Electrostatic Desalting

What does Neet Know?

- **Newer company with familiar faces (est 2019)**
  - Founded to counter "*the dark ages*" of desalter design
    - Large companies replace best practices for marketing and low cost
    - Small companies copy designs without real knowledge of why
    - A successful design is done empirically – we aim to preserve that knowledge

- **Recognized refinery desalting design experts**
  - Each individual team member has decades of experience specifically in refinery desalting
    - Most junior member -19 years
    - Most senior member - 41 years

- We are a technology company who provides service, not a service company mimicking technology they see

- Team members have participated in several white papers, patents, and appearances as panel experts in desalter design and optimization



Desalter Major Components (High Level Overview)

Voltage controller - Adaptive Control Electrostatic (ACE) automatically sets applied voltage, as required, constantly changing per the desalter's internal electrical environment. Programmed based on empirical knowledge Optional upgrade for optimization – one to three per desalter as required

Level Control Instrumentation - one or more technologies per desalter. Supports operation by controlling internal interface levels

Can be capacitance, radar, sonar, nuclear or other technologies. (Sonar Pictured courtesy of Transducer USA)
SS, Monel, Hastelloy or other metallurgies.

Desalter Major Components (High Level Overview)

Local Control Panel – One per design. On/Off pushbutton with analog volt and amp meters. Can include a pilot light as well as 4-20mA transmitters for remote indications

Level Switch - one per desalter. Safety interlock, wired normally open allows the power units to energize only when the technology host vessel is liquid full

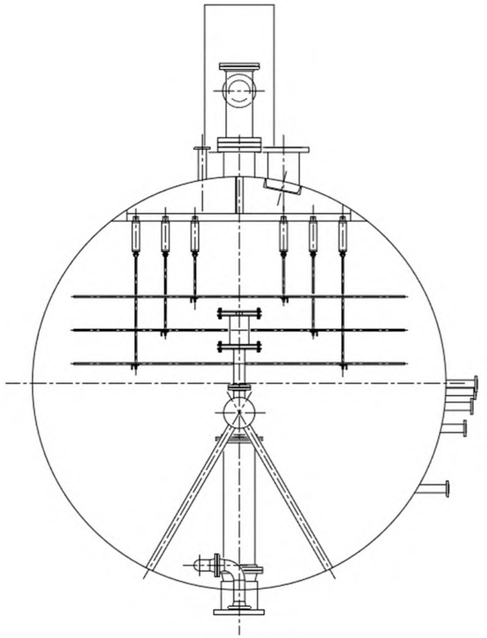
Can be mechanical float, capacitance, radar, sonar, or other technology.
(Sonar Pictured courtesy of Transducer USA)
SS, Monel, Hastelloy or other metallurgies.



Desalter Major Components (High Level Overview)

Internal headers – CS or SS, removable

Mudwash – sediment removal
Crude Inlet - distribution
Crude Outlet – metered collection
Cuff – upset rag removal
Effluent water – metered collection (when installed)



Electrical Grid – Solid CS recommended.
Some examples are composite materials, SS or a hollow tube
Vertical or horizontal orientation

Some illustrations are the property of Neet Desalters while other photographs/illustrations are only examples used from Google.com and Bing.com

Desalter Major Components (High Level Overview)

<u>Insulator</u>- physically supports grid and electrically insulates grid from ground
Teflon or other proprietary plastics blend

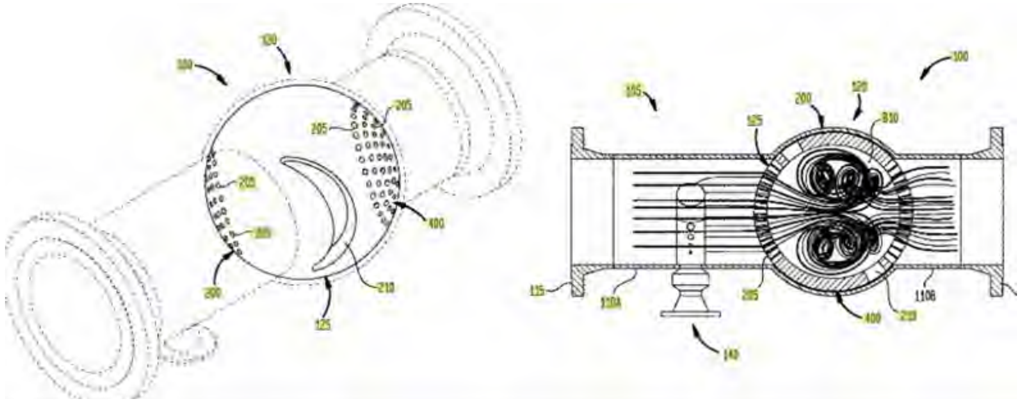
<u>Entrance Bushing</u> – vessel pressure boundary, transfers power from power supply to grid
Teflon or other proprietary plastic



