Industry Application Report Number Two

Product Applications for the Oil Refining Industry

Non contacting, non-intrusive Radiometric Measurements

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Atmospheric Distillation

Application

The Atmospheric Distillation Column, or Crude Distillation Unit (CDU) is the first stage in most refineries. The Column distills incoming crude into fractions with various boiling points. They are processed downstream. Incoming crude oil is preheated by exchanging heat with the hot, distilled fractions and other streams. After desalting, the crude is heated by exchanging heat with distilled fractions and other streams. Upon further heating, the crude is routed into the Column. The liquid falls to the bottom and the vapor rises, passing through a series of perforated trays. Heavier hydrocarbons condense faster and settle on lower trays. Lighter hydrocarbons remain as a vapor longer—condensing on higher trays. The cooling/ condensing of the distillation tower overhead is provided by exchanging heat with the incoming crude by condensers. The overhead distillate fraction produces naphtha. Fractions are removed from the column at levels between the column top and bottom. These (kerosene, light gas oil and heavy gas oil) are cooled by exchanging heat with the incoming crude and the bottom residue is piped into the Column for further treatment.

Application problem

Residual bottoms level in the Column is a critical measurement. The hydrocarbon fluid is hot and very viscous. Constant level of the residue at the bottom of the column is required. Too high a level risks spillover of liquid in to the upper fractions, reducing product quality. The higher the level, the longer the existence of product in the column and more volatile components are evaporated off. This increases process efficiency. Contacting technologies can produce marginal results and require excessive maintenance.

The Berthold Technologies Solution

Berthold Technologies' non contacting/non-intrusive Continuous Level gauges keep a constant residual level measurement at the bottom of a Column as well as preventing overspill into upper Column fractions.

Catalytic Reforming

The Application

Catalytic Reforming is a chemical process used in refineries to convert low octane rating napthas from Vacuum Distillation, into high-octane liquid products (reformates) —components of high-octane gasoline. The process re-arranges hydrocarbon molecules in the naphtha feedstock as well as breaking some of the molecules into smaller molecules. The effect—product reformate —contains hydrocarbons with complex molecular shapes having higher octane values than the hydrocarbons in the naphtha feedstock. The process yields Hydrogen rich gasses and Liquefied Petroleum Gas (LPG). The two Processes licensees are UOP CCR platforming process and Axens Octanizing process (France). Both serve as CCR (Continuous Catalytic Reforming) processes.

Application problem

In time, the catalyst coke builds up on the catalyst surface reducing efficiency and needs regeneration to burn off the coke. This process can either be performed sequentially every 6-24 months (semi-regenerative catalytic reformer (SRR) or continuously in special regenerator vessels. Density, point / continuous level measurements are required throughout the process. Due to high pressure and temperatures, contacting type technologies are ill suited for these conditions.

The Berthold Technologies Solution

Berthold Technologies gauges are used in the Regenerator (Continuous and point level), First upper hopper (Continuous and point level), Reduction Chamber (Point level), 2nd-4th upper hoppers (Level and continuous level) Upper Surge Drum (Continuous and point level), and Lock Hopper(High and low level point switches).

Vacuum Distillation

Application

The residual of the Atmospheric Distillation (Atmospheric Bottoms) is fed into the Vacuum Distillation column. Distillation under reduced pressure (less than atmospheric) i.e. Vacuum Distillation will lower the boiling temperature of the liquid being distilled permitting the production of distillates at lower temperature than would be necessary in atmospheric distillation, thus avoiding coke formation. As a result hydrocarbons with high molecular weight can still be separated from the atmospheric bottoms thus increasing the yield and efficiency of the refinery.

