Abstract

Desulfurization diesel oil has been carried out in present research paper by selective adsorption using coconut shell activated carbon having high adsorptive capacity. Coconut shell is easily available and cheap raw material. Batch operation was carried out at room temperature for adsorption. Coconut shell carbon was activated by H₂SO₄ with thermally activated. Batch adsorption experiments were carried for sulphur removal using varied contact time, adsorbent dose, sulphur concentration and adsorbent size.

I. INTRODUCTION

Mohammed K et.al were carried out adsorption experiments for the removal of sulfur compounds from Tawke diesel fuel by using granular Na-Y type zeolite, MOR type zeolite, molecular sieve 3A type, local clay and activated charcoal. They were investigated that the desulfurization by activated charcoal was more efficient than by the clay, zeolite type and almost reach more than 20% [1]. Dr. Neran K. Ibrahim and Samar K. Aljanabi were studied desulphurization and kinetic studies of diesel fuel by batch adsorption on activated carbon. They were found that the residual sulfur concentration in diesel fuel was decreased from 580 to 247 ppm. Investigators were investigated that highest desulfurization efficiency obtained was 57% at the best operating conditions of 2.5h, 50°C, 2ml/gm D/AC, 0.8mm AC particle size, and 1000 rpm [2]. G. Daware et.al desulphurization of diesel by using low cost
Adsorption experiments for removal of sulphur from diesel using neem leaves. They observed that the desulphurization of diesel oil by adsorption process using neem leaves sulphur get reduced by more than half of the original amount of sulphur. Investigators were use contact time of 3.5hrs and dose of neem leaves powder of 2gm in 10ml of diesel obtained. They showed that maximum removal of sulphur is 65% [3]. A. Khodadadi et.al Adsorptive desulfurization of diesel fuel with nano copper oxide. Authors were carried out adsorption experiments for desulphurization by using nano copper oxide as an adsorbent. Investigators were carried out experiments at at 35°C temperature to test the effect of temperature and agitating rate and CuO nano particle concentration [4].

II. MATERIAL AND METHOD

1. Material
The diesel fuel was used which from local petrol station. The initial sulfur content was determined using UV 159 Spectrophotometer and was found to be 334.5 ppm. Desulphurization of diesel fuel was carried out using coconut shell activated carbon. Coconut shell were collected and washed with fresh water and allowed to tray drying. Then dried coconut shell was burned at room temperature. Then grinded and sieved (particle size3.35 mm to 0.35 mm).

2. Activation of adsorbent
Activation of the coconut shell activated carbon was conducted to increase the surface area of adsorbent for better adsorption. Activation of activated carbon was done by using activating agent H₂SO₄ with thermally activated. For activated charcoal respective amount of coconut shell carbon was soaked in 5 N H₂SO₄ for 12-18 hours to become activated carbon. Then carbon was washed with distilled water and spread on tray at room temperature to be drained after draining dried in oven at temperature 110 °C for 3 hours and packed respective amount of activated carbon in airtight plastic for further processing. For thermal activation coconut shell carbon was kept in oven at 800 °C for 3 hours. After cooling activated carbon was packed in airtight container.

3. Batch adsorption using activated carbon (activated by H₂SO₄)
50 ml of the diesel sample was taken in the Erlenmeyer flask and 10 gm of adsorbent having particle size3.35 mm to 0.35 mm was added to it. And stirred with the help of a magnetic stirrer for about four hour at room temperature. After each time interval of 10 min the mixture was given a rest of 2 min and then filtered through Watt man
No. 42 filter paper. The filtrate was reserved for sulfur analysis and the charged adsorbent was kept for further examination.

