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## **Question 65: What are the impacts on coker operation (yields, capacity, energy, coke quality) of FCC slurry oil in the feed?**

**Gary Gianzon** (Marathon Petroleum Company)

When one of MPC's refineries starts processing heavy Canadian resid, they add 5 to 10 volume percent of slurry oil in the feed to mitigate making shot coke. The slurry also helps meet anode grade specifications on metals and sulfur. Processing slurry backs out resid processing which can impact unit economics.

FCCU slurry has a similar boiling range to heavy coker gasoil, so a large amount of slurry flashes out of the drum and ends up in the heavy coker gasoil product. The coke yield from slurry feed is around 2 to 3 x Concarbon (depending on coker unit operation) which is significantly higher than vacuum resid at 1.3 to 1.6 x Concarbon. If a high percentage (over 10 percent) of slurry is processed in the coker unit, the slurry can cycle up between the coker and FCCU unit. The amount of recycle built-up is somewhat self-correcting depending on operations in the coker and FCC and whether the HCGO is processed in a FCCU Feed Hydrotreater.

**Rajkumar Ghosh** (Indian Oil Corporation)

We are adding approx. 3–4 wt% FCC Slurry oil in Coker feed in one of our Coker and about 10 wt% in another. We also had undertaken a study in the Delayed Coker pilot plant in our R&D centre. Our experiences with processing of FCC slurry oil in the Coker feed, based on field and pilot plant results, are as under:

a) Yield: The impact of slurry oil in Coker feed depends upon the quality of the base feedstock, CLO/slurry oil and also the pressure / temperature of the coke drums. If FCC slurry oil boiling point distribution and the coke drum pressure / temperature are such that most of the slurry oil vaporizes out of the coke drum, yield of coke and gas reduces with increase in distillate yield.

In case of Fuel grade Coker, with CLO (with minimum overlap of LCO) below 10wt% in VR feed, coke yield by and large may be constant or may increase marginally depending on the relative quality of VR and CLO. Yields of total gas and liquid decrease marginally. Beyond 10 wt% (10-20 wt%) of CLO in VR feed, the coke yield may increase up to 4 wt%.

b) Capacity: The Coke produced with significant FCC slurry in Coker feed (>10 wt%) has a close-knit Coke matrix which ensures good porous structure to the Coke bed. This reduces the chances of hot spots and blowouts. But the negative impact of adding FCC slurry is pronounced where the coke drum is already limiting, as the porous structure results in lower coke bed bulk density and hence lesser vapor space in the Coke Drum. It may limit the Coker capacity.

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c) Product quality: Tendency of formation of Shot coke significantly reduces with the addition of FCC slurry in the Coker feed, as it keeps asphaltenes in solution form. As per our experience at Panipat Coker, impact of slurry addition in the Coker feed is clearly visible on the Coke quality w.r.t. reduction in Shot coke formation. With increased FCC slurry in Coker feed, increase in Silica content in the green Coke would be a criterion to limit its wt% in the feed. This is significant for the Cokers producing Anode grade coke. Typical limit of Silica in Anode grade green Coke is 0.02 wt % max. Depending on the quality of the slurry oil and unit operating conditions, there may be a negative impact on the quality of the LCGO and HCGO. They will become more aromatics and heavier.

d) Energy: Slurry processing will require higher heater duty. High aromatic content in the slurry oil prevents the precipitation of Asphaltenes and thus increases the heater run length. Injection of slurry oil into the coke feed is limited by refinery configuration. In our Refineries with FCC and/or Hydrocracking units, we limit the slurry oil within 5 to 10 wt% on fresh feed to Coker. Increase in injection rate can lead to a massive recycle between the Coker and the FCC or will result in accelerated catalyst deactivation in the Hydrocracker unit.

### **Eberhard Lucke** (Commonwealth E&C)

In general, FCC Slurry has a similar effect as VGO in terms that it replaces residue in the feed and increases mainly the HCGO yield. The difference in this case is that FCC Slurry is a highly aromatic stream and is often used as additional Coker feed (up to 15wt% max. recommended) to reduce heater fouling and to push coke morphology to sponge coke (for anode grade coke). The heavy aromatics in the FCC Slurry help keeping asphaltenes in solution a lot longer and promote coke formation by poly-condensation, therefore increasing sponge type coke content in the coke bed (preferred for low sulfur, anode grade coke production). On the downside, FCC Slurry will contain entrained catalyst fines and – if too high in concentration – may have a negative impact on fouling rates in the charge heater(s). The fine catalyst particles can deposit inside the heater tubes, act as seeds for coking and may promote deposits of heavy oil and coke fines from the oil film inside the tubes.

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