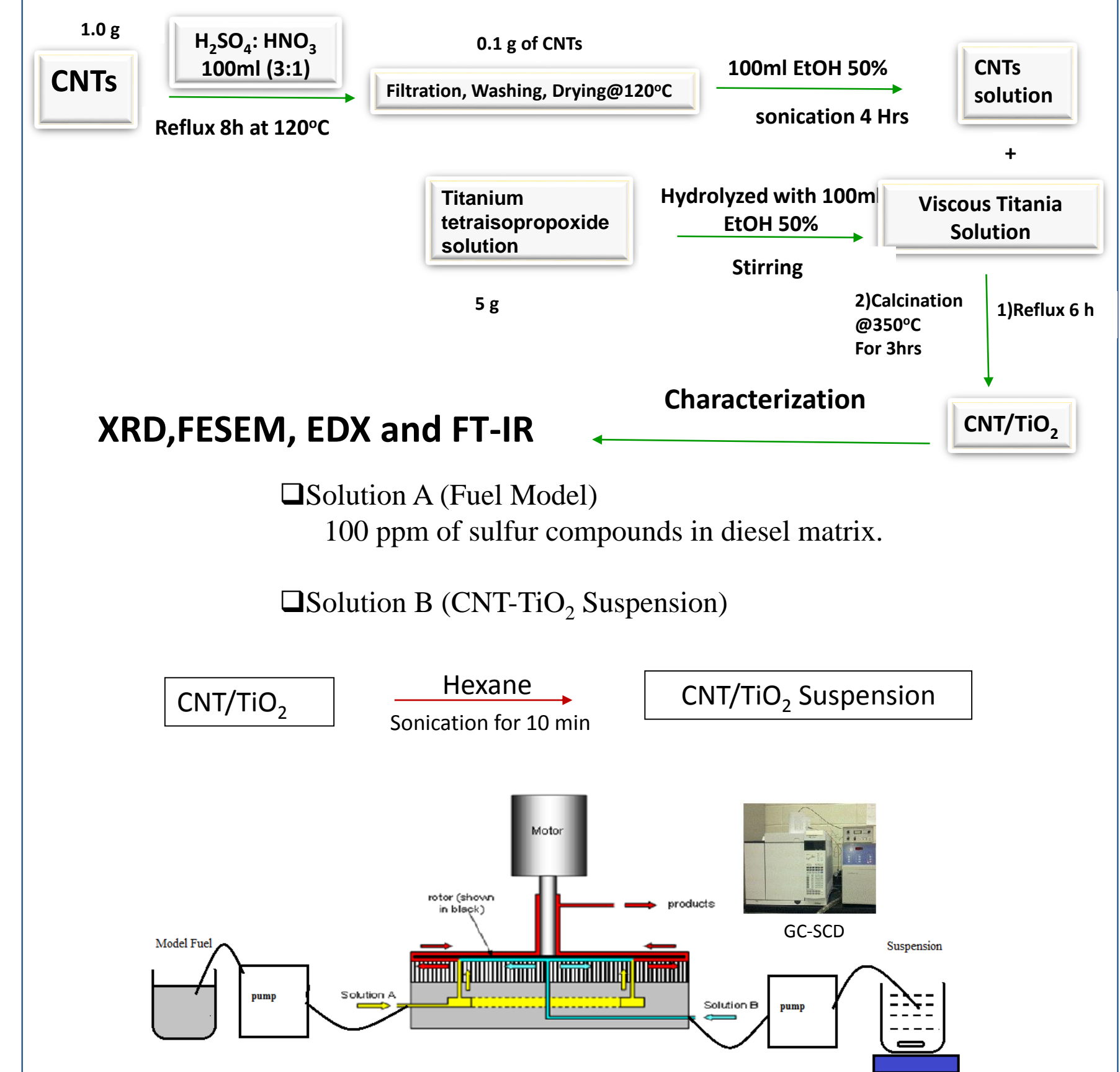
### Membrane Flow Reactor



### 100 ppm of sulfur compounds in diesel



## Methods and Materials



## Introduction

- The sulfur compounds (such as thiophene, benzothiophene, dibenzothiophene.) are naturally present in the crude.
- The removal of sulfur compounds from crude oil is very important to improve its quality.
- Desulfurization of diesel is actually carried out by hydro-treating. Generally, this allows the elimination of aliphatic and alicyclic sulfur compounds.