Desalter Major Components (High Level Overview)

Emulsification Device – Mix Valve
Traditional valve to create sheer and resulting dP
dP is amount of "mix" applied to the emulsion
dP is adjustable by position of valve stem
Aggressive to lite mixing applications

Static Mixer – in line dedicated mixer
Includes packing, typically SS, set to generate a specific dP for a specific crude rate and type



Proprietary Valve Like Mixer – relatively low dP
set to generate a specific dP for a specific crude rate and type
Some limited adjustability
Tends to be lite mixing in application
(graphic source Google Patents US patent 10828610B2, inventor Tom Collins and others)



Stokes Law

$$V = K\,(D^2(P_w - P_o))\,/\,\mu$$

- V = Velocity of water drop
- D= Diameter of water drop
- P_w = density of water
- P_{o} = density of oil
- μ = viscosity of oil



Electrical Environment

Per Stokes Law, Diameter is the largest contributor to rate of separation.

In an electrical desalter, diameter is affected by:

1) water droplet size set by the mixer and
2) wash water population set by wash water rate and
3) electrostatic coalescence (effectiveness of small drops into large drops)

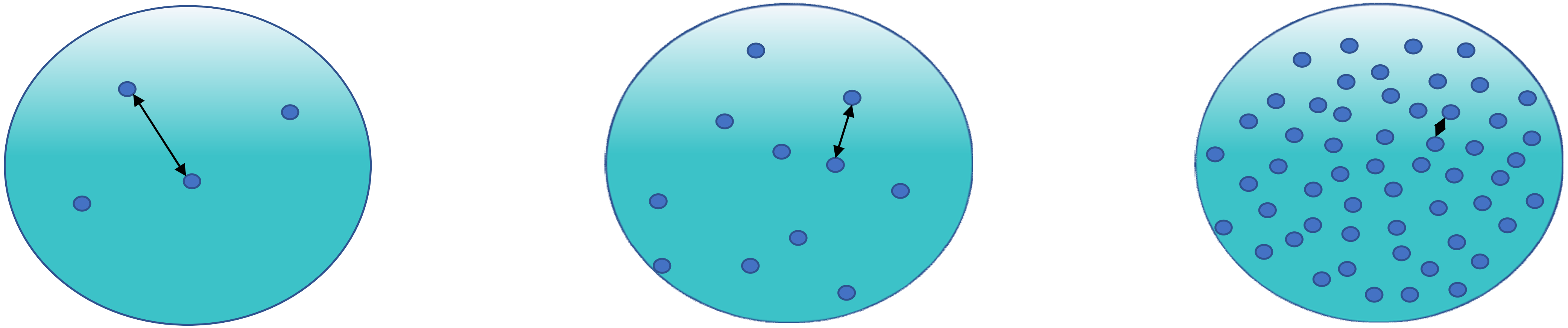
Electrostatic coalesce occurs when brine droplets in a crude oil / water emulsion enter

A) an electrical field and
B) are in close enough proximity to each other to attract, migrate together, and form larger drops.

The electric field is the force that moves the droplets by inducing a voltage into each drop. The induced charge then moves the droplet.



