Level & Flow Applications for **CRUDE OIL** PROCESSING

Level and flow controls in these applications are crucial for both process control and safety shutdown systems.

The actual nature and number of steps in crude oil processing most often depends upon the source and makeup of the wellhead production stream. In some cases, several of the steps shown in the schematic below may be integrated into one unit or operation, performed in a different order or at alternative locations, or not required at all.

Crude Stream Level Applications

Plant Inlets

1. Fluid Tanks
2. Chemicals
3. Separation
   - Test Separation
4. Crude Dehydration
5. Desalting
6. Degassing
8. Crude Collection and Storage Tanks
9. Vapour Recovery
10. Flare Stack

Natural Gas Processing

Natural Gas processing is found in many crude oil drilling and processing operations. For information on level applications for natural gas processing, see our Natural Gas Processing brochure and application road map.

Water Stream Level Applications

7. Sumps → Collection Tanks

Outlet Produced Water

FLOW APPLICATIONS

Flow controls for pumps, compressors, and liquids are found throughout crude oil field operations. They include:

- **Flow Alarm:** Thermatel® Model TD2 Thermal Dispersion Flow Switch

- **Continuous Gas Flow:** Thermatel® Model TA2 Thermal Dispersion Mass Flow Meter
- **Continuous Liquid Flow:** Coriolis Mass Flow Meter. RHM Series

- **Clamp-on Ultrasonic Flowmeter:** SlugMaster Intelligent Dual Technology Ultrasonic Flowmeter

1 PRODUCTION FLUID STORAGE

Back


Storage Tanks

Application:

A variety of chemicals are typically stored in the field or processing facility to expedite processing time by preconditioning an inlet fluid. These fluids may first enter into a holding tank to allow upstream solids and liquids time to separate prior to production, which enables the facility to better handle upset conditions without stopping production. Stored additive chemicals include dispersants, flocculants, surfactants, glycols, diluents and rust inhibitors.

Challenges:

Fluids are typically stored in a series of outdoor steel tanks. The tank fluid volume should be continuously monitored since level variations may lead to upsets. Tanks contain agitated media with suspended solids that can coat floats, displacers and probes.

INTERFACE MEASUREMENT APPLICATION

Click on an instrument for more information

INSTRUMENTATION

▲ **Point Level:**
Thermatel® Model TD1/TD2 Thermal Dispersion Switch or Model A15 Series Displacer-Actuated Level Switch

▲ **Continuous Level and Interface Level:**
Eclipse® Model 706 Guided Wave Radar Transmitter with Enlarged Coaxial Probe or Pulsar™ Model R86 or Model R82 Radar Transmitters

2 CHEMICAL INJECTION

Back


Chemical Injection Skid

Application:

Chemical agents employed in crude processing include drilling fluid additives, methanol injection for freeze protection, glycol injection for hydrate inhibition, produced water treatment chemicals, foam and corrosion inhibitors, de-emulsifiers, desalting chemicals, and drag reduction agents. Chemicals are frequently administered by way of chemical injection skids.

Challenges:

Level monitoring controls chemical inventory and determines when the tanks require filling. The careful selection and application of level controls to chemical injection systems can effectively protect against tanks running out of chemicals or overfilling.

Click on an instrument for more information

INSTRUMENTATION

▲ **Point Level:**
Echotel® Model 961 Ultrasonic Switch; THERMATEL Model TD1/TD2 Thermal Dispersion Switch or Tuffy® II Float-Actuated Switch

▲ **Continuous Level:**
ECLIPSE Model 706 Guided Wave Radar Transmitter or Jupiter® Magnetostrictive Transmitter

▲ **Visual Indication:**
Atlas™ or Aurora® Magnetic Level Indicators can be supplied with switches or transmitters

▲ **Chemical Dosage Monitoring:**
Rheonik Coriolis mass flow meters are ideal for these high pressure and low flow measurement applications

3 WELL STREAM SEPARATORS

Back


Oil Field Separator

Application:

Separators are large drums designed to separate wellstreams into their individual components. They are commonly designed to separate two-phase (gas/liquid) or three-phase (gas/crude/water) wellstreams. Separators are also classified according to horizontal or vertical configuration (see below), operating pressure, turbulent or laminar flow, and test or production separation.