Application Problem

The Level of the residual bottoms in the vacuum distillation column is a critical measurement task. The hydrocarbon fluid is at ~380°C and very viscous. Due to the low pressure, the liquid very often has a foam layer on top. The goal is to keep a constant level of vacuum residue at the bottom. A level too high risks overflowing of foam in to the upper fractions, diminishing the product quality. However, the higher the level, the longer is the residence time of product in the column and more of the volatile components are evaporated off. This increases the efficiency of the process. Using contacting technologies (i.e. DP switches) will be affected by wall deposits and changes in product density.

The Berthold Technologies Solution

Berthold Technologies Continuous Level systems provide excellent performance and be unaffected by the ills of contacting devices. Pending arrangement, a single detector, cascaded LB 490 integrated gauges, or the LB 490 Tower Sens can be used. Due to this critical measurement, a second Radiometric system is employed—oriented 90 degrees from the first one. As there is a tendency for the product to develop a foam layer, the Cobalt 60 isotope is sometime used to minimize the effect of the foam.

Fluid Catalytic Cracking (FCC)

Application

Fluid catalytic cracking (FCC) is an important conversion process used in over 400 petroleum refineries. It is used to convert the high-boiling, high-molecular weight hydrocarbon fractions of petroleum crude oils (atmospheric gas oils, vacuum gas oils, certain atmospheric residues) to more valuable high-octane gasoline, light fuel oils and olefin-rich light gases. About one-third of the crude oil refined in refineries is processed in an FCCU (Fluid Catalytic Cracking Unit. Refineries use fluid catalytic cracking to correct imbalance between the demand for gasoline and the excess of heavy, high boiling range products resulting from the distillation of crude oil.

Application problem

FCCs contain different vessels from Risers through Distillation Columns. As such there are many different applications for Continuous/Point level and Density measurements. All have the same thing in common—the high temperature, pressures and other vessel conditions make contacting type technologies largely ineffective without increased maintenance costs and downtime.

The Berthold Technologies Solution

Berthold Technologies gauges are the solution to measurement challenges in an FCC. Among them are Density in a Regenerated Catalyst Standpipe, Catalyst Fines Cyclone Level, the FCC Distillation Columns (Point and Continuous Level) and Regenerated Catalyst Standpipe Continuous Level. Due to the problems with contacting technologies (coating, high pressure, high temperatures), Berthold Technologies Radiometric gauges provide superior measurements without costly downtime and costly repairs.

Hydrocracking/Hydrotreating

Application

Many refineries employ hydrocracking (sometimes referred as Hydrotreating) technology to convert heavy hydrocarbon oils into lighter and more valuable products. With Hydrotreating, the objective is remove sulfur and increase the octane number. The objective of the Mild Hydrocracking process is to convert 20-60% of the vacuum gas oil (343°C material from the Vacuum Distillation) to low sulfur distillates and produce high quality cat cracker feedstock. The feedstock is mostly vacuum gas oil (VGO) although sometimes mixed with distillate streams. Good quality upgrading of the vacuum gas oil is achieved at moderate mild hydrocracking pressure operation. Low sulfur and over 40 cetane diesel are achieved. The resulting FCC feed is low in sulfur, nitrogen, Conradson carbon and metals. Hydrocracking is very common in India, Europe and Asia because those regions have high demand for diesel and kerosene. In the US, Fluid Catalytic Cracking (FCC) is more common because of higher gasoline demand.

Application Problem

In many individual process vessels in a Hydrocracking configuration, the uniquely high pressures and temperatures can cause measurement problems. Unwanted feed materials such as scale, polymers and other solids can build up on vessel walls thus causing erroneous level measurements and causing premature end to the operating cycle through pressure drop buildups, catalyst lugging, or deactivation.

The Berthold Technologies Solution

Berthold Technologies can solve these measurement problems easily and efficiently. For example, scale and other vessel wall deposits can be detected—thus giving serving as a predictive maintenance tool. Accurate and repeatable continuous level measurements can be done using either integrated gauges (LB 490, LB 480), or using systems employing remote electronics (LB 440).