Distance Between Drops



0.5% 5% 10%

Some illustrations are the property of Neet Desalters while other photographs/illustrations are only examples used from Google.com and Bing.com

Crude Continuous Water Emulsion

- Mixture of Two Immiscible Liquids

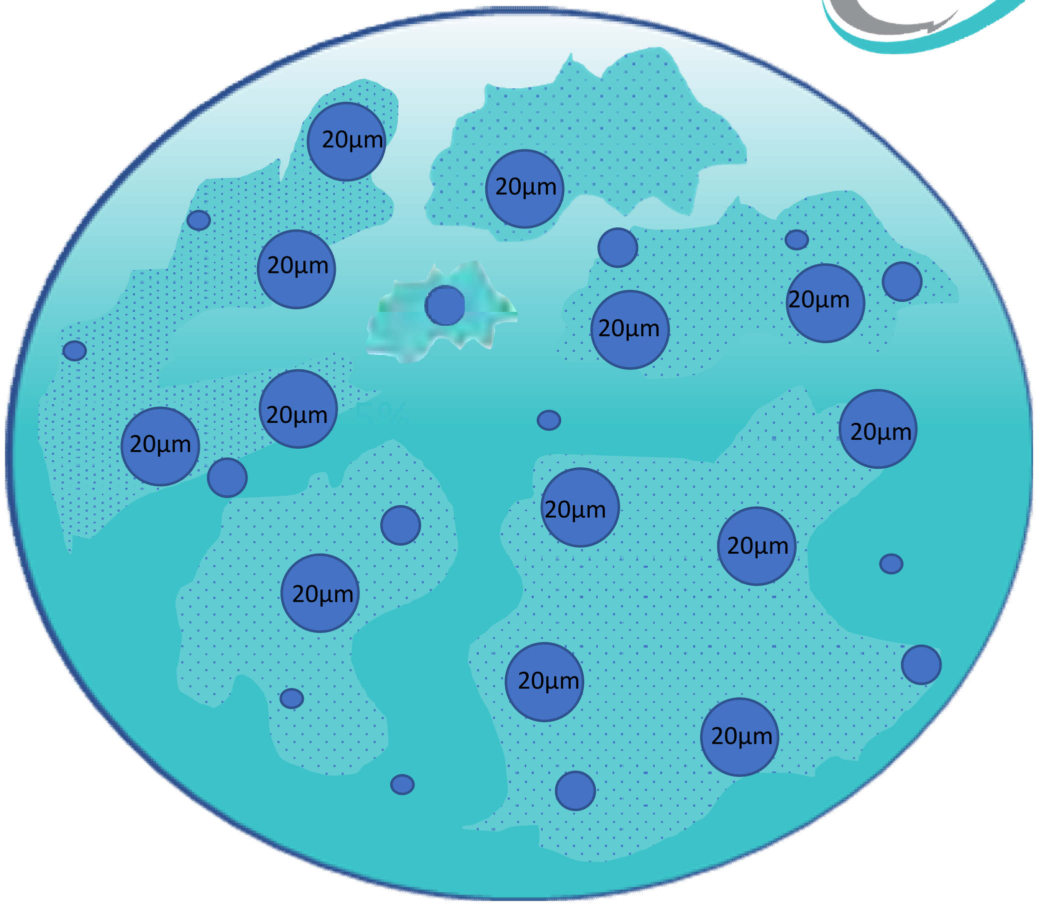
- Energy from Sheer Produces Small Droplets
- 1- 20 Micron in Diameter

