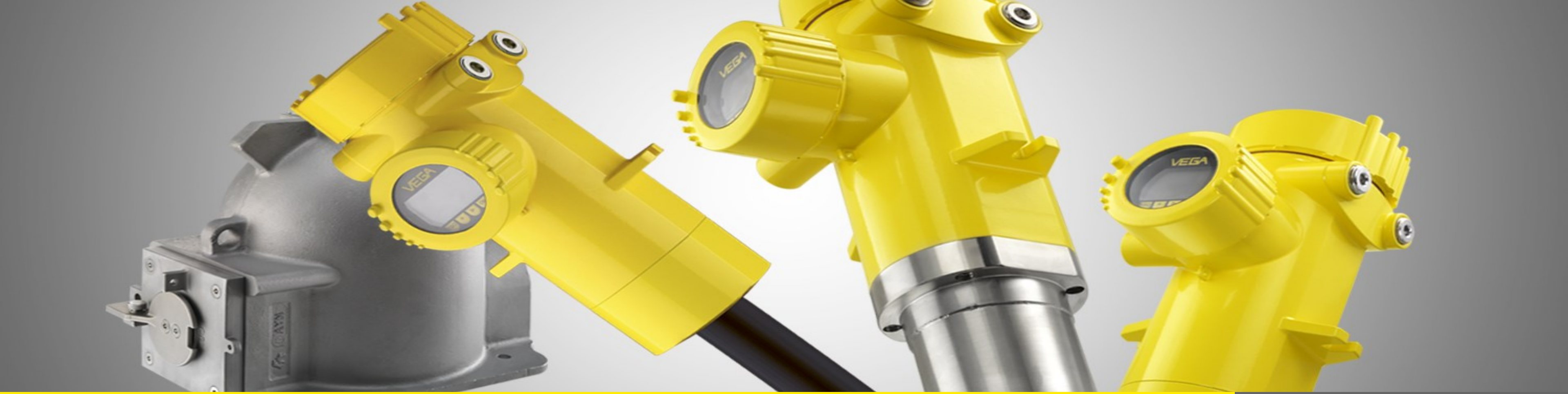


ISA Group Meeting 2-9-2021

Technologies for Interface Level Measurement

Jonathan Hermosillo – Direct Sales, Los Angeles
Dan Stigler – EPC Manager

Looking Forward VEGA

Goal

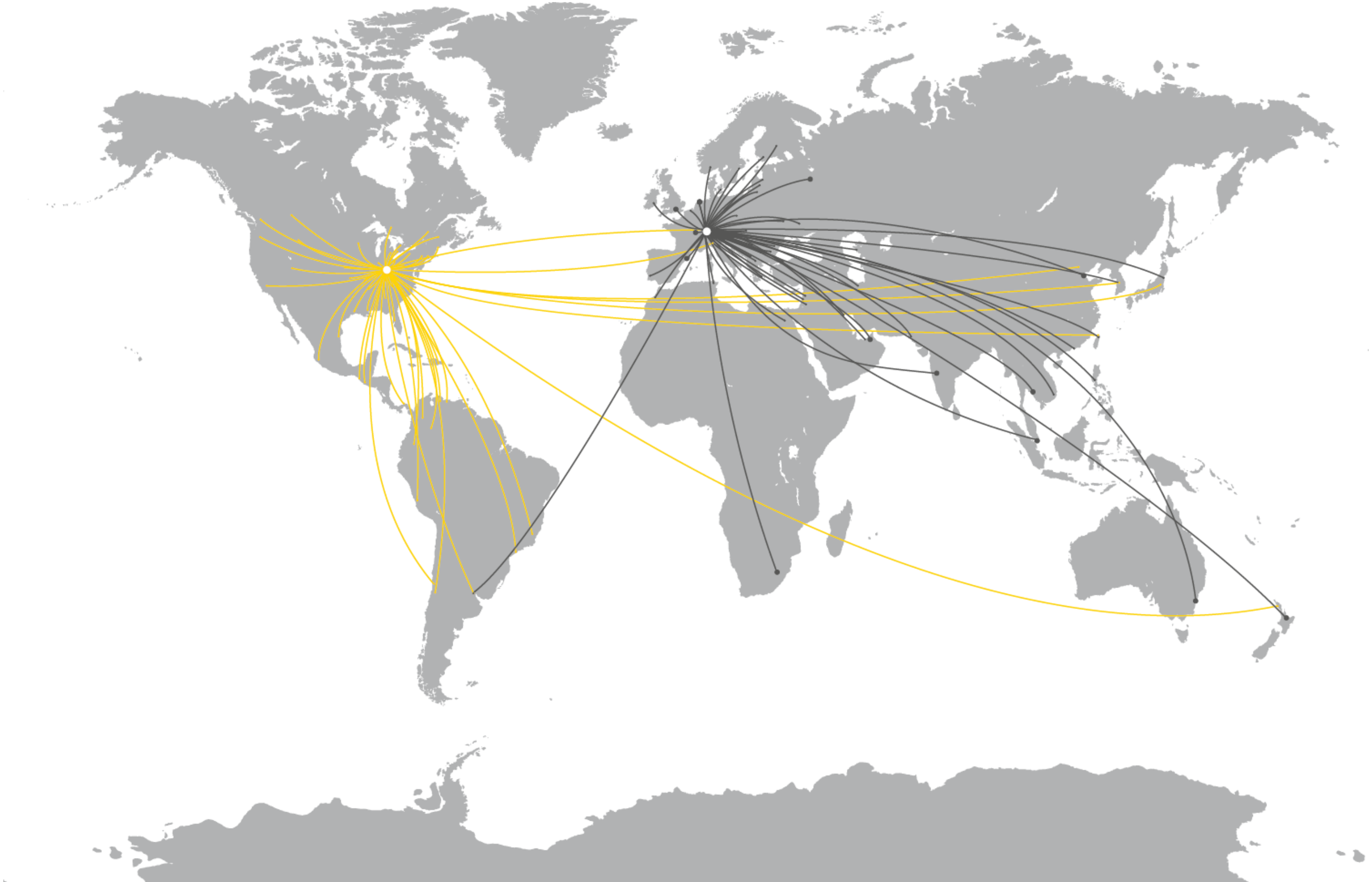
At the end of this presentation you should be able to analyze an application and understand the how each of the different level detection technologies brings value to the measurement.

Roadmap

- Who is VEGA?
- Defining Interface Applications
  - Emulsion Layers
- Technologies
  - Guided Wave Radar
  - Capacitance
  - Radiometric
  - Magnetic Level Indicators
- Questions

Who is VEGA?

Level, Pressure and Density Instrumentation



US Manufacturing Headquarters

Cincinnati, OH

German Manufacturing Headquarters

Schiltach

Defining Interface Applications

Interface
Applications

- Is the edge between two *immiscible* fluids with different density characteristics.
  - *Immiscible:* Incapable of being mixed or blended together
- In O&G applications for the upstream (onshore/offshore), midstream and downstream sectors the most common example of this is between oil and water fluids in process or storage vessels.

