Processing of High Tan Crude Oil in Khartoum Refinery: A Unique Experience

By

Mohamed Osman Khalil,
Studies Section Head, Ministry of Petroleum and Gas, Sudan

The views expressed are those of the author and do not necessarily reflect the views of UNCTAD.
Republic of Sudan
Ministry of Petroleum & Gas
DOWN STREAM GENERAL DIRECTORATE (DGD)

Processing of High Tan Crude Oil in Khartoum Refinery: A Unique Experience

Presented by:
Eng. MOHAMED OSMAN KHALIL
Outlines

➢ Introduction – Refineries in Sudan

➢ Khartoum Refinery

➢ Refining acidic crude

➢ Potential challenges caused by Total acid Number

➢ Challenge crude processing Issues- High TAN

➢ Delayed Coking Unit DCU

➢ KRC challenge of processing Fula Crude

➢ Conclusion
Introduction – Refineries in Sudan

➢ Port Sudan Refinery
Established: 1964
Capacity: 25,000 bbl/day
Crude: Middle East.

➢ Abu Gabra Refinery
Established: 1992
Capacity: 2,000 bbl/day
Crude: Abu Gabra.

➢ Elobeid Refinery
Established: 1996
Capacity: 15,000 bbl/day
Crude: Nile Blend.
Khartoum Refinery

**Phase 1**
Established: 2000
Capacity: 50,000 bbl/day
Crude: Nile Blend.

**Phase 2**
Expansion Project: Jan 2006
Expansion Capacity: 40,000 bbl/day
Crude: Heavy Fula.
Khartoum Refinery Overview

- Khartoum Refinery Company is a joint venture between the Sudan Ministry of Petroleum & Gas [MoPG] and Chinese National Petroleum Company [CNPC], China.
- Number of employees in KRC is 1045 Sudanese and 190 Chinese.
The Main Production Units

- CDU
- RFCC
- DHT
- DCU
- GDHT
- CCR
- Utility
# KRC Main Products

- **LPG**
- **Gasoline**
- **Diesel**
- **Jet-A1**
- **Heavy Coker diesel**
- **Petroleum Coke**

<table>
<thead>
<tr>
<th>Production</th>
<th>Amounts (kt/a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPG</td>
<td>315</td>
</tr>
<tr>
<td>Gasoline*</td>
<td>1,159</td>
</tr>
<tr>
<td>Diesel*</td>
<td>1,837</td>
</tr>
<tr>
<td>Jet-A1</td>
<td>123</td>
</tr>
<tr>
<td>Heavy Coker diesel</td>
<td>364</td>
</tr>
<tr>
<td>Petroleum Coke</td>
<td>306</td>
</tr>
</tbody>
</table>

*Gasoline: RON 92; S: 50ppm

*Diesel: Euro IV
What IS TAN? Total Acid Number (TAN) is a measurement of acidity that is determined by the amount of potassium hydroxide in milligrams that is needed to neutralize the acids in one gram of oil.

• The TAN value indicates to the crude oil refinery the potential of corrosion challenges.

- Refining acidic crude oils is of increasing interest due to their increased production and usually discounted value.
- Acidic crudes are produced in every oil producing region. China will dominate production. Other locations historically noted for high TAN crudes include Venezuela, India, Russia and some fields in California. Newer regions include the North Sea, West Africa, Mexico and offshore Brazil.
Potential challenges caused by High TAN crude oil

- Crude Storage Tanks
- Minimal water removal in crude oil tanks
- Oily tank drain water
- Crude unit
  - Desalter operations (Frequent upsets, Poor dehydration/salt removal, Scaling on desalter internals).
  - Atmospheric column overhead systems, Increased neutralizer consumption.
- Naphthenic acid corrosion attack.
Challenge crude processing Issues- High TAN

- Increased potential for naphthenic acid corrosion crude oil distillation units.
- High equipment costs lower unit reliability and availability.
- Increased severity of downstream unit fouling.
- Impact on quality of crude unit distillates.
- Uniqueness in process conditions, materials of construction and the frequent variation in crude.
- Despite the economic incentive, many refiners may avoid high TAN crudes because of these risks.
Processing Heavy Fula Crude (High TAN) in KRC
Main characteristics of Fula crude

- High TAN                    7.8 mgkOH/g
- Ca content                  1300 ppm
- High viscosity
  @ 100 °C 40 mm²/s
- Low sulfur                      0.135 ppm
Main characteristics of Fula crude

- KRC process 40,000 bbl/day of High TAN, high Ca Fula crude oil.

- API° 21
- TAN 7.8 mgkOH/g
- Density @15 °C 0.9353 kg/l
- Ca content 1300 ppm
- Pour Point °C 12
- Flash Point °C 48
- viscosity @100 °C 40 mm²/s
- sulfur 0.135 ppm
KRC Preventive Measures

Design Measures

1- Crude fed directly to DCU to minimize negative impacts.

2- Adopted four stages desalting to improve desalter efficiency.

3- Use corrosion resistant materials for DCU equipment.

4- Furnace designed to facilitate on-line decoking.

Operational Measure

1- Special emulsion breaker was selected and applied.

2- Application of proper type of anti coke agent injection.

3- Increase guard catalyst layer in GDHT reactor.

4- Good corrosion management system.
## Material of construction

<table>
<thead>
<tr>
<th>No</th>
<th>Equipment</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Coker drums</td>
<td>15Cr MOR+OCR 13 (Top) 15Cr MOR (Bottom)</td>
</tr>
<tr>
<td>2</td>
<td>Fractionator (cladding)</td>
<td>316L</td>
</tr>
<tr>
<td>3</td>
<td>Heat exch. bundles</td>
<td>316L</td>
</tr>
<tr>
<td>4</td>
<td>Corresponding valves</td>
<td>316L</td>
</tr>
<tr>
<td>5</td>
<td>Furnace tube</td>
<td>316L</td>
</tr>
</tbody>
</table>
1- The best technique for processing High TAN, high calcium crude without blending or metal removing; through delayed Coking unit (DCU).
2- Good corrosion management done by selecting high corrosion resistance material metallurgy. In addition to high quality corrosion inhibitors and corrosion monitoring program.
Conclusion

• KRC successfully processed High TAN Fula crude without blending.

• DCU added value to Fula crude
  ➢ No fouling.
  ➢ Insignificant corrosion.
  ➢ Minimal impacts on downstream units.
Thank You!