Removal of Objectionable Material from Kerosene Range Hydrocarbon

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ABSTRACT

Kerosene is commonly used as solvent in industry as well as fuel for domestic purposes. It mainly consists of paraffinic, naphthenic and aromatic hydrocarbons of the range C\textsubscript{11} to C\textsubscript{14}. Some impurities like sulphur and its derivative are also associated with kerosene. Aromatic hydrocarbon particularly benzene is highly carcinogenic in nature. Similarly sulphur also creates problem of pollution, corrosion and deactivation of catalyst. Traditional method adopted in refinery for removal of aromatics and sulphur is very costly. A work is carried out to reduce concentration of aromatic hydrocarbon as well as sulphur from kerosene range hydrocarbon by using simple technique. The work shows that simple adsorption technique by using different adsorbent can able to reduce the concentration of above species to minimum level. The adopted technique is highly eco-friendly, economical and efficient.

Keywords:
Kerosene, sulphur in kerosene, desulphurization of kerosene, aromatic hydrocarbons, aniline point enhancement, smoke point enhancement.

INTRODUCTION

Petroleum is also called rock oil. It is a complex mixture of hydrocarbons of various molecular weights, and other organic compounds. Crude oil is process in refinery to obtain various fractions. The most common liquid hydrocarbon fractions are gasoline, kerosene, diesel and lube oils.\textsuperscript{1–3}

Kerosene is distillate fraction of crude oil in the boiling range 150 – 250\textdegree C. Various types of hydrocarbons present in kerosene are paraffins (alkanes), naphthenes (cycloalkanes) aromatics and non-hydrocarbon compounds containing sulphur, nitrogen, oxygen and metals. Carbon number of hydrocarbon associated with kerosene varies from C\textsubscript{11} to C\textsubscript{14}. Kerosene is widely used as a fuel to power jet engines, cooking and lighting as well as solvent. It is also used to manufacture insecticides, herbicides and fungicides.\textsuperscript{3–6}

In case of kerosene fraction, the sulphur compounds mostly prevailing include mercaptans, sulphides, disulphides and thiophenes. The sulphur containing compounds in petroleum and its fractions are undesirable in refining process as they affect the quality of the final product, causes catalyst poisoning and deactivation in catalytic converters. It leads to corrosion problem in oil pipelines, pumps, refining equipment etc. and also causes high processing cost as well as environmental pollution from their combustion. Higher sulphur present in fuel leads to increased emission of sulphur dioxides, responsible for acid-rain.\textsuperscript{7,8}

There are various methods for sulphur removal. The most recent method adopted in refinery is the hydrodesulphurization. Hydrodesulphurization (HDS) is a catalytic chemical process widely used to remove sulphur from refined petroleum products such as gasoline or petrol, jet fuel, kerosene, diesel fuel and fuel oil. The HDS takes place in a fixed bed reactor at elevated temperatures ranging from 300 – 400\textdegree C and at elevated pressure ranging from 30 to 130 atmospheres. Ruthenium disulphide (RuS\textsubscript{2}) appears to be the single most active catalyst, but binary combinations of Cobalt and Molybdenum on support are also highly active. A liquid hydrocarbon fraction of kerosene range which used as a solvent having a problem of odour. The literature survey indicates that the odour is due to the presence of sulphur and its derivatives.\textsuperscript{7–12}
AIMS AND OBJECTIVES
A research work is proposed to deodorized the hydrocarbon solvent i.e. kerosene by using simple adsorptive technique.

MATERIALS AND METHODS
To deodorized, i.e. to remove sulphur from the kerosene range hydrocarbon solvent, following experimental techniques are used:
1. Evaluation (characterization) of hydrocarbon solvent,
2. Dehydration of hydrocarbon solvent,
3. Characterization of dehydrates hydrocarbon solvent,
4. Adsorptive treatment to dehydrated hydrocarbon sample by using Granular Activated Carbon (GAC) and Charcoal,
5. Characterization of treated sample.

The GAC is first activated by washing and boiling several times with distilled water followed by drying whereas charcoal is dried in an oven. The 200 ml dehydrated sample is then agitated with 5 wt% of adsorbent at 40°C for one hour then allowed to settle for 24 hours in a processing vessel. After filtration of settling sample it is subjected to characterization as per IP/ASTM norm.13–20

RESULT AND DISCUSSION

<table>
<thead>
<tr>
<th>S.N.</th>
<th>Test</th>
<th>Feed (20°C)</th>
<th>GAC (20°C)</th>
<th>Charcoal (20°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Specific gravity</td>
<td>0.8030</td>
<td>0.8025</td>
<td>0.8022</td>
</tr>
<tr>
<td>2</td>
<td>Viscosity cSt.</td>
<td>1.58</td>
<td>1.45</td>
<td>1.38</td>
</tr>
<tr>
<td>3</td>
<td>Smoke Point, mm max.</td>
<td>26</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>4</td>
<td>Refractive Index (20°C)</td>
<td>1.4409</td>
<td>1.4403</td>
<td>1.4400</td>
</tr>
<tr>
<td>5</td>
<td>Aniline Point, °C</td>
<td>68</td>
<td>72</td>
<td>72</td>
</tr>
<tr>
<td>6</td>
<td>Colour</td>
<td>Light yellow (10 unit)</td>
<td>Light yellow (10 unit)</td>
<td>Light yellow (10 unit)</td>
</tr>
<tr>
<td>7</td>
<td>Odour</td>
<td>Observable (10 unit)</td>
<td>Non-observable (7.14 unit)</td>
<td>Non-observable (6.71 unit)</td>
</tr>
<tr>
<td>8</td>
<td>*Sulphur, ppm</td>
<td>143</td>
<td>121</td>
<td>112</td>
</tr>
</tbody>
</table>

*Source: Ancon Labs., Nagpur

The heavier hydrocarbons have high viscosity and high specific gravity. Decrease in specific gravity and viscosity values of treated sample indicates that heavier hydrocarbon is able to remove by the adsorption technique. Similar is the case with refractive index values, it also get reduces. Low values of smoke point and aniline point indicates that the presence of more amount of aromatic hydrocarbon. The increase in value of smoke point and aniline point indicates the removal of aromatic hydrocarbons.4–6,21

Verification of colour and odour is carried out by using simple physical test assuming feed values for colour and odour is 10 units. These physical verifications test indicates the removal of odour. The sulphur content is reduces by both adsorbent used in this treatment.

CONCLUSION
The result shows that the physical adsorptive treatment able to reduce the odour i.e. sulphur content of the kerosene range hydrocarbon solvent. Again among GAC and charcoal, charcoal has shown more impact on removal of odour.
ACKNOWLEDGEMENT

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REFERENCES
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