Float Switch

Sight Glass

Guided Wave Radar

Tape Systems

Servo Gauges

Magnetostricive

Pressure Based Technologies

Capacitive

Load Cells

Radiometric

Displacers

Sonar

Interface
Applications

- Selecting the right level technology can be difficult as there is no single level instrument that will work for all level applications.
- However, we have narrowed down the applicable instrument pool to 4 particular technologies in this next section.

Guided Wave Radar

Capacitance

Magnetic Level Indicators

Radiometric

Emulsion Layers

Emulsion Layers

- This is a mixture of two or more liquids that are normally immiscible.
- It is possible to have multiple emulsions in a single application such as water in oil in water emulsion.
- The density of an emulsion layer will vary depending on how the two fluids are distributed.
- An emulsion layer can lead to inaccuracies in the measurement of level interface.

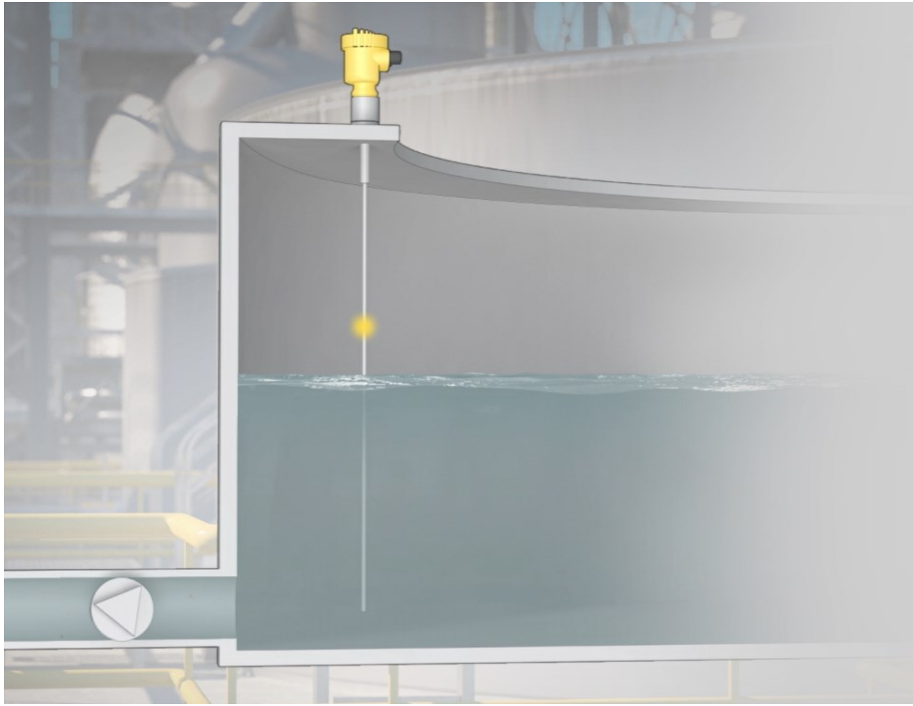
Image Courtesy of Kimray

Guided Wave Radar

Guided Wave Radar

Principal of Operation

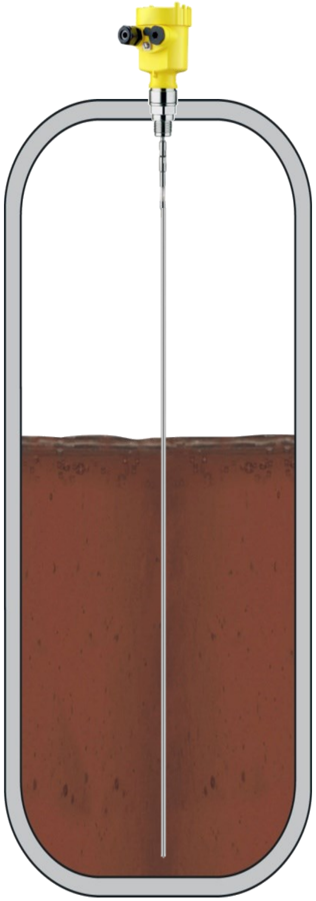
- Microwave pulses travel on the outer surface of a rod or cable
- The energy field has a radius of approximately 20 inches
- The product reflects the microwaves
- The running time of the pulse is used to calculate the level



Interface Measurement

Two **Products**

Only **Lower Product**



Only Upper Product

Guided Wave Radar

Advantages

- Even in applications with vapor, build up, foam generation and condensation, the sensor delivers precise and reliable measured values
- Can measure interface with vapor space or flooded
- Probes can be modified in the field
- No recalibration required
- High accuracy (+/-2mm)
- Unaffected by density changes
- No moving parts

Guided Wave Radar
Disadvantages

- Considerations in mounting locations
  - Height of nozzles
  - Proximity to vessel side walls
- Emulsion Layers:
  - Large rag layers can create inaccuracies and inconsistencies in the measurement as the GWR struggles to determine where the true interface level between the two mediums is located.

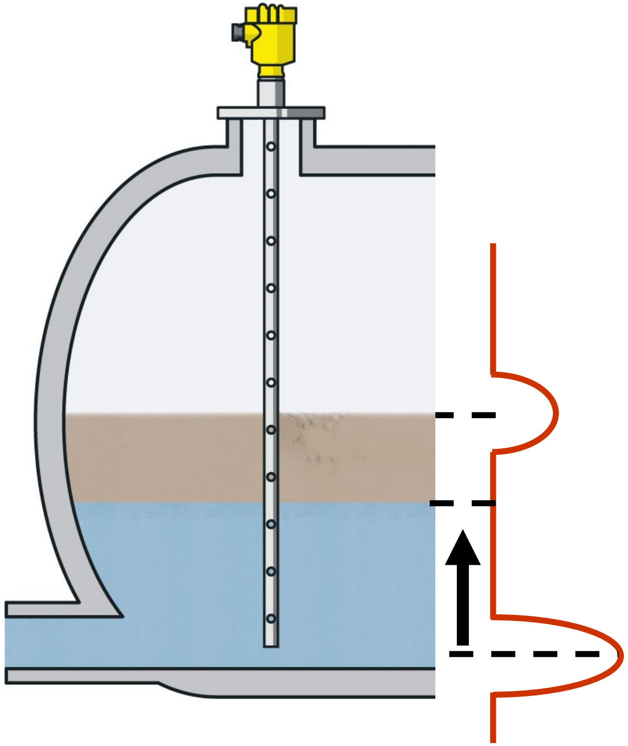
Guided Wave Radar

Interface Considerations

Upper medium (1)