### Limitations of HDS

- Requires high purity, high pressure of H<sub>2</sub>
- Leads to reduce the octane numbers of fuel
- Hydrogen consumption also increases very sharply at very low product sulfur levels

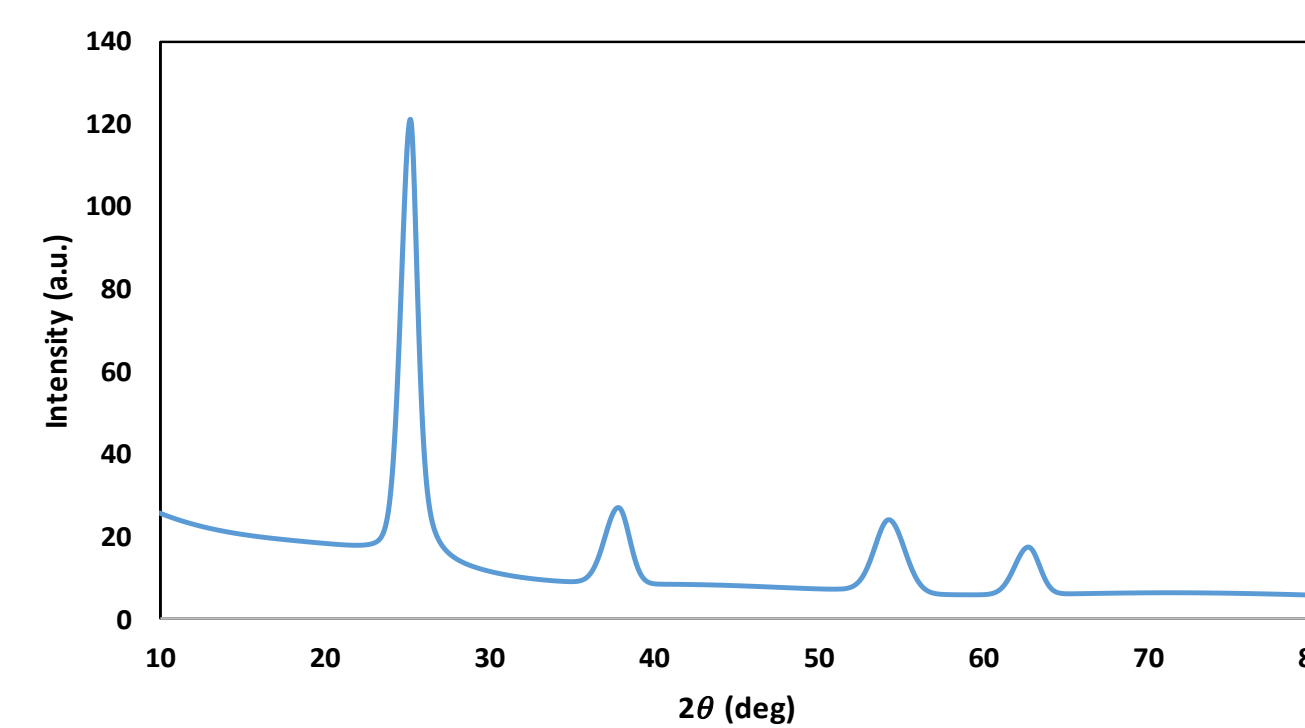
### Other methods used for Desulfurization

Oxidative-desulfurization	The sulfide contaminants are oxidized through the sulfoxide and onto the sulfone
Ionic liquids	The ionic liquids was used as direct extracting agent for the sulfur contaminants
Extractive-desulfurization	The removal of sulfur contaminants based on the solubility of sulfur in certain solvent
Adsorptive desulfurization	This process is depend on the ability of solid sorbent to adsorb the sulfur, (activated carbon, alumina, and MWNT and their corresponding composite.

