Refining

Micro Motion® | EMERSON Process Management

Crude and Vacuum Distillation is the first unit in this seven-step overview of Refining

Overview of Crude and Vacuum Distillation

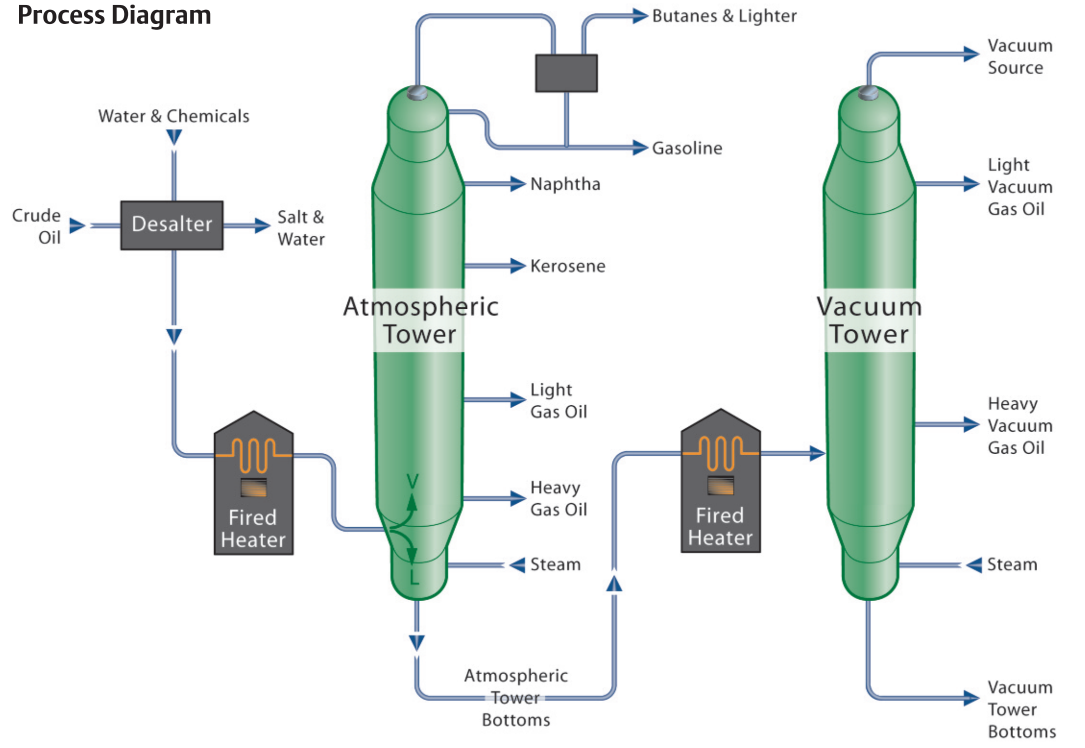
The crude stills are the first major processing units in a refinery. They are used to separate the crude oils by distillation into fractions according to boiling point, so that each of the processing units following will have feedstocks that meet their particular specifications. Higher efficiencies and lower costs are achieved if the crude oil separation is accomplished in two steps: first by fractionating the total crude oil at essentially atmospheric pressure; second by feeding high-boiling bottoms fraction (topped or atmospheric reduced crude) from the atmospheric still to a second fractionator operated at a high vacuum. The vacuum still is employed to separate the heavier portion of the crude oil into fractions because the high temperatures necessary to vaporize the topped crude at atmospheric pressure cause thermal cracking to occur.

Before the crude enters the atmospheric distillation tower, it normally requires desalting. This is necessary to minimize fouling and corrosion caused by salt deposition on heat transfer surfaces and acids formed by decomposition of the chloride salts. The salt in crude oil is in the form of dissolved or suspended salt crystals in water emulsified with the crude oil. The basic principle is to wash the salt from the crude oil with water.

After desalting, the crude oil is pumped through a series of heat exchangers and its temperature is raised to about 550°F (288°C) by heat exchange with product and reflux streams. It is then further heated to about 750°F (399°C) in a furnace and charged to the flash zone of the atmospheric fractionators. The furnace discharge temperature is sufficiently high to cause vaporization of all products withdrawn above the flash zone plus about 10 - 20% of the bottoms products. Reflux is provided by condensing the tower overhead vapors and returning a portion of the liquid to the top of the tower, and by pump-around streams lower in the tower.

The bottoms from the atmospheric crude tower feed the vacuum tower. Distillation is carried out with absolute pressures in the tower flash zone area of 25 to 40 mm Hg. To improve vaporization, the effective pressure is lowered even further (to 10 mmHg or less) by the addition of steam to the furnace inlet and at the bottom of the vacuum tower. The vacuum tower products are used as FCC charge stocks or lube oil stocks.