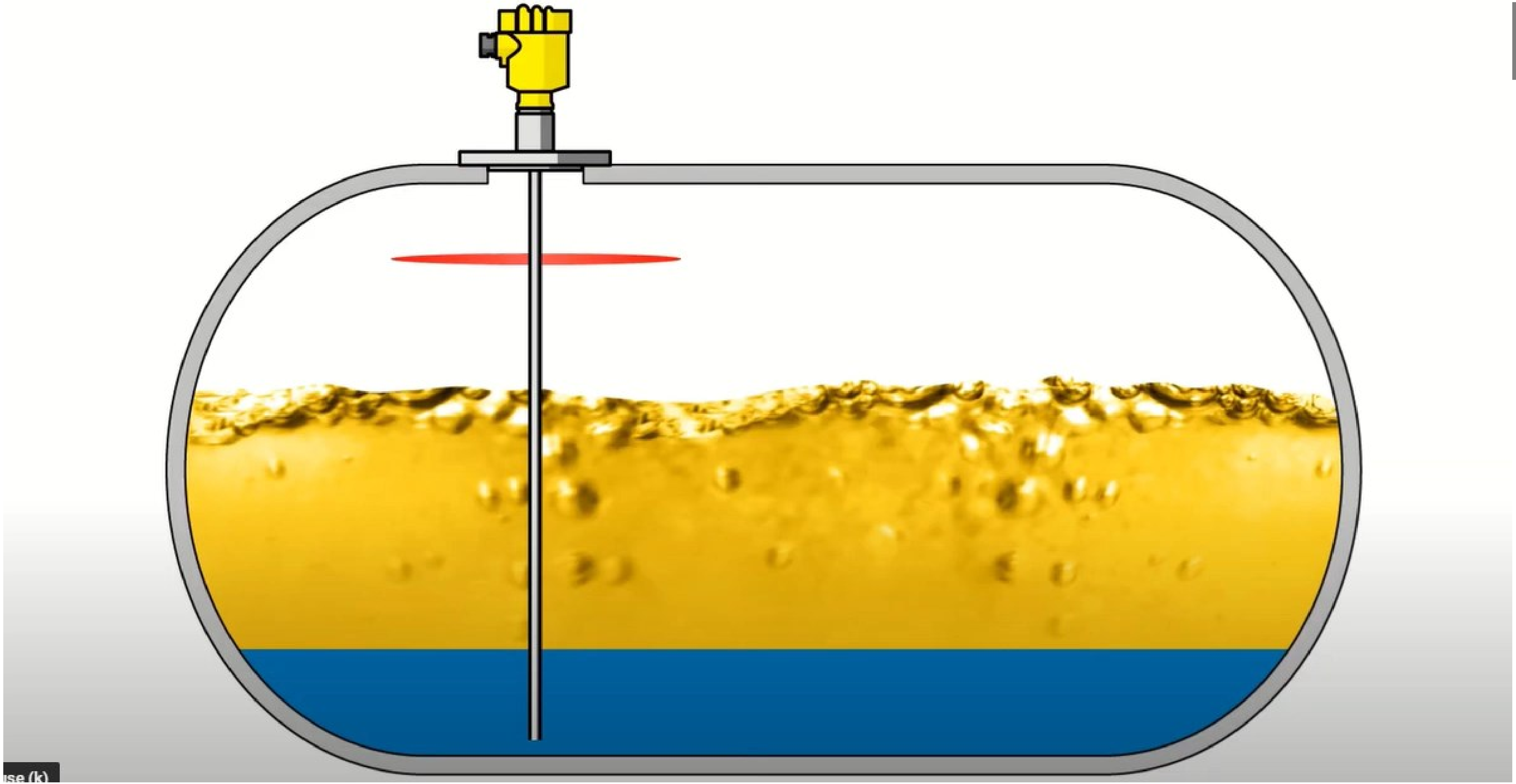
- The DK value must be known and entered
- Min. layer thickness = 2”
- Robust and homogeneous layer
- Low emulsion (< 4”) and no layer of reaction between the two products

- Lower medium (2)
  - The dielectric value must be at least 10 points higher than the upper product



Expert tip

- Consider integral stilling well for internal interface levels
- Slotted design to allow better fluid separation for interface applications.
- Stilling well can be segmented for extreme lengths.
- Highly customizable to meet a variety of installation requirements.


use (k)

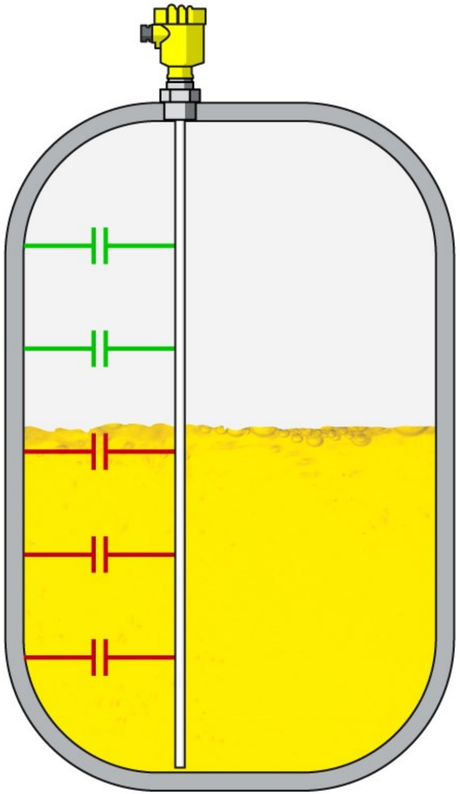

Interface measurement with guided radar | VEGAFLEX Series 80
s/n: 23568964
www.vega.com
Coating/plastic parts
Pause (k)
2:04 / 3:28

Capacitance

Capacitance
Principal of Operation

- The capacitive or admittance probe forms together with the vessel an electrical capacitor

- The capacity of the capacitor is determined by the:
  - Dielectric figure εr
  - Installation location of the probe (vessel distance, socket)
  - Height of the level



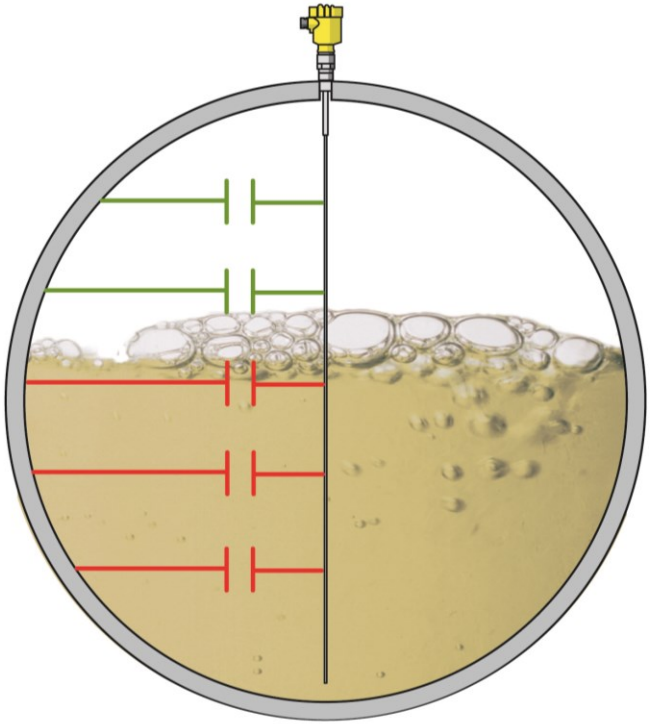
Capacitance
Advantages

- Reliable even in abrasive, aggressive or very adhesive products
- Proven and tested measuring principle - robust and safe
- Very low requirements to the installation conditions
- Measurement without blocking distances/dead zones possible

