Changes in RFCC optimization with IMO Global Cap’s sweet-sour disruption

BASF FCC Conference | 18-20 September 2019

Are you getting the most out of your FCC? Let’s REdeFINE the possibilities.

Gonçalo Caeiro
1. 2020 IMO Global Cap 0.5%S
2. FCC Feedstock
3. FCC Product Quality
4. Unit Optimization
2020 IMO Global Cap 0.5%S
IMO Global Cap 0.50%S in the High Seas
And future ECAs (0.10%S) are being planned

To comply with IMO regulation in 2020 shipping industry will have to run heavily on compliant fuels (< 0.50%S). Scrubber uptake in existing ships has been slow since this is not cost-effective solution for small and old ships.

Nonetheless, 30% of the ships (larger ones which are installing scrubbers) represent 70% of the fuel consumption.
The Impact of IMO

Global Bunker Fuel Consumption (Mton/year)

Marine fuels demand to increase in all scenarios until 2040. Scrubbers, LNG and MGO are alternative competitors to Fuel Oil 0.5%. In 2040, HSFO consumption in Bunkers is expected to be half of what it is today (source: Platts).
IMO: Crude Oil and Product Prices will be Impacted

SR VLSFO production is not possible with most crude oils

Source: BP Statistical Review Of World Energy - 2018
To stay competitive, refineries without full barrel conversion will must...

... produce VLSFO with vacuum residues maintaining VGO conversion units competitiveness!

- CE Delft study assumed almost 75 vol% distillates in the VLSFO European blend and did not use vacuum residues, the main component currently used in HSFO blending;
- Around half of the European refineries do not have Bottom of the Barrel conversion units, but do have VGO conversion units (FCC and/or HCK). Thus, to be competitive and maintain the VGO conversion units on stream, vacuum residues will need to be used in the VLSFO blending;
- But changing refinery crude-mix to sweeter crudes will be enough?
2. FCC Feedstock
Vacuum Gas Oil (VGO) medium term supply could be threatened

- A significant reduction of Russian & CIS VGO supply is foreseen. Russia & CIS: New HC facilities to be operational in 2020+?
- With IMO there will be incentive to blend LS VGO in VLSFO.
- Hydrotreated VGO that is now going to the FCC can also find a more profitable outlet in VLSFO.
- This can have an impact on VGO cracks and FCC throughputs.
ATR processing is most interesting when Fuel Oil is discounted
VLSFO high value can reduce the profitability to process sweet ATR

- The advantage of processing ATR in the FCC unit is to achieve full conversion, i.e. no fuel production.
- The incentive to treat ATR increase as the value of heavy fuel oil decreases.
- With IMO, LS Heavy Fuel Oil will be very valuable with can pose a threat to existing RFCC units.
- The alternative would be to treat higher sulfur ATRs since HSFO will have a lower demand and price in 2020+.
The best ATR to feed FCC are typically low sulfur

Specific Gravity and CCR increases with sulfur

- Two of the two variables that most impact FCC yields are specific gravity and CCR.
- LS ATR are typically lower in specific gravity and CCR which means that they are better feedstocks.
- With IMO 2020 the LS ATR that is currently being processed in RFCCs will be also be used to produce VLSFO, which means that LS ATR will be less available and more expensive, this could affect the RFCC profitability.
- On the other hand HS ATR will typically lead to poorer yields and lower quality products.
3. FCC Product Quality
FCC Sulfur Balance

About 60% of the feedstock sulfur is removed.

- Gasoline: 5%
- LCO: ≈15%
- Slurry: ≈20%
- Coke: ≈10%
- FG (H₂S): ≈50%

Approximately:
- 9% SO₂
- 1% SO₃

Sulfur (%m) distribution:

- <250
- 250-350
- 350-450
- 450-550
- >550

Types:
- Brent Blend
- Urals
- Cabinda
- Arab Heavy
LCO and Slurry are the biggest concerns...

...since these two cuts concentrate the sulfur

- LCO was a sulfur content which is between 1.5 and 2x the sulfur content of the feedstock. In order to have 0.5%S in Slurry the feedstock must have <0.3%S.
- Slurry was a sulfur content which is between 2 and 2.5x the sulfur content of the feedstock. In order to have 0.5%S in Slurry the feedstock must have <0.2%S.
- Hydrotreating the feedstock can help to reduce the sulfur content in these two products
- Catalyst and additives that promote sulfur removal can also be helpful.
4. Unit Optimization
New drivers to FCC optimization

The sulfur balance will be key in unit optimization

- With the increase in price of LS/hydrotreated VGO and sweet ATR there will be an incentive to treat heavier and more sour feedstock. However this will lead to LCO/Slurry with a high sulfur content which is incompatible with VLSFO production.

- Other outlets have to be found to these high-sulfur products (Coker feed, LCO hydrotreating, etc.) or refiners must reduce their production (Slurry recycling to the riser, increase activity in e-cat, etc.)

- Other alternative is to feed the FCC with very low sulfur feedstocks to enable LCO/Slurry incorporation in VLSFO.