Delayed Coking

The Application

The delayed Coking Process involves a series of activities designed to process the residual oil from Vacuum Distillation through a chain of events designed to produce, among other products, petroleum coke. Delayed Coking Drums normally operate in pairs and run 16-24 hour cycles—sometimes less. The key is to fill the drum up as high as possible without creating an overspill at the overhead vapor lines at the top of the Drum. This event is catastrophic in terms of expensive clean up and lost production time.

Application Problem

The Process creates noxious foam which rises unpredictably and at rapid rates. It is necessary to use expensive, silica based anti foam to control the height and rate of rise. The need to determine this rate of rise and the relative height of both the process and the foam is key to filling the Drum to maximum level—without creating an overspill. Due to the high temperatures and characteristics of the coke, insertion probes are not a good measurement choice. The use of neutron backscatter systems only shows 18 inch windows along the drum and do not detect what is happening in between these points. This reduces the time that might be necessary to prevent an overspill.

The Berthold Technologies Solution

Berthold Technologies provides a radiometric gamma continuous level measurement system that can measure the top of the foam layer at any point along the drum. This permits greater flexibility in Drum operation and greater productivity and throughput in the operation of the Drum. The continually rising process can be more carefully monitored for better prevention against a costly spillover.

Alkylation

Application:

Alkylation is a refining process that provides an economic outlet for very light olefins produced at the FCC and Coker. Alkylation is the opposite of cracking. The process takes small molecules and combines them into larger molecules with high octane and low vapor pressure characteristics which are used in gasoline blends to reduce knocking. Alkylation combines low-molecular-weight olefins (primarily a mixture of propylene and butylene) with isobutene in the presence of a catalyst, either sulfuric acid (H_2SO_4) or hydrofluoric acid (HF). Sulfuric Acid and Hydrofluoric Acid are the two processes most commonly used. UOP and Phillips are the Process Licensors for the HF Alkylation process. With the Phillips process, olefin and isobutene stock are dried and fed to a combination reactor/settler system. The UOP Process uses two reactors with separate settlers.

Application Problem

Due to acids being used in both processes , these processes can be problematic from a measurement standpoint. With the acid settler, one of the key measurements is to provide the interface between the light and heavy phases as well as the interface layer in the vessel. Contacting technologies are problematic due to maintenance/replacing probes. And the measurement itself is challenging—especially determining when the phases change condition.

The Berthold Technologies Solution:

Berthold Technologies' can meet this measurement requirement without the hassle of constantly changing contact probes. Whether its providing a density profile in an Acid settler tank/drum or measuring level in the storage drum, Berthold Technologies has the answer for this process where non contacting and non intrusive technology is a must!

Coker Fractionator Bottoms

The Application:

The Coker Fractionator separates Coker overheads into gases, diesel, gasoline and other products. An oversized Coker Fractionator can be used to maximize diesel product and minimize the heavy Coker gas oil to the FCCU. Hot overhead vapors can cause coking in the lower section (bottoms) of the Fractionator trays if not kept wet. The bottom of the Fractionator should be operated at as high a temperature as possible without causing coking in the bottom so the tube furnace can be kept at low duty.

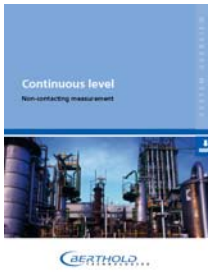
Application Problem:

Proper measurement of the bottom level of the Coker Fractionator is important for several reasons. Most important is to prevent Coke formation in the Bottom of the Fractionator —thus causing problems further down the process stream. Because this is a very hot section of the vessel (typically running between 343C to 382C), contacting probes or other technologies prone to problems with higher temperatures do not work well.