Capacitance
Disadvantages

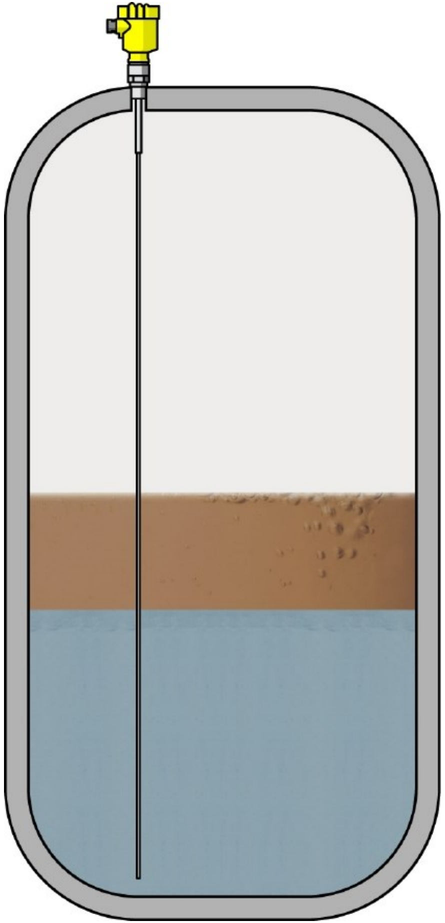
Cylindrical vessel

- 1” level at bottom results in more capacitance change than 1” level in the middle.
- If the dielectric value changes, then level indication also changes
- Large temperature changes can influence the dielectric figure
- The overall level cannot change, but the interface position can change.



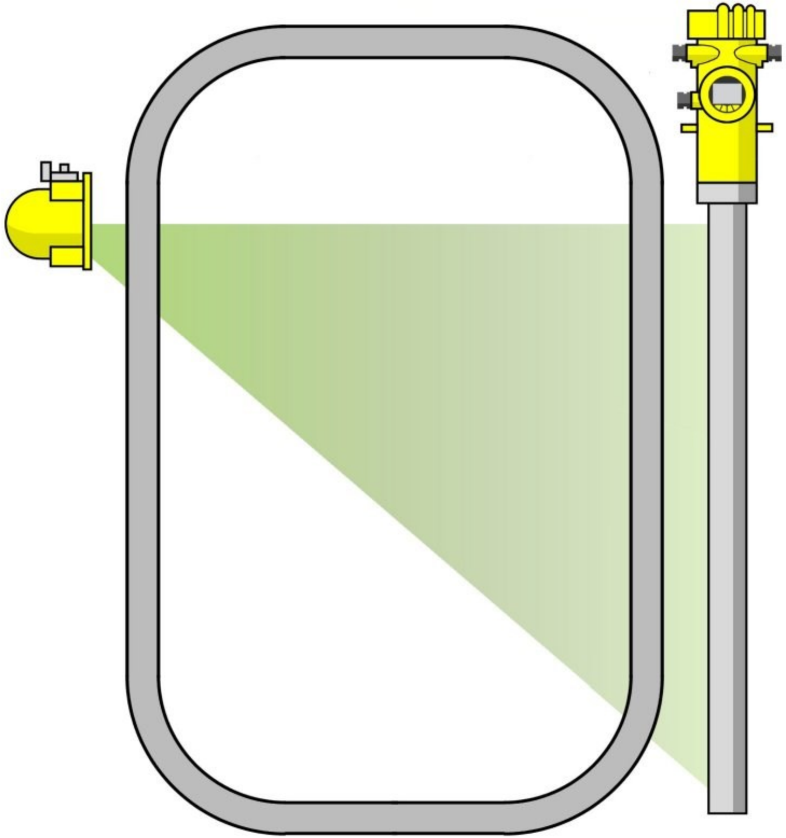
Capacitance
Interface Considerations

- Between conductive and non-conductive medium
- One of the two levels must remain unchanged, as e.g. with an overflow weir
- Special adjustment required
  - 0% = full covering with the non-conductive medium
  - 100% = full covering with the conductive medium
- Emulsion Layer:
  - Output remains constant however it is not possible to know for certain if your interface is clean or not.



