PROCESSING & REFINING OF AVIATION FUEL

This module will introduce you to processing and manufacturing of jet fuel. Definitions and methods, specification and some understanding on their effect on product quality

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KEROSENE IS A VERY GOOD JET FUEL

- Good combustion characteristics – clean burning

- Easy to handle liquid fuel with excellent energy density

- Good cold flow performance – easy to handle at low temperatures
CRUDE OIL VARIES WIDELY

- Crude oils vary in colour, from clear to tar-black
- Crude oils vary in viscosity, from water to almost solid
- Crude comprises paraffins, aromatics, naphthenes across a wide range of molecular weights
- Crude quality varies greatly, (e.g. density and S) and yields of different products vary widely
- Levels of sulphur, mercaptans and acids are key to determine which refinery processes are needed to produce kerosene to meet the jet fuel specification
- Almost all jet fuel is derived from crude oil…
Crude oil is “sweet”

“Sweet” is a description of how much Sulphur is in the oil. In the 19th century, oil workers would taste and smell small amount of oil to determine its quality. Crude oil with low Sulphur content had a mildly sweet taste and pleasant smell. Today, oil workers can measure the Sulphur content of an oil sample and it is classified as sweet if it contains less than 0.5% Sulphur.
Ethanethiol, commonly known as ethyl mercaptan (CH3CH2) occurs naturally as a minor component of petroleum, and may be added to otherwise odorless gaseous products such as liquefied petroleum gas (LPG) to help warn of gas leaks.

Butyl mercaptan
SINCE SEPT 2009 CRUDE OIL IS NOT THE ONLY SOURCE FOR JET FUEL

Kerosene made via the Fischer-Tropsch process now permitted

- Work started by SASOL – semi-synthetic jet fuel approved in 1999 as a special case

- More recently interest in new alternative and bio fuels has lead to a generic approval for kerosene made via the FT process (ASTM D 7566, September 2009)

- Feedstocks can be natural gas, coal or biomass and all are approved.
Fractions decreasing in density and boiling point

160 - 300 °C

CDU (Atm Dist)

Caustic wash NaOH

- Provides alkalinity
  i.e. Reducing acidity (TAN)
  Water wash & salt drier

Clay Treatment

- Note! This unit is water sensitive

Off site / tank farm ready for shipping

Jet Fuel

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Heating the crude oil with superheated steam to temperatures greater than 600º C
Jet Fuel – Hydrotreating and effects:

- Eliminates sulphur, contents depend on the severity (pressure, temp and catalyst) of hydroprocessing and range from as low as 10ppm up to 600ppm, other ‘impurities’ and other chemical properties like olefins, nitrogen.

- Good thermal stability,

- Water shedding properties and Fuel cleanliness

- Good response to SDA i.e. no trace impurities

- Poor lubricity or deteriorates

- But Expensive!!

Catalyst (e.g. Ni$_2$Mo$_3$S – Nickel Molybdenum material)
Jet Fuel - Hydrocracking

- Hydro cracking is another major conversion process
- Use heat and pressure to ’crack’ heavy molecules into lighter ones
- The reactions take place under a high pressure of hydrogen
- Yet not very common which produces kerosene from larger hydrocarbon molecules. It is similar to hydro treating but uses higher temperatures and pressures. Sulphur levels are typically very low 10-60ppm
- The feed to the hydro cracking process is usually a heavy VGO (Vacuum Gas oil)
- The large molecules in the VGO are broken down into smaller molecules by breaking carbon-carbon bonds and adding hydrogen atoms to the fragments
Jet Fuel Specifications
Def Stan, Check List, ASTM