Refinery Optimizes Slurry Oil Recycle Stream and FCC Profitability with Micro Motion Fork Viscosity Meter

RESULTS

- Utilizing a continuous viscosity measurement on recycled slurry oil, the refinery was able to better to optimize the blend of light and heavy cycle gas oil resulting in savings of at least $100,000 from the utilization of the less expensive product
- Reduction in lab samples from twice a day to once a day

The Micro Motion Fork Viscosity Meter delivers reliable multivariable, viscosity, density and temperature measurement readings in pipelines, bypass loops and tanks.

APPLICATION

The Fluid Catalytic Cracking Unit (FCC) in a refinery is a catalytic cracking conversion unit. Liquid hydrocarbon feed is vaporized and contacted by a powdered catalyst. The hydrocarbon molecules are cracked into smaller, more valuable high-octane components usually used in gasoline and diesel production. The catalyst and hydrocarbons are separated after the reaction. The catalyst is sent to the regenerator where coke accumulated on the catalyst from the reaction is burnt off in order to regenerate the catalyst. The main hydrocarbon vapors are sent to a fractionation column where the vapors are separated into off gas, naphtha, light cycle gas oil (LCGO), and heavy gas oil (HCGO). The main fractionator bottom product contains residual catalyst particles and is known as slurry oil. This refinery did not have a slurry settler, so the slurry oil in this FCC was made up of HCGO and catalyst fines. At this refinery, some slurry oil is recycled back to the main fractionator for temperature and distillation control and the remainder slurry oil is pumped to tankage and sent to the Delayed Coker for further processing.

CHALLENGE

There are many challenges with recycling FCC Slurry Oil. HCGO by itself has the benefits of utilizing a lower value product, but coke formation can occur and/or the oil can become too viscous for pumping. LCGO, on the other hand, has a low viscosity and does not result in coke formation, but is a higher value product. To maintain a lower viscosity and mitigate coke make, the refiner adjusted the fractionator cuts to drop more LCGO into the HCGO.

The refiner would control the viscosity of the slurry oil by sampling the fractionator cuts twice a day. Based on the lab samples, the fractionator cuts would be adjusted to meet the viscosity

requirements in the slurry oil. With the delay between sampling periods and to be safe, higher quantities of LCGO were typically dropped into the HCGO, resulting in higher operating costs. The margin between LCGO and HCGO varies between refineries, but the marginal difference between them is typically between $10 and $30/bbl range.

The refinery wanted to increase profitability by optimizing the use of LCGO through tighter viscosity control of the recycle slurry oil.

SOLUTION

To optimize the amount of LCGO in the FCC slurry system, a continuous viscosity measurement was needed. The refinery installed a Micro Motion Meter Fork Viscosity Meter to measure the viscosity of the recycled slurry oil on a continuous basis. The viscosity measurement accuracy is ±0.2 centipoise. The Fork Viscosity Meter has great installation flexibility and can be installed on bypass lines which is beneficial for installing the meter without taking a shutdown. The Fork Viscosity Meter is a multi-variable device and can output density and temperature as well as viscosity. By having the ability to accurately measure the viscosity continuously, the amount of LCGO can be reduced. In addition, an online measurement provided eliminated the difficulty in obtaining these samples as frequently via manual methods.

As part of the project justification analysis, the refiner found that reducing the amount of LCGO in the slurry oil by just 0.5%, could result in significant savings. On a theoretical basis, a reduction of just 2 bbl/hr of LCGO in the HCGO results in savings of between $150K and $500K per year, depending on the cycle oil price differentials.

Due to consistently reliable results over the past several years comparing lab samples to the output from the online viscosity meter, the refiner is also looking at further optimization by utilizing the viscosity output in the Advanced Process Control models to adjust and optimize the fractionator cuts. In addition, the Fork Viscosity Meter can output API gravity, which was previously done by manual sampling twice/day. If the refiner leverages this capability, they can improve safety by eliminating an API gravity sample that requires fresh air.

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