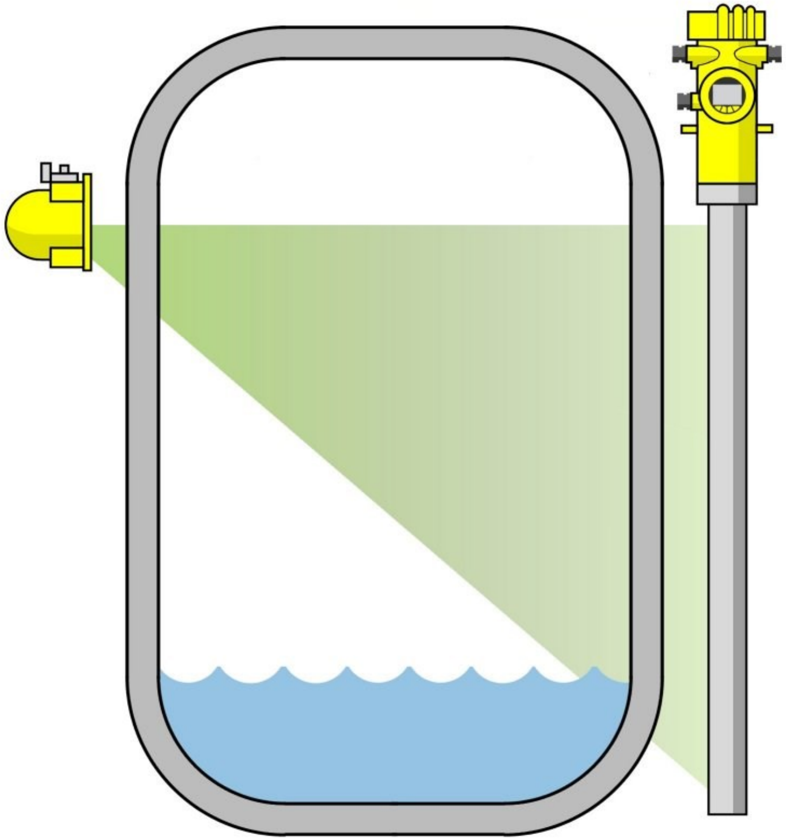
Radiometric

Measurement Principle



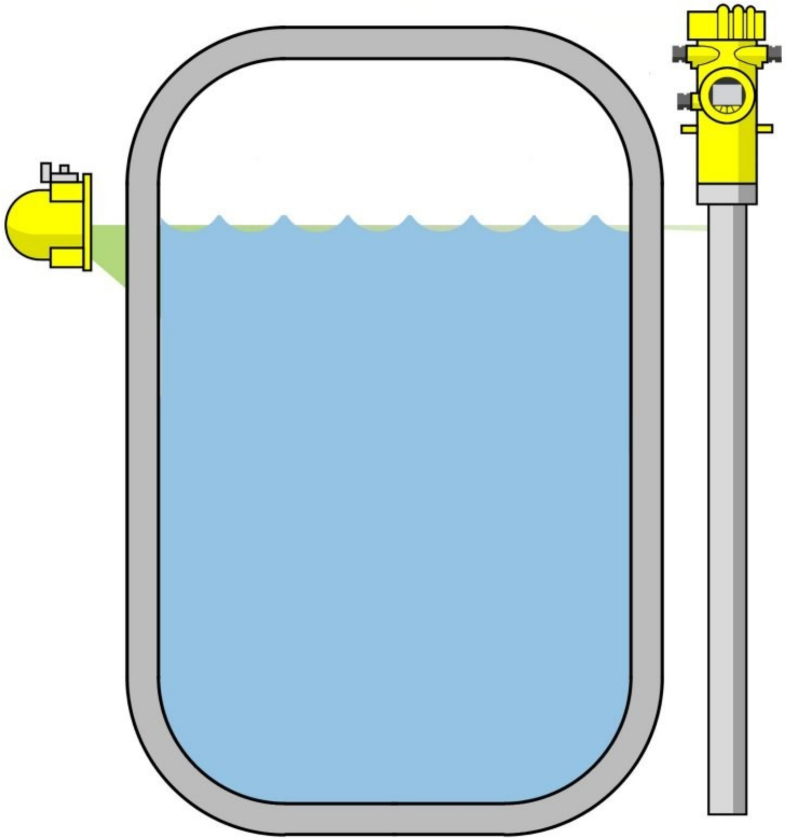
- Radiation beam passes through process container
- Beam is affected by changes in process mass

Measurement Principle



- Low mass absorbs least amount of radiation energy
- →High field at detector
- = Low Process Condition:
  - Low Level
  - Low Density
  - Low Weight

Measurement Principle

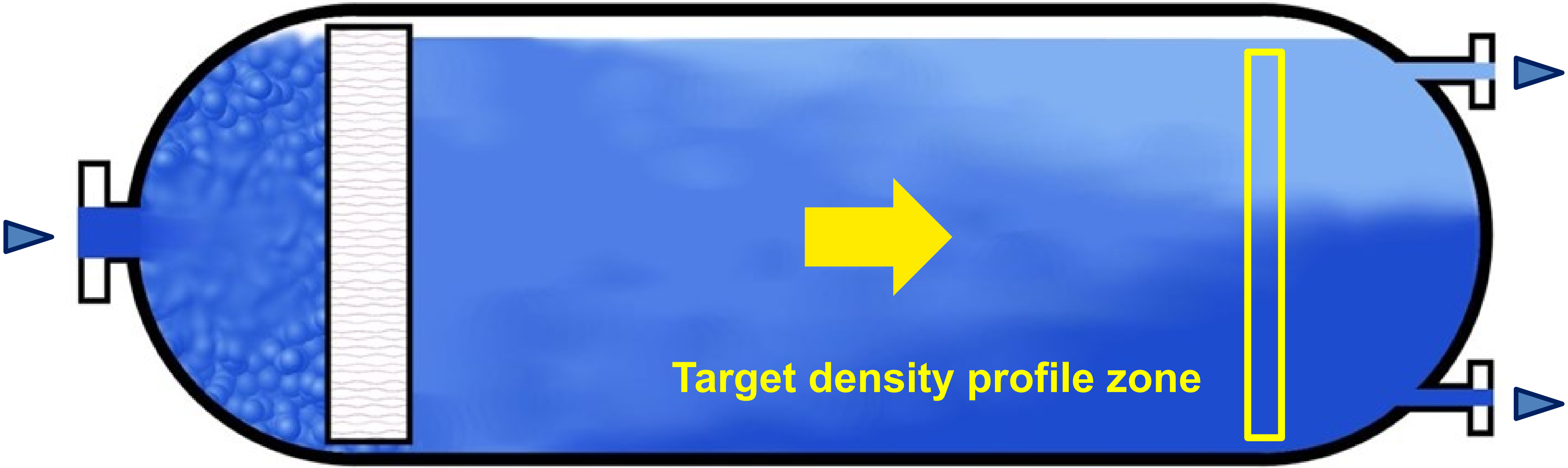


- High mass absorbs highest amount of radiation energy
- →Low field at detector
- = High Process Condition:
  - High Level
  - High Density
  - High Weight

Density Application

- Source and detector mounted on pipe center-line
- Preferred orientation: vertical run, flow up
- Counts fall as density increases
- Always need radiation at detector
- Can calculate mass flow with 4 … 20 mA flow input

Basic application: hydrocarbon separation



Need a solution that allows operator to increase throughput without decreasing outlet product quality

Enables reliably automated separation control

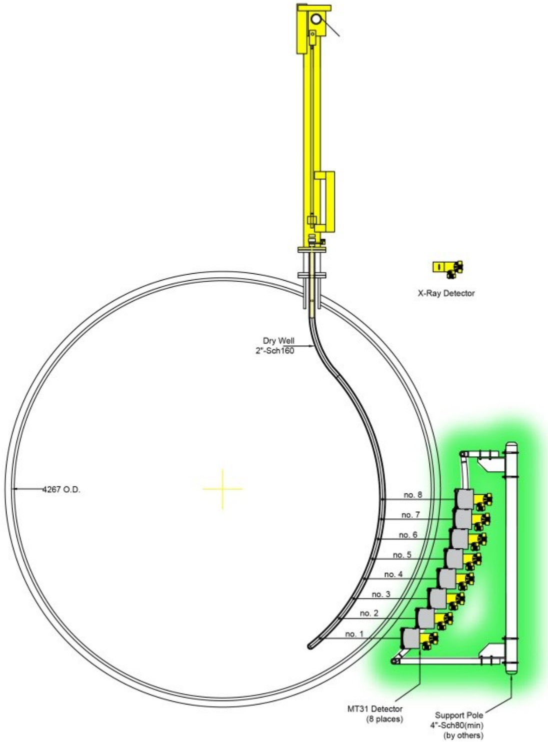
For new & existing vessels

Multi Density Array (MDA)