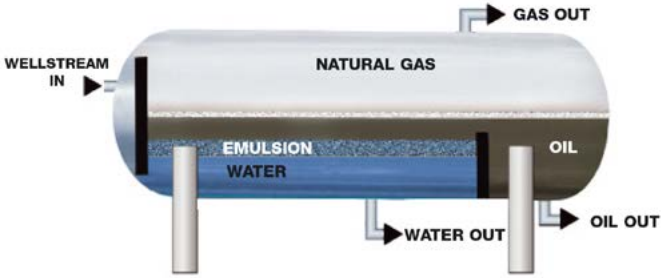
Challenges:

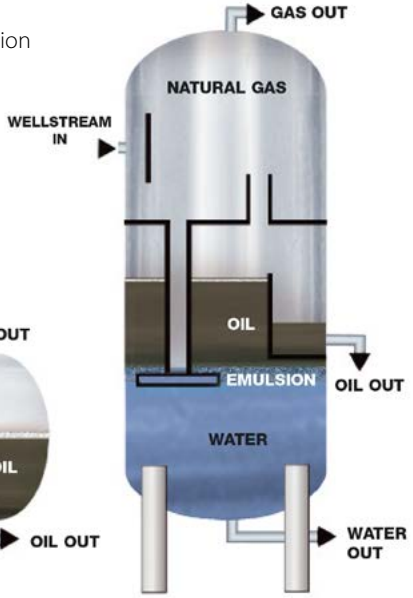
Interface level measurement will actuate a valve to adjust vessel level. An emulsion layer along the oil/water interface can contaminate the oil with water or the water with oil. Foaming along the gas/liquid interface, if entrained, can cause liquid carryover or gas blowby.

TWO PRINCIPAL TYPES OF SEPARATORS

Vertical: Vertical separators can accommodate large surges of liquids. They are well suited for high sediment loads; conical bottoms are sometimes attached for large volumes of sediment. Vertical separators are preferred when wellstreams have large liquid-to-gas ratios. These separators occupy less floor space than horizontal types and are often found on offshore platforms where floor space is at a premium.

Horizontal: These separators are well suited for three-phase separation because of their large interfacial area between the two liquid phases. Horizontal types are preferred when wellstreams have high gasto- oil ratios, when wellstream flow is more or less constant, and when liquid surges are insignificant. These separators also have a much greater gas/liquid interface area, which aids in the release of solution gas and in the reduction of foaming.





Click on an instrument for more information

INSTRUMENTATION

▲ **Point Level:**
Series 3 Float-Actuated External Cage Switch; THERMATEL Model TD1/TD2 Thermal Dispersion Switch or Model A15 Series Displacer-Actuated Switch

▲ **Continuous Level and Interface Level:**
ECLIPSE Model 706 Guided Wave Radar Transmitter; JUPITER Magnetostrictive Transmitter or E3 Modulevel® Displacer Transmitter

▲ **Visual Indication:**
ATLAS or AURORA Magnetic Level Indicators can be supplied with switches or transmitters

▲ **Flow Indication:**
ALARM: THERMATEL Model TD1/TD2 Flow Switch; CONTINUOUS: THERMATEL Model TA2 Mass Flow Meter

▲ **Separator Efficiency:**
DREXELBROOK Universal IV water cut indicator for density compensated water in oil measurement

▲ **Separator Efficiency:**
Process vision based technology for primary analysis of water in oil

4 CRUDE DEHYDRATION

Back


Crude Dehydration

Application:

Not all water is removed from crude oil during the first stage of gravity separation. Separated crude may contain up to 15% water which exists in an emulsified form that is difficult for a separator to remove. The oil and water emulsion must be broken down so that the water can be removed before the crude is shipped. De-emulsification processes are accomplished using chemical agents such as glycol and heat.

Challenges:

Level control is found on two-phase and three-phase water knockout drums, heater treaters and chemelectric dehydrators. Interface measurement is critical in dehydration as it keeps the water-emulsified oil from flowing over the separator weir.