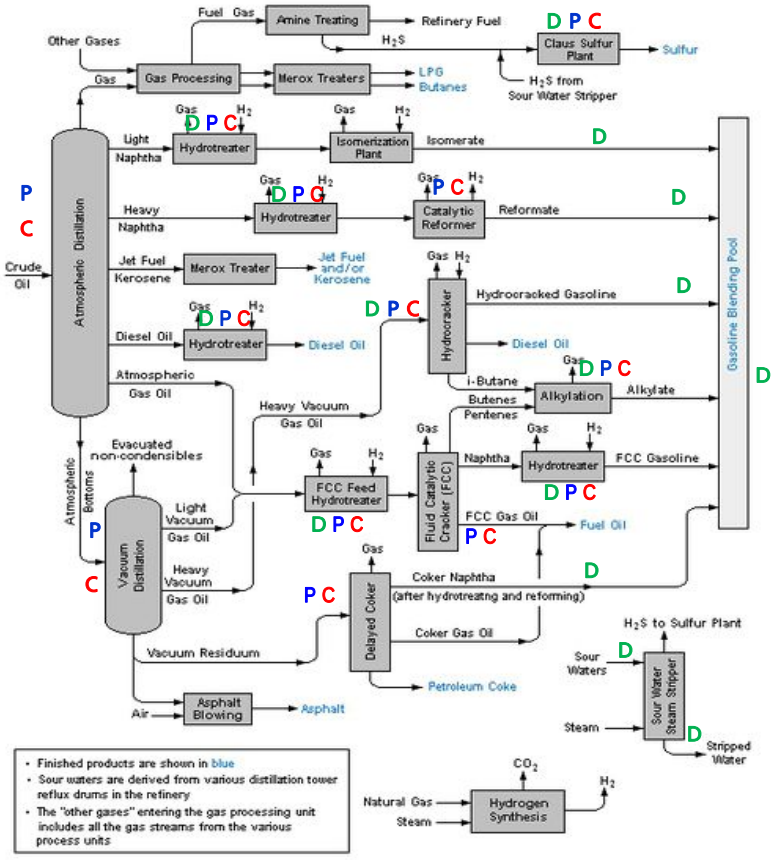
The Berthold Technologies Solution:

Berthold Technologies' Continuous Level gauges are the answer to this very challenging measurement. Unaffected by the higher temperatures or other problems that make contacting type technologies inefficient, Berthold Technologies Continuous Level measurement gauges provide a reliable and repeatable measurement in the span required. Downtime, probe replacement , repairs and other maintenance problems are virtually eliminated. Production can be maximized and Furnace activity can be minimized.

Continuous Level Measurement



Berthold Technologies has continuous level measurement platforms to fit the most demanding measurement requirement. If a traditional configuration is needed, then the LB 440 with remote electronics is the answer. If an integrated system with HART, Foundation Fieldbus or other protocols are required, then the LB 490/LB 490 Tower-Sens can meet the challenge. A patented internal process keeps the measurement stable—even in widely varying temperature changes common to most processes. Using the lowest source sizes in the industry thanks to superior sensitivity and proprietary detector technology, Berthold Technologies Continuous Level Measurement systems is the solution for any tough process level measurement.



Applications for Berthold Technologies Radiometric Measurement Gauges

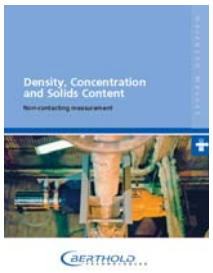
As an aid to Berthold Technologies systems placement, the following is a general guide for placement of particular technologies:

C Continuous Level (LB 440, LB 980,LB 490)

P Point Level (LB 471,LB 480, LB480)

D Density (LB 444, LB 491, LB 480)

Density. Concentration and Solids Measurement



Berthold Technologies specializes in density and solids measurements. Using highly sensitive scintillation detectors, a variety of platforms are available depending upon the operational requirement. From integrated electronics with HART, Foundation Fieldbus and other protocols, to the traditional remote electronics configurations, Berthold Technologies has the answer to the most challenging density measurement applications. Maintenance and downtime are virtually eliminated due to the non-contact and non– intrusive operation of the system.

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