Nuclear Density Profiling

Fully independent of process variables

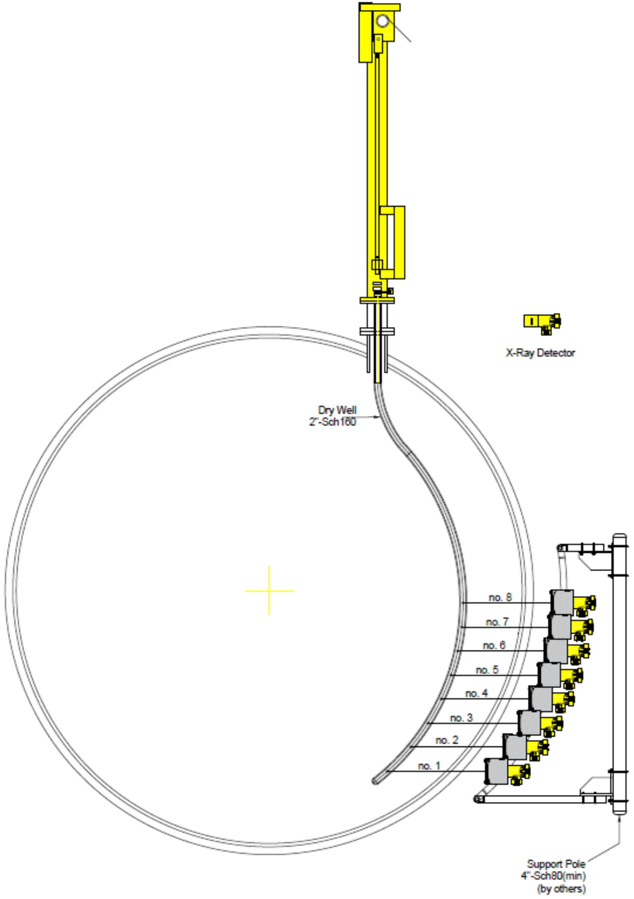
MDA Components



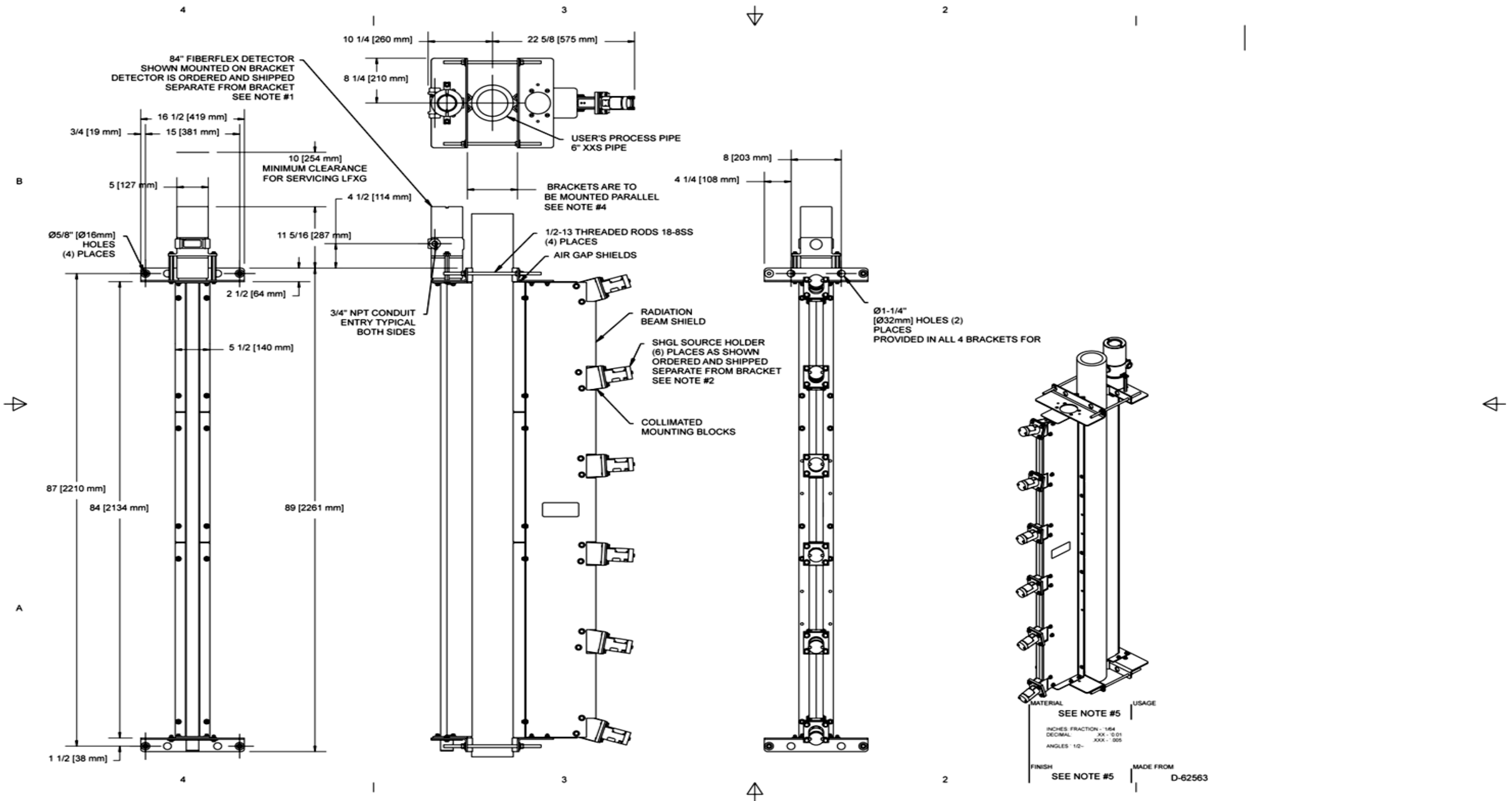
- Fixed radiation based profile system consisting of
  - Flange mounted source holder
  - Small Cesium sources in a drywell
  - High sensitivity density gauges mounted on the outside of the vessel
  - Optional X-ray detector
  - Flexible mounting bracket system

Drywells

- Can be **straight** or **curved**
  - Curved wells are limited by the nozzle configuration (size/height) to pass the curved drywell
- Application and available nozzle location determine drywell configuration
- Typically will be Schedule 40 to Schedule 160 pipe
- Carbon or stainless steel material (others on request)

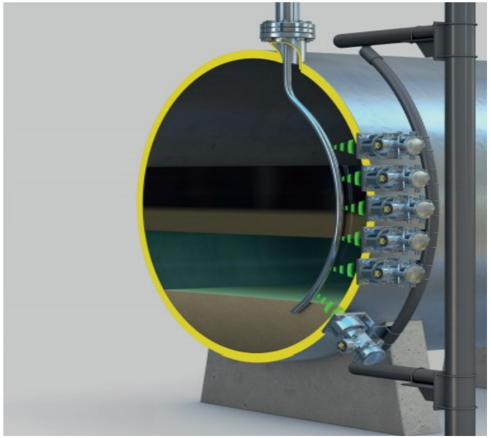


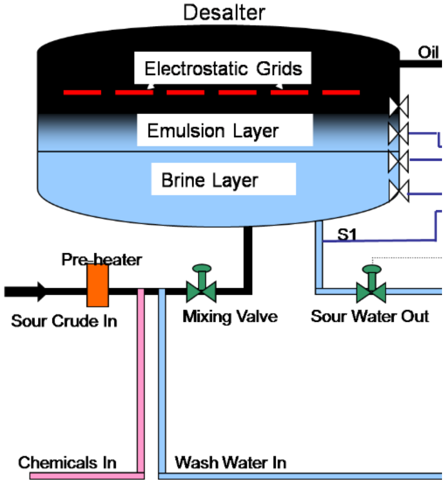
Possible Alternate Solutions



Desalter Operation

- Heavy Crude Slate In
  - Varying crude qualities
  - Slug issues from tank farm
- Separation induced by
  - Mixing water with chemicals and crude
  - Electrostatic Grids
- Maximize Quality & Thru-put
  - Minimum water contained in oil outlet
  - Minimum oil in water outlet
  - Maximum production of desalted oil
  - Automated control even under upset situations





Reality with Emulsions

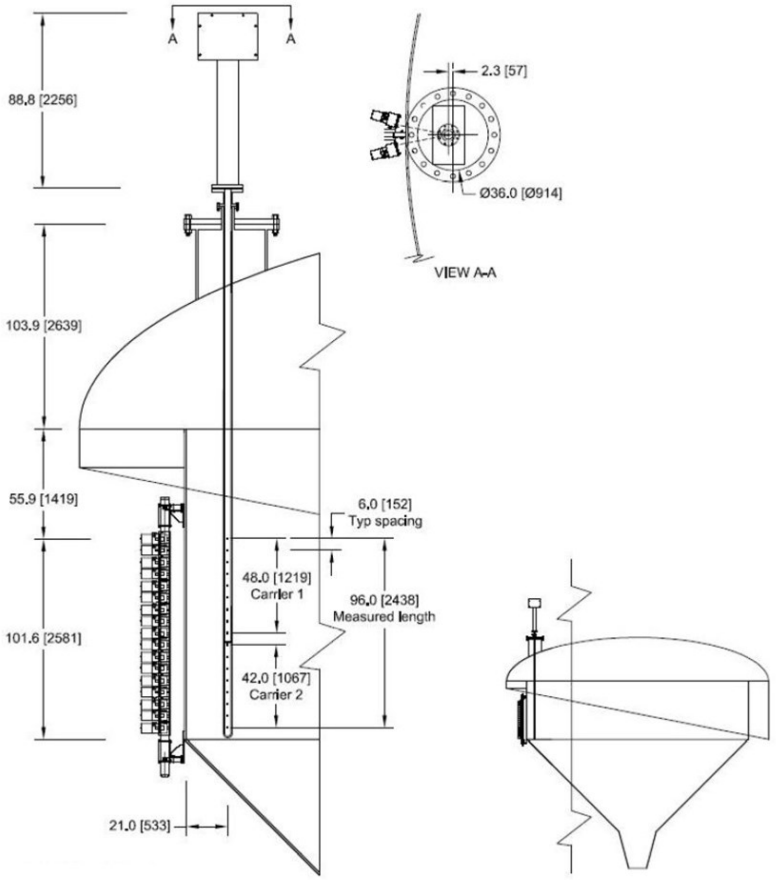
Manual Sampling Systems

- Scheduled lab sampling not efficient
  - Conducted periodically, NO real time measurement
  - Human mistakes (sample swap, wrong tapping, etc.)
  - HSE risks when taking samples

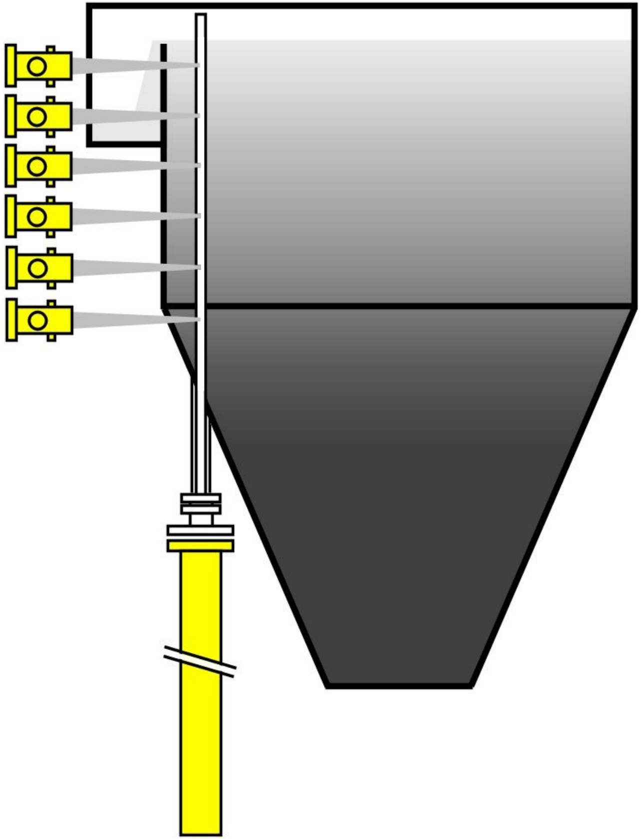
Resulting in:

- Over / Under treatment of emulsion
  - Chemical costs
- Excess water with dissolved salts/minerals into the refinery
  - Long term corrosion issues
  - Wasted energy in heating
- Water too high into the grid
  - Grid shorting causing delays and damage
- Oil under carry into the WWTP
  - Potential environmental offense

Surface Extraction – Primary Froth Separator



Surface Extraction – Flotation Separator



Magnetic Level Indicators

Magnetic Level Indication

Principal of Operation

- The float used in the bypass with integrated permanent magnet system transmits the liquid level contactless to the magnetic display mounted on the outside of the bypass.

- Thus, the level of a vessel is displayed on the magnetic indicator without external energy and can be seen from afar.

Magnetic Level Indication

Advantages

- Great alternative to sight glasses
- Improved visibility and elimination of leak paths associated with sealing glass
- The MLI can be isolated for maintenance without taking the process vessel out of service.
- Multiple transmitter technologies available for redundant monitoring of liquid level.
- Simple structure, easy installation and does not require power (MAG itself)

Magnetic Level Indication

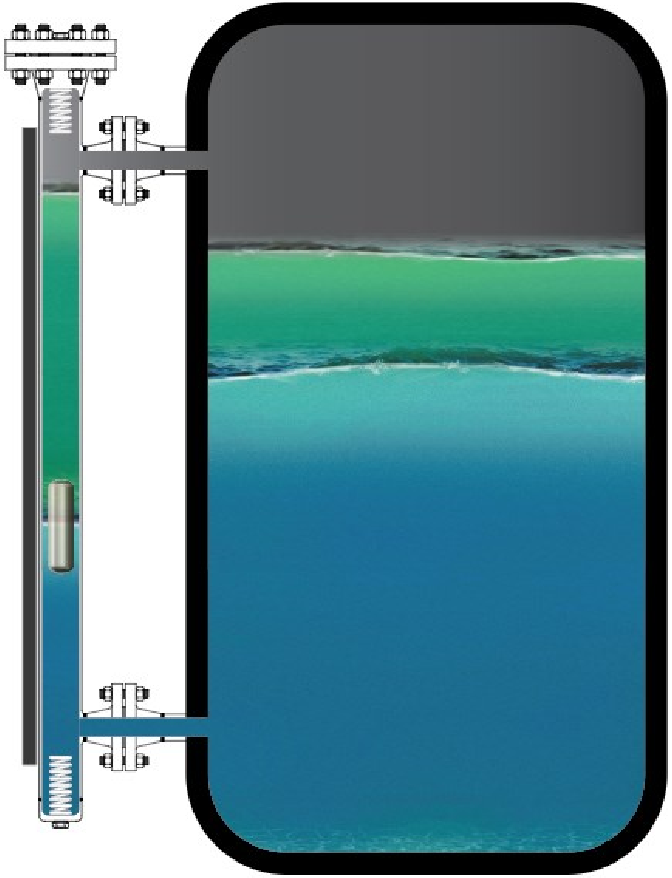
Disadvantages

- Specifications are critical for float selection
- Challenges with dirty services with the potential for build ups to occur
- Density changes can effect the accuracy of the measurement
- Emulsion Layer:
  - Difficult to predict where the float will be positioned in the rag layer

Magnetic Level Indication

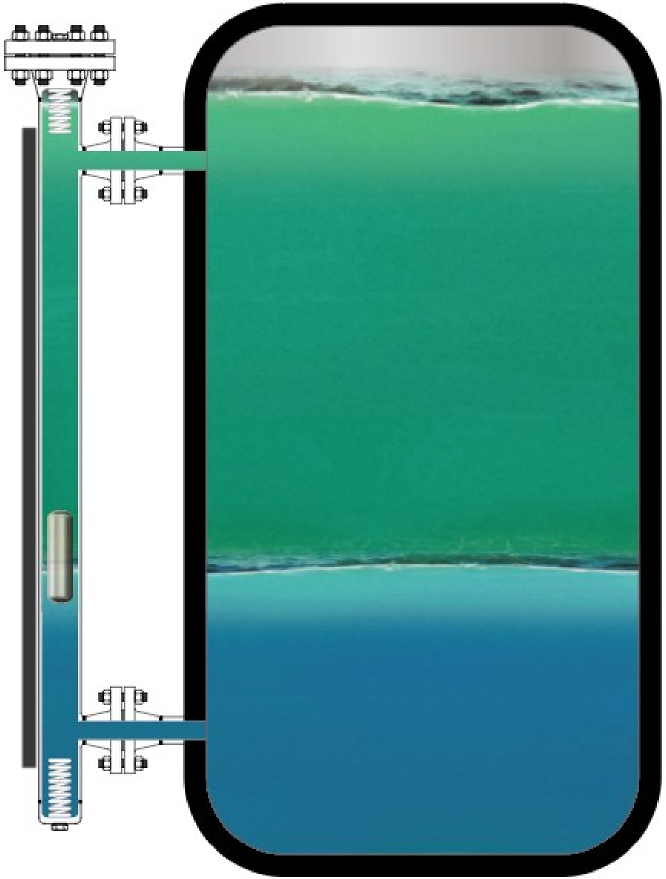
Interface Considerations

- Both process taps need to be covered with fluid. If not, the magnetic level indication may possibly not read the same as the interface seen within the vessel



Magnetic Level Indication
Interface Considerations

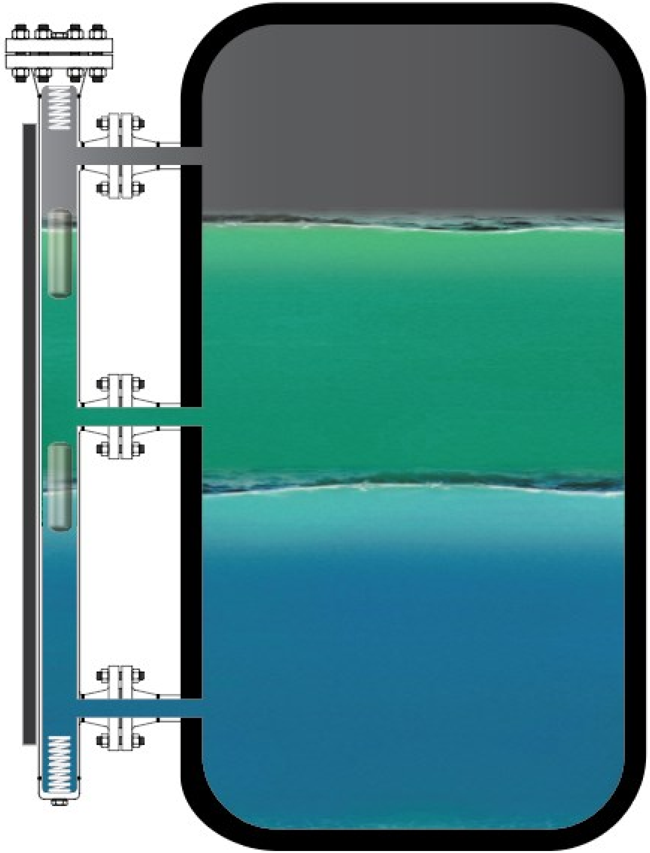
- A flooded chamber allows for accurate level representations with only two process connections



Magnetic Level Indication

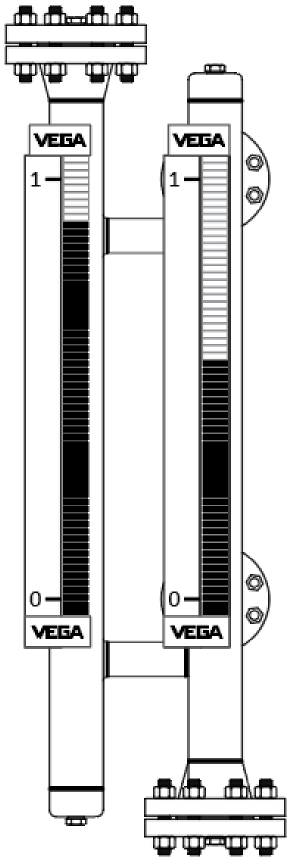
Interface Considerations

- Specify additional process tap
- Upper layer thickness is critical to avoid float interference



Expert tip

- Consider optional design for dual float measurement for interface applications



Key Takeaways

- Recognize different technologies for level interface level measurement.
- Understand limitations to the corresponding technology.
- Understand considerations for technology selection.

Speakers

Jonathan Hermosillo

Direct Sales – Los Angeles

J.Hermosillo@VEGA.com

909-706-5924

Dan Stigler

EPC Manager

D.Stigler@VEGA.com

Questions?