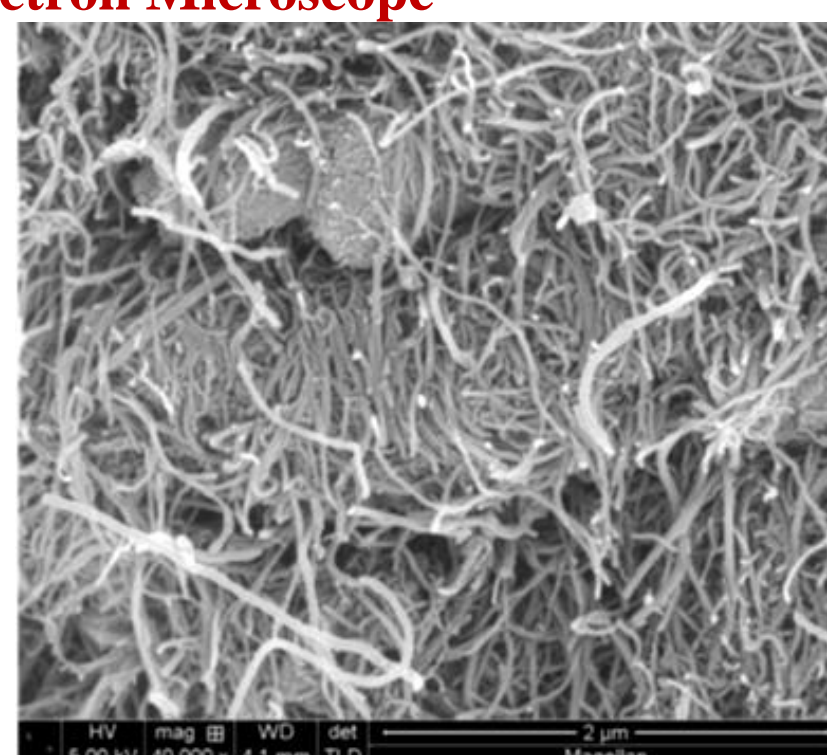
## Results and Discussion

### Characterization of CNT/TiO<sub>2</sub>

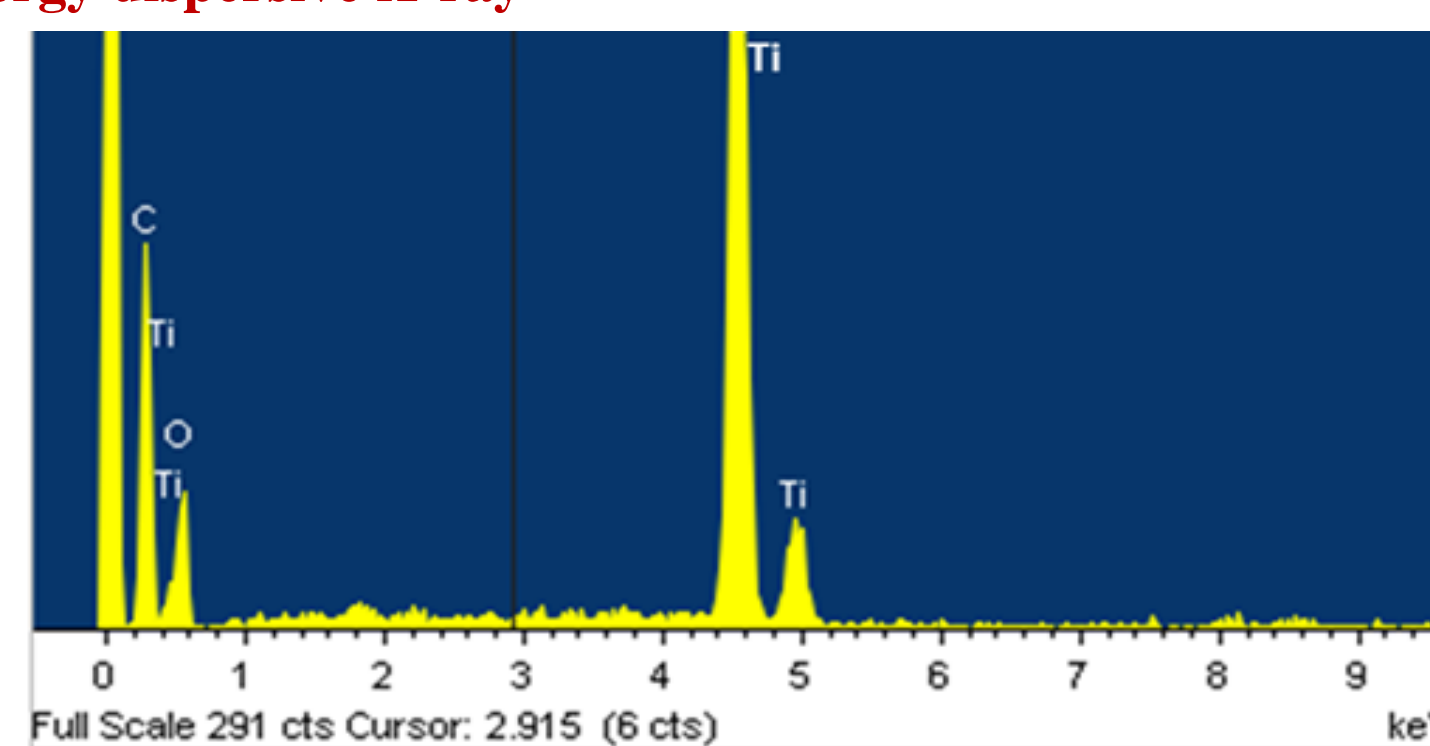
#### X-ray Diffraction



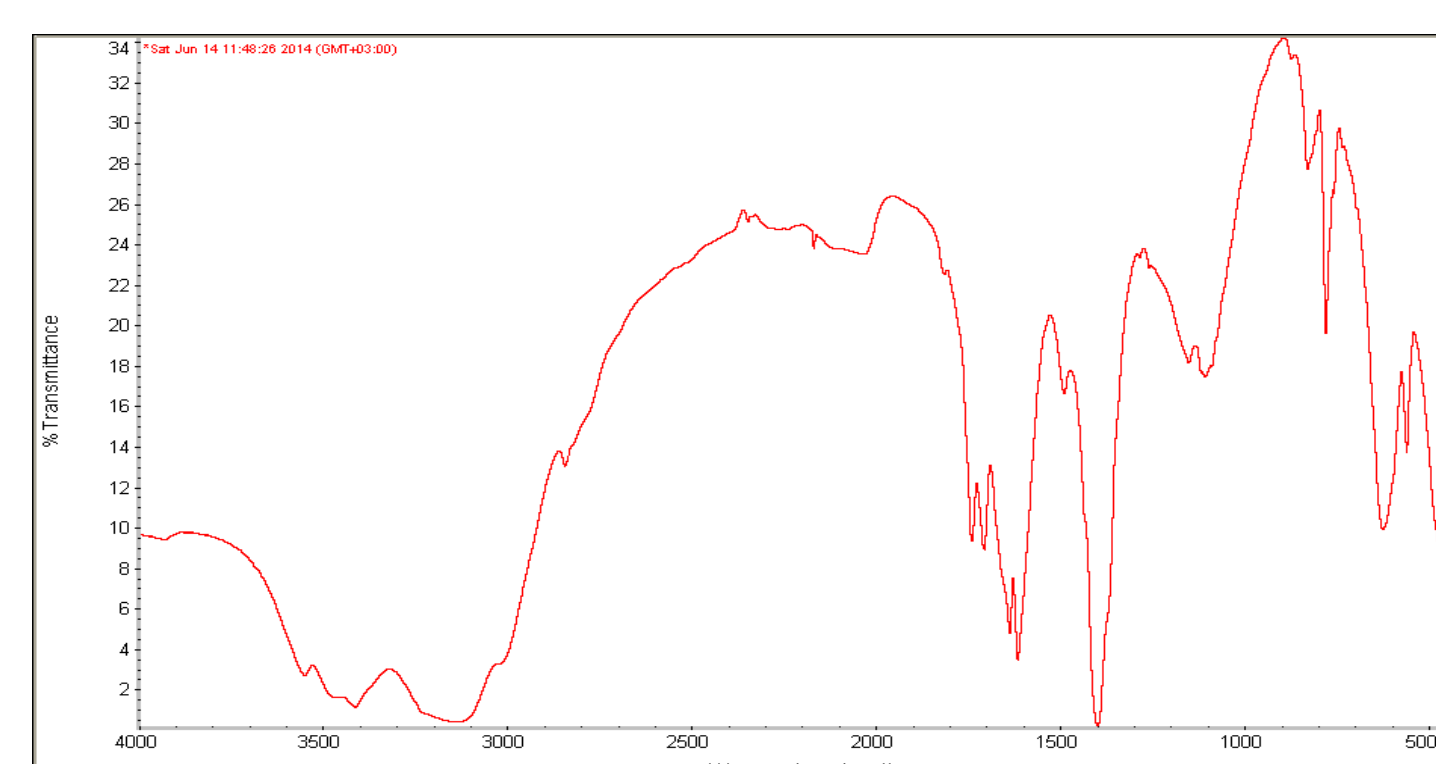
#### Scanning Electron Microscope



#### Energy dispersive X-ray



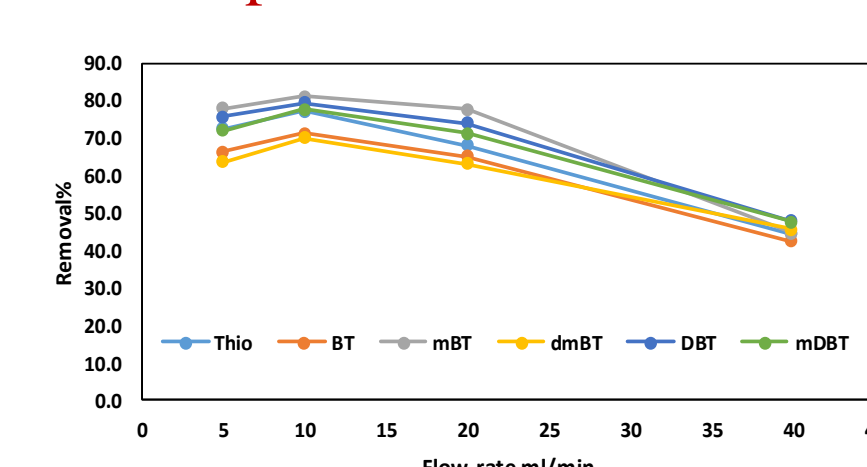
#### Fourier Transform Infra-Red



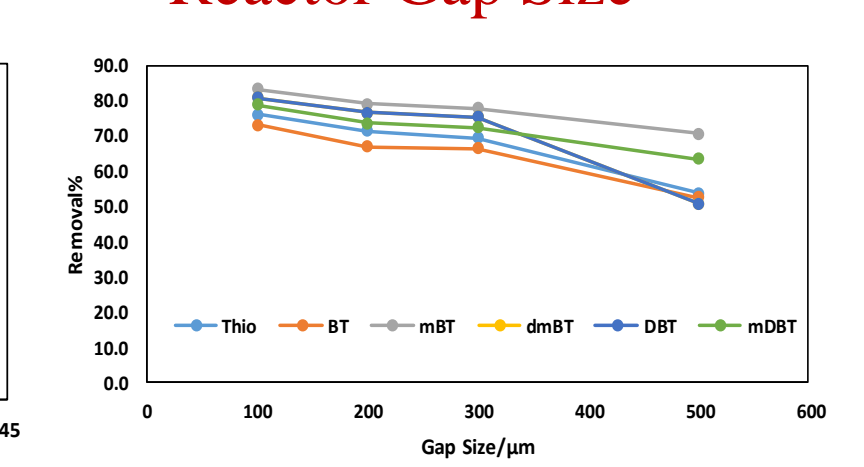
## Results and Discussion

### Removal Parameters Optimization

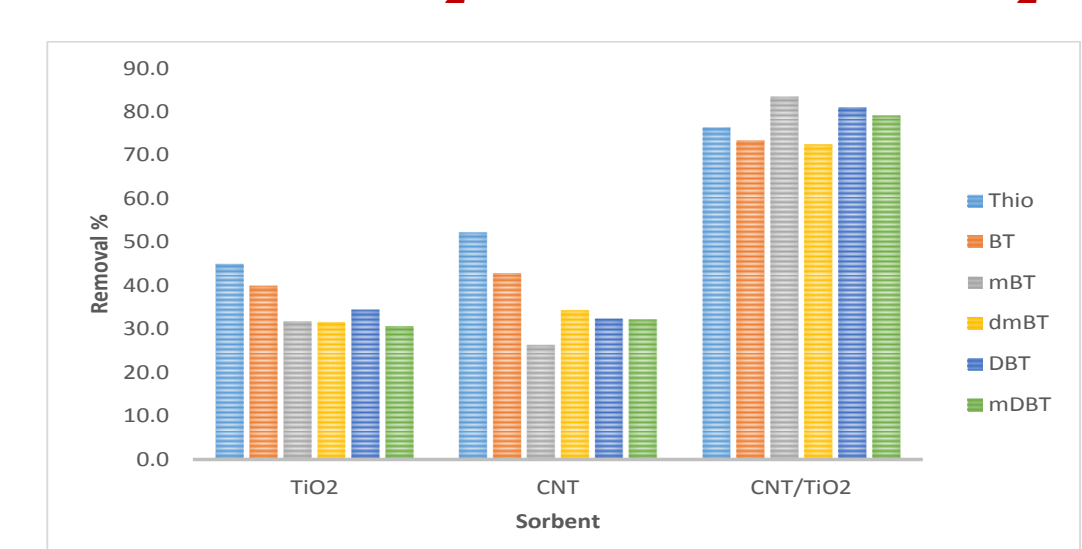
#### Pump Flow rate



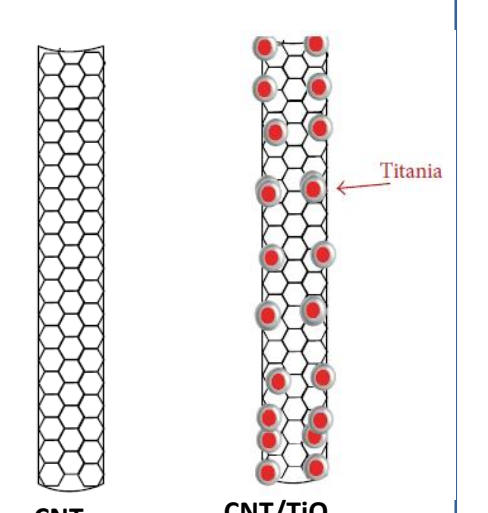
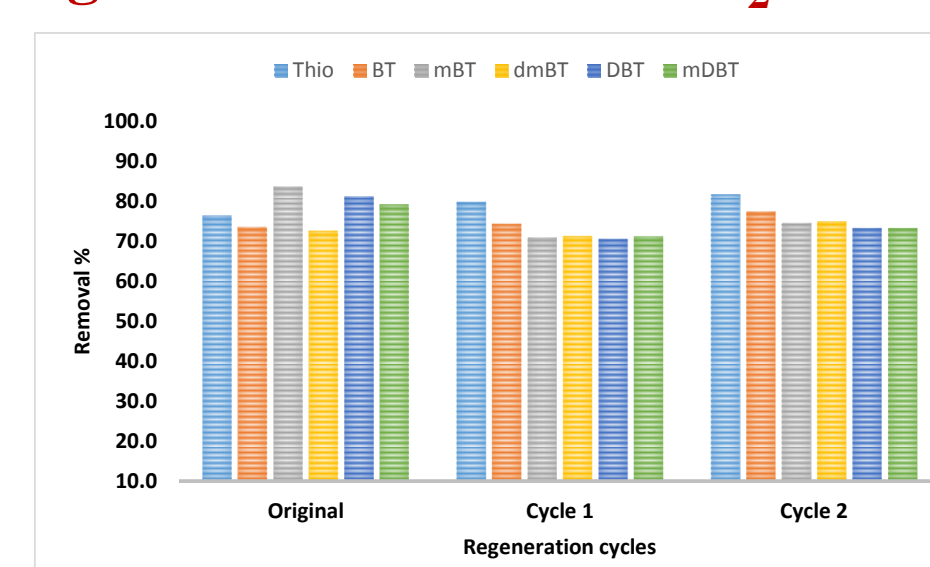
#### Reactor Gap Size



### Comparison between TiO<sub>2</sub>, CNT & CNT/ TiO<sub>2</sub> composite



### Regeneration of CNT/ TiO<sub>2</sub>



## Conclusions

- For the first time film shear reactor using titania nanocomposite suspension was used for the removal of sulfur contaminants in diesel samples.
- The proposed method is simple, fast, inexpensive and efficient, the parameters of the removal were optimized and the removal efficiency was around 80%.

## Contact

<Munzir H. Mohamed Suliman>  
<KFUPM>  
Email: g201304270@kfupm.edu.sa  
Website: www.kfupm.edu.sa  
Phone: 0544386245

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## Acknowledgement

The authors would like to acknowledge the support provided by King Abdulaziz City for Science and Technology (KACST) through the Science & Technology Unit at King Fahd University of Petroleum & Minerals (KFUPM) for funding this work through project No. 12-PET3009-04 as part of the National Science, Technology and Innovation Plan (NSTIP).