INTERFACE MEASUREMENT APPLICATION & OIL IN WATER

Click on an instrument for more information

INSTRUMENTATION

▲ **Point Level:**
Series 3 Float- Actuated External Cage Switch; THERMATEL Model TD1/TD2 Thermal Dispersion Switch or Model A15 Series Displacer-Actuated Switch

▲ **Continuous Level and Interface Level:**
ECLIPSE Model 706 Guided Wave Radar Transmitter; JUPITER Magnetostrictive Transmitter or E3 Modulevel® Displacer Transmitter

▲ **Visual Indication:**
ATLAS or AURORA Magnetic Level Indicators can be supplied with switches or transmitters

▲ **Separator Efficiency:**
DREXELBROOK Universal IV water cut indicator for density compensated water in oil measurement

▲ **Separator Efficiency:**
Process vision based technology for primary analysis of water in oil

5 CRUDE DESALTING

Back


Two-stage Desalter

Application:

Salt in the crude stream presents serious corrosion and scaling problems, and must be removed. Salt is dissolved within the remnant brine of the crude oil. Desalting removes both salt and the residual free water. Field desalting is necessary due to pipeline requirements.

INTERFACE MEASUREMENT APPLICATION

Challenges:

Level instrumentation is integral to single and two-stage desalting systems, multiple orifice plate mixers, and the settler tank of a chemical desalter. Interface level control keeps free water from hitting the desalter electrodes and prevents expensive damage. The interface level should be kept constant, otherwise electrical field changes will disturb electrical coalescence.

Click on an instrument for more information

INSTRUMENTATION

▲ **Point Level:**
Series 3 Float-Actuated External Cage Switch; THERMATEL Model TD1/TD2 Thermal Dispersion Switch

▲ **Continuous Level and Interface Level:**
ECLIPSE Model 706 Guided Wave Radar Transmitter with Enlarged Coaxial probe or E3 MODULEVEL Displacer Transmitter

▲ **Visual Indication:**
ATLAS or AURORA Magnetic Level Indicators can be supplied with switches or transmitters

▲ **Separator Efficiency:**
DREXELBROOK Universal IV water cut indicator for density compensated water in oil measurement

6 CRUDE DEGASSING

Back


Reboiler

Application:

By removing dissolved gases and hydrogen sulphide, crude stabilization and sweetening processes improve safety and negate corrosion problems. Gases are removed by a stabilizer. Sweetening employs stabilization or vaporization processes along with a gas or steam-based stripping agent.

Challenges:

Removing dissolved gases by stabilization requires level control in the reboiler unit. Sweetening by stage vaporization and trayed stabilization require level control in a series of staged separators. Sweetening by reboiled trayed stabilization requires additional level control in a reboiler.

Click on an instrument for more information

INSTRUMENTATION

▲ **Point Level:**
Series 3 Float- Actuated External Cage Switch or TUFFY II Float-Actuated Switch

▲ **Continuous Level and Interface Level:**
ECLIPSE Model 705 Guided Wave Radar Transmitter or E3 MODULEVEL Displacer Transmitter

▲ **Visual Indication:**
ATLAS or AURORA Magnetic Level Indicators can be supplied with switches or transmitters

7 WATER PROCESSING

Back


Water Wash Tank

Application:

Produced water, wash-down water or collected rainwater require treatment whether they're reused for reservoir flooding or simply disposed of. Water collected from process operations contains hydrocarbon concentrations too high for safe discharge. Suspended hydrocarbon droplets in water also hinders well-injection.

Challenges:

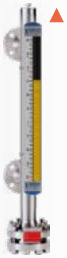
Treatment equipment is similar to threephase separators except that water is the main product. Level control is found on skim tanks, precipitators, coalescers, flotation units, and collection tanks and sumps. Interface level measurement is essential for proper draining of clean water and removal of the residual oil.

Click on an instrument for more information

INSTRUMENTATION

▲ **Point Level:** Series 3 Float-Actuated External Cage Switch or TUFFY II Float- Actuated Switch

▲ **Continuous Level and Interface Level:** ECLIPSE Model 705 Guided Wave Radar Transmitter or E3 MODULEVEL Displacer Transmitter



▲ **Visual Indication:** ATLAS or AURORA Magnetic Level Indicators can be supplied with switches or transmitters

▲ **Produced Water Total Flow:** SlugMaster Intelligent Clamp-on Ultrasonic Flow Meter unique dual technology USM – 1 deal for applications involving varying levels of aeration solids

▲ **Separator Efficiency:** CANTY INFLOW Oil in produced water processed vision based technology for primary analysis of oil in water

8 PROCESSING & STORAGE TANKS

Back

Storage Tanks

Application:

Crude oil and water are stored in oil fields. Unlike midstream tank farms at terminals and refineries, field storage consists of smaller vessels associated with oil and water processing. Diesel generator fuel, potable water, and fire water are also stored.

