pH Control Reduces Corrosion in Crude Unit Overhead

BACKGROUND

Oil refineries use distillation columns to separate light components such as gasoline and heavy components such as lubricants from crude oil. The distillation towers consist of a series of reboiling and condensation steps whereby the heavier components are concentrated in the lower sections and the lighter components are concentrated in the upper section.

The upper third of the crude tower produces light oil with substantial amounts of water that must be allowed to drop out of a separator vessel. Salt impurities found in most crude oils are more soluble in water than in oil and tend to accumulate in the distillate (or overhead) product. These impurities cause the separated water to become quite acidic.

The water/oil vapors from the top of the crude tower are passed through a condenser and the resulting liquid is separated into oil and water. The oil is mostly transferred to another column, though some may be recycled to meet process specifications. The corrosive acidic water will tend to attack metal process equipment, particularly the upper portion of the crude tower, overhead piping, condensers, and accumulators (see Figure 1).

PROCESS

A sample is drawn from the bottom of the accumulator and, after another separation step, is measured for pH. A neutralizing chemical is added overhead to raise the pH and prevent corrosion in the tower. The flow system creates a time lag of 15-45 minutes between injection of the neutralizer and pH measurement at the sensor. This time lag can cause inadequately slow response to large changes and oscillations for periodic changes. To minimize these problems, the pH is neutralized in 2 stages:

1. A film-forming corrosion inhibitor (an organic amine), which also has neutralizing properties, is manually fed into the overhead to neutralize about 80% of the stream acidity. If flow rates may vary, flow-paced control addition can be used.

   This coarse pH adjustment also forms a protective film on the metal surfaces.

2. A proportional control algorithm is used to "trim" the pH to within .2 pH units of the setpoint (usually between 5.5 and 6.5). This is achieved by separately injecting the neutralizing amine to correct only the final 20% of the acidity.

INSTRUMENTATION

The proportional control signal used to trim the pH reading can come from a separate controller, a DCS, or a FOUNDATION® Fieldbus calculation block. The Model 5081pH (available in loop-powered HART® or Foundation Fieldbus versions) transmitter is well accepted in refineries as robust electronics in a rugged explosion proof enclosure. The transmitter has several hazardous area certifications and includes complete pH sensor diagnostics that can immediately notify the user to problems such as sensor coating, glass breakage, or non-immersed sensor.

The PERpH-X® Model 3500 OR is the top recommendation for continuous pH measurement here since it includes an oil resistant electrolyte that resists coating from trace oil. The double junction design uses two layers of porous junctions to separate the process chemicals from the silver reference, and allows the outer reference solution to be conveniently refilled with a preloaded syringe. The PERpH-X design can be customized for different application situations and includes a titanium solution ground for complete diagnostics of the reference and glass portions of the sensor. The PERpH-X design is also available with the convenient VP connector and in a retractable metal housing (Model 3400), which allows sensor removal without shutting down the process.

OPERATION TIPS

- A separator should be installed upstream of the pH sensor to remove large amounts of oil.
- Don't remove the sensor immediately if a drift is noticed. Wait a couple of hours, and then standardize to a grab sample when the pH value is steady.
- Clean an oil-coated pH electrode (as necessary) with a mild detergent solution or water, but do not rub the glass surface.
- Use a jet-spray cleaner (PN 12707-00) to reduce maintenance time. The jet-spray is very effective at removing oil coatings on the glass.

INSTRUMENTATION

Model 5081 pH/ORP Smart Two-Wire Transmitter

- Hand-held infrared remote control link to activate all the transmitter's function.
- NEMA 4X (IP65) weatherproof, corrosion-resistant enclosure.
- Comprehensive pH glass and reference diagnostics.
- Non-volatile EEPROM memory to hold data in event of power failure.
- HART® and FOUNDATION® Fieldbus options.

SENSOR

Model 3500 High Performance pH Sensor

- Advanced on-line sensor diagnostics for use with all Rosemount Analytical analyzers and transmitters.
- High temperature design increases sensor life at elevated temperatures.
- Rebuildable double junction reference provides longer service life in a variety of processes by using specially formulated reference SOLUTIONS.

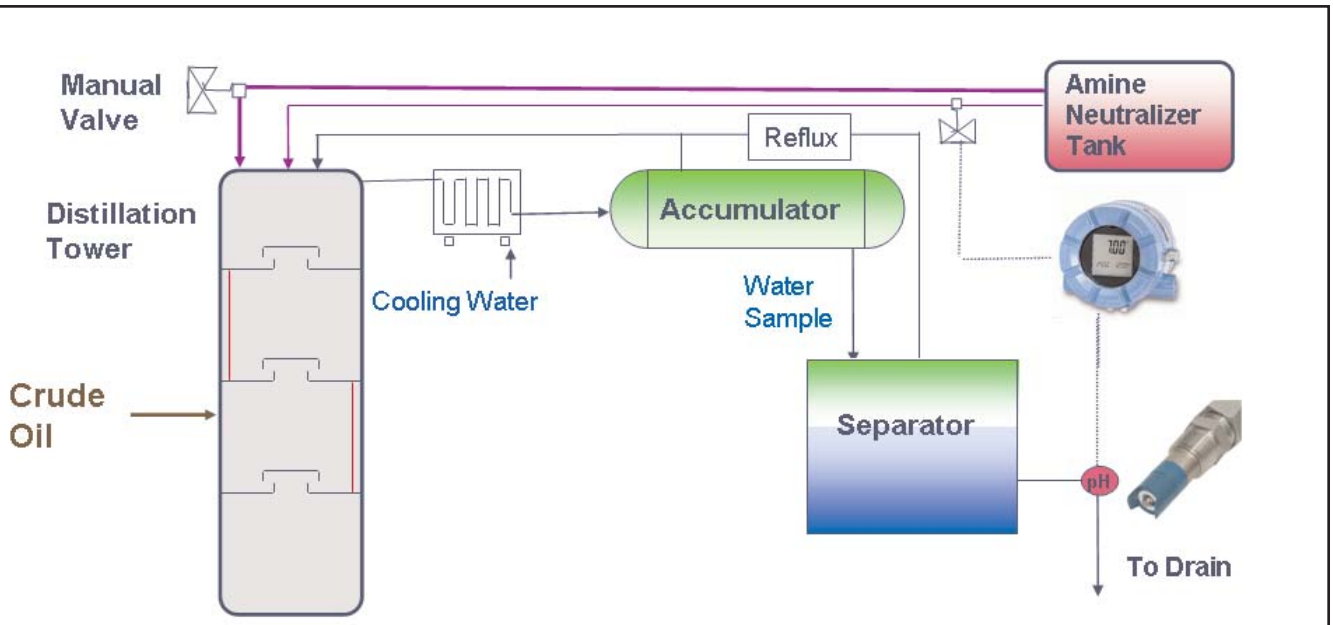

FIGURE 1. Crude Tower pH

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