- 2 Phases
  Crude Oil Continuous
  Water Droplets

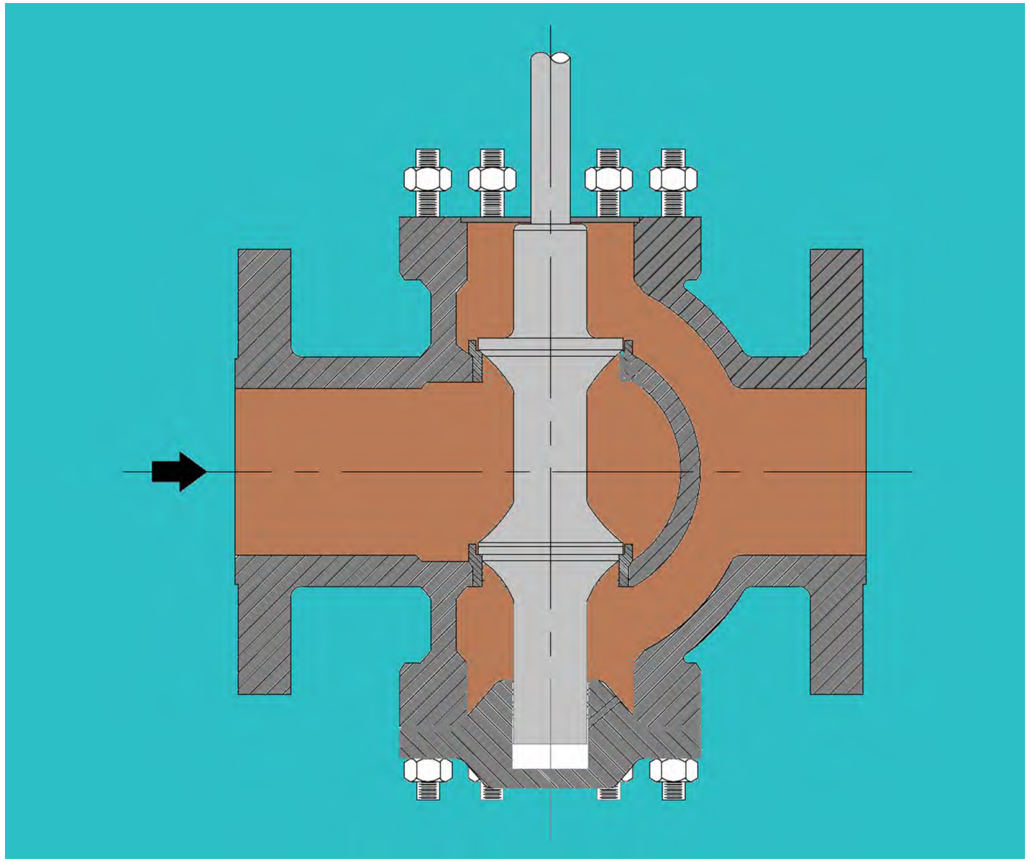
- Presence of Surface-Active Emulsifying Agents in Crude

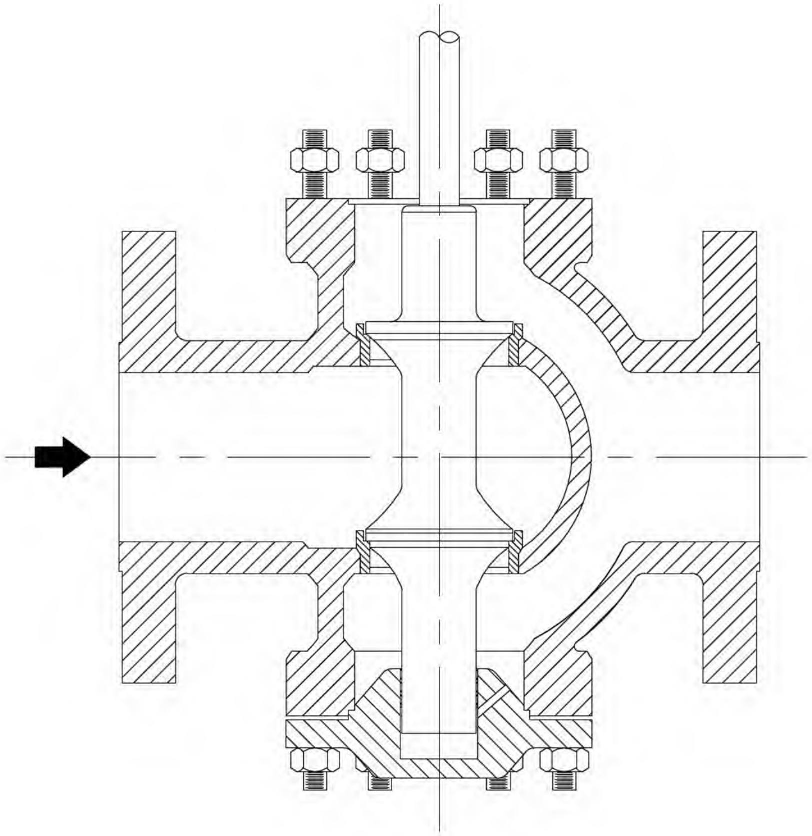
- Barriers Formed Around Water Droplets Block Coalescence

- Emulsion Becomes More Stable Over Time



Emulsification Device Valve Internals