Crude and Vacuum Distillation Process Diagram



Key factors affecting the distillation effectiveness:

- Feed temperature and Composition
- Feed/ Reflux Ratio
- Pump-around, reboiler and condenser duties
- Column temperature profile (top to bottom temperature cascade)
- Tower pressure
- Product draw-off rates

Customer Challenges

Because it is the first step in the refining process, and all the other processes depend on it, availability of this unit is critical. Emerson Smart instrumentation and AMS™ Suite has a strong play here. All other Emerson PlantWeb® drivers play an important role as well, especially in terms of advanced process control and optimization.

Customer Process Challenge #1 – Maximizing feed rate, meeting production targets

Challenge: Getting an accurate measurement of the amount of crude the refinery is processing each day is critical for yield accounting, meeting production targets, and planning and scheduling. With high refining margins, refiners are usually trying to maximize the feed rate through the crude distillation unit.

The crude that enters the crude column is normally a blended mixture of a number of different crude types. The blend must meet specifications of the refinery LP to maximize profit and manage inventory levels.

Customer Process Challenge #2 – Reduction in process fluctuations

Challenge: It is important to minimize disruption while switching crude tanks or crude blends. Many refiners will switch crudes several times a week, so a smooth transition between the different feeds is critical.

Customer Process Challenge #3 – Reducing Utility Costs

Challenge: With changing compositions of the fuel gas or fuel gas/ natural gas supply, the energy to the crude furnace can fluctuate making it challenging to control the furnace efficiently. If the furnace uses a cascade control scheme of volumetric flow to temperature, and the composition of the fuel changes, a volumetric flow device will not see the change in the energy content, contributing to instability of the furnace.

Customer Process Challenge #4 – Reducing Chemical Costs

Challenge: A number of chemicals are used in the crude and vacuum process areas. Chemicals and caustics are used for corrosion control, and demulsifiers for the desalting unit are examples. Though the responsibility for the chemical injection systems is normally outsourced to a chemical supplier who works with the refiner on-site, there is usually interest in more accurate injection to reduce chemical usage and the associated costs.

Improving Coker Efficiency

Recommended Product Solution

Customer Challenge #1 - Maximizing feed rate, meeting production targets

Control Point Challenge: Maximizing crude feed rate to meet production targets is critical, especially in an environment of high refining margins. The accurate accounting of the crude processed each day is also important for planning and scheduling purposes. Processing the right crude by accurate blending is also important for profitability.

Solution: Micro Motion meters on the crude feed to the crude distillation tower will significantly improve the accuracy and reliability of that measurement, so that production targets can be met.

Blending of the crude feed components is also improved with Micro Motion. Measuring density and flow will improve the accuracy of the blend.

Competing Technology: Orifice dP, wedge meters.

Micro Motion ELITE CMF300, ELITE CMF400 and D600

Application

Crude feed

Crude blending components

Customer Challenge #2 - Reduction in process fluctuations

Control Point Challenge: Minimizing process disruptions while dealing with large-scale shifts in crude oil quality.

Solution: By measuring the density of the crude oil feed, the refiner can anticipate and plan for process changes that must take place in order to avoid process upsets.

Competing Technology: Orifice dP meters

Micro Motion ELITE CMF400 or D600 for full stream measurement, and ELITE CMF50 or ELITE CMF100 for slip stream density

Application

Meters on crude oil feed

Slip stream density measurement on crude oil feed

Customer Challenge #3 - Reducing Utility Costs

Control Point Challenge: Utility costs on the crude unit are considerable, so any reduction will result in large cost savings.

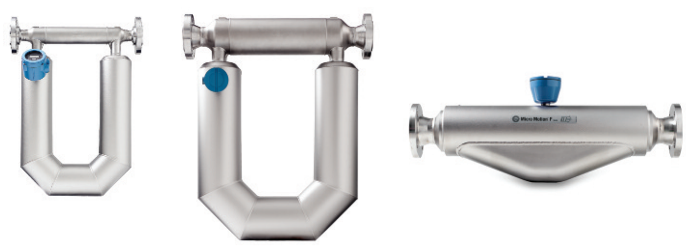
Solution: Controlling the mass rate of the fuel gas to the crude furnace will help to control the energy feeding the furnace, thereby stabilizing the furnace and improving the efficiency. Large changes in the fuel gas composition will no longer cause big temperature swings in the furnace.

Competing Technology: Orifice dP meters

Micro Motion ELITE CMF200, ELITE CMF300, F-Series F200 or F300

Application

Fuel gas to the crude furnace



Improving Coker Efficiency

Recommended Product Solution

Customer Challenge #4 - Reducing Chemical Costs	**Micro Motion ELITE CMF010, ELITE CMF025**
Control Point Challenge: Better control of the chemicals used to demulsify the crude/water blend in the desalter and to control corrosion in the towers will reduce chemical usage costs. **Solution:** Micro Motion meters can accurately measure the low flow rates of chemicals even after pulsating injection-type pumps. Better control of chemical usage can reduce costs and sometimes reduce downstream process problems caused by too much or too little chemical injection. **Competing Technology:** Metering pumps	 **Application** Demulsifier chemical on the desalter Overhead tower corrosion control chemical injection Caustic concentration measurement