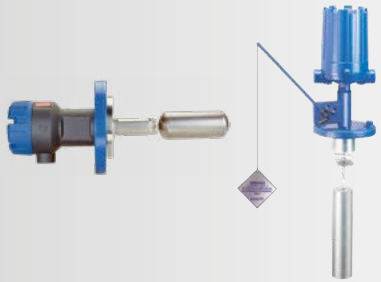
Challenges:

Tank level monitoring can be provided with overflow control and alarm systems or shutdown pumps when level falls below the specified low level. Interface controls will sense the beginning of an oil/water interface during tank dewatering and control the water draw-off.

API 2350: New recommended practices regarding tank overfill protection for above-ground storage tanks that receive Class I (flammable) liquids outline that careful selection and application of level controls can effectively protect against tank overfills.

Click on an instrument for more information

INSTRUMENTATION



▲ **Point Level:**
Model A15 Series Level Switch with optional Proof-er® Ground Check or TUFFY II Float- Actuated Switch

▲ **Continuous Level and Interface Level:**
ECLIPSE Model 706 Guided Wave Radar Transmitter with Flexible Probe; PULSAR Model R86 Radar Transmitter or E3 MODULEVEL Displacer Transmitter

9 VAPOUR RECOVERY UNIT *FLASH DRUM*

Back


Field VRU

Application:

If allowed to escape into the atmosphere, hydrocarbon vapours diminish income through loss of hydrocarbon volume and create fire hazards and pollution problems. A Vapour Recovery Unit (VRU) collects vapors from storage and loading facilities, reliquefies the vapours and returns the liquid hydrocarbons back to storage. Methods to recover vapours include absorption, condensation, adsorption and simple cooling.

Challenges:

A VRU is a simple, economical process unit that provides SEPA/EA compliance and improves operating economies by capturing up to 95% of fugitive emissions. Critical to the VRU is the flash drum where vapours are reliquefied. Liquid level control of the flash drum is essential.

Click on an instrument for more information

INSTRUMENTATION

▲ **Point Level:**
Series 3 Float Actuated External Cage Switch; TUFFY II Float-Actuated Switch or ECHOTEL 961 Ultrasonic Switch

▲ **Continuous Level:**
ECLIPSE Model 706 Guided Wave Radar Transmitter or E3 MODULEVEL Displacer Transmitter

▲ **Visual Indication:**
ATLAS or AURORA Magnetic Level Indicators can be supplied with switches or transmitters

▲ **Flow Indication:**
CONTINUOUS: THERMATEL Model TA2 Thermal Dispersion Mass Flow Meter

10 FLARING

Back

Flare Stack

Application:

Flare gas is the surplus or waste gas produced in industrial processes such as crude oil processing. Flare gas systems are utilized all over the world as a safety mechanism to burn flammable gas rather than releasing it into the atmosphere. These systems protect people, equipment, and the environment.

Flare gas lines at refineries contain a mixture of hydrocarbon gases. While the continuous sweep gas is usually methane or nitrogen, other gases are released into the system from various process units, creating a mixture of gases with varying proportion

There is a requirement for onshore and offshore oil & gas exploration companies to monitor and report daily volumes of flare and vent gas under environmental regulatory mandates. Therefore, a high accuracy mass flow meter, often with high temperature capability, is required to quantify the amount of Green House Gases being flared (Water vapor, Carbon dioxide, Methane, Ozone, Nitrous oxide, Chlorofluorocarbons).

Challenges:

There are well documented issues with Flare Gas Meters that can compromise their performance with regard to accurate and sustainable mass flow measurements; these include density distorting gas compositions, transducer contamination and extreme flow velocity (blowdown).

In order to be able to supply accurate reporting in a fiscal format for stakeholders and regulators on a daily, weekly or monthly basis, achieve the required tier compliance, and reduce possible penalties/tax liability, operators must try and negate the effects of process upsets as much as possible.

Click on an instrument for more information

INSTRUMENTATION

▲ **Flare Gas Monitoring:**
ABLE FlareMaster FT Ultrasonic Flare Gas Meter with advanced analytics and a built-in dual redundancy, supervisory system for sustainable measurements during process upsets.