4. Analysis of Sulphur
Sulphur analysis was carried using standard test method. The total sulphur concentrations in the standard samples and desulphurised diesel was carried out using UV-visible 159 spectrophotometer. Sulphur calibration curve made with the help of known sulphur solutions in 0-500 ppm sulphur range. The relevant equation for calculating sulphur content is shown as:

\[ \text{Desulphurization Rate} = \left( \frac{S_F - S_P}{S_F} \right) \times 100 \]

\( S_F \): Sulphur content in feed
\( S_P \): Sulphur content in the product

II. RESULT AND DISCUSSION

1. Effect of Size of adsorbent particle:
Experiment was performed for study the effect of adsorbent particle size. Adsorbent was screened and was separated according to particle size 3.35 mm to 0.35 mm. The desulfurization efficiency was increased as the sorbent particle size was increased from mesh no 6 to 52. 50 ml diesel sample was treated with 10 gm of adsorbent of each size (mesh no 6, 12, 18, 30, 52) was stirred continuously for 4 hour. Graph was plotted percentage sulphur removal vs size of adsorbent particle. It was found that sulphur removal efficiency for particle size (mesh no 12) maximum. Sulphur in original sample reduced upto 120.75 ppm.

![Figure 1: Effect of adsorption size on desulphurization of diesel.](image)

2. Effect of Adsorbent dose
The effect of adsorbent dose was studied at room temperature by varying the sorbent amounts from 2-10 gms. With an initial concentration 50 ml of diesel sample was treated with adsorbent dose of 2 gms for 4 hours with constant stirring by magnetic stirrer. Similarly the sample was treated with adsorbent dose 4 gms, 6 gms, 8 gms and 10 gms. As sorbent dose increases there was increase in surface area which increases
desulfurization efficiency for constant volume of diesel fuel. It was found that desulphurization efficiency was increases from 23.61% to 63.90 %. Percentage sulphur removal from the diesel oil was plotted against different adsorbent concentration.

![Graph showing desulfurization efficiency against adsorbent concentration](image)

**Figure 2: Effect of adsorption concentration On desulphurization of diesel.**

### 3. Effect of contact time:

The effect of contact tie was studied. The 50 ml diesel sample was treated with 10 gm adsorbent. The sample were stirred for 1 hr. Same procedure were followed for time interval 2,3,4 hours. Plotted graph time vs percentage sulphur removal. It was found that sulphur removal was increases as time increases. The highest sulphur removal efficiency was found at 4 hour. It was observed that sulphur removal at 4 hour was 63.90 %.

![Graph showing effect of contact time on desulfurization](image)

**Figure 3: Effect contact time on desulphurization of diesel.**
4. Effect of Initial Sulphur Concentration:
An experiment was carried out to study effect of initial concentration on the sulphur removal. Experiments were carried out by using different different sulphur concentration It was found that desulfurization efficiency decreases when the initial sulfur concentration in the diesel fuel increased for constant sorbent dose and constant diesel concentration for 4 hour. Percentage sulphur removal from the diesel oil will be plotted against initial concentration. It was found that desulphurization efficiency was decreases from 41 % to 4.6 % with increase in sulphur concentration.

III. CONCLUSION
Thus activated carbon prepared from low cost coconut shell and activated by different activating agents. Activated carbon activated by sulphuric acid is found to be best among remaining which gives good surface area and high adsorption capacity. Experiments were carried out using different adsorbent size, contact time, sulphur concentration and conc of adsorbent.Sulphur removal efficiency was studied for every experiment .It was concluded that Mesh no 12 size particles gives good sulphur removal efficiency at 4 hr by using adsorbent dose of 10 gm. Desulphurization of diesel by adsorption using sulphuric acid activated carbon gives reduction in sulphur more than 50% of that original sulphur content.

IV. REFERENCES


AUTHOR’S BIOGRAPHY

Mrs. Pratibha R. Gawande has completed her Masters in Chemical Engineering and Membrane separation and technology. She is working as Assistant Professor in Chemical Engineering Department of Datta Meghe College Of Engineering, Navi Mumbai having 12 years teaching experience. Her area of interest includes membrane separation and technology and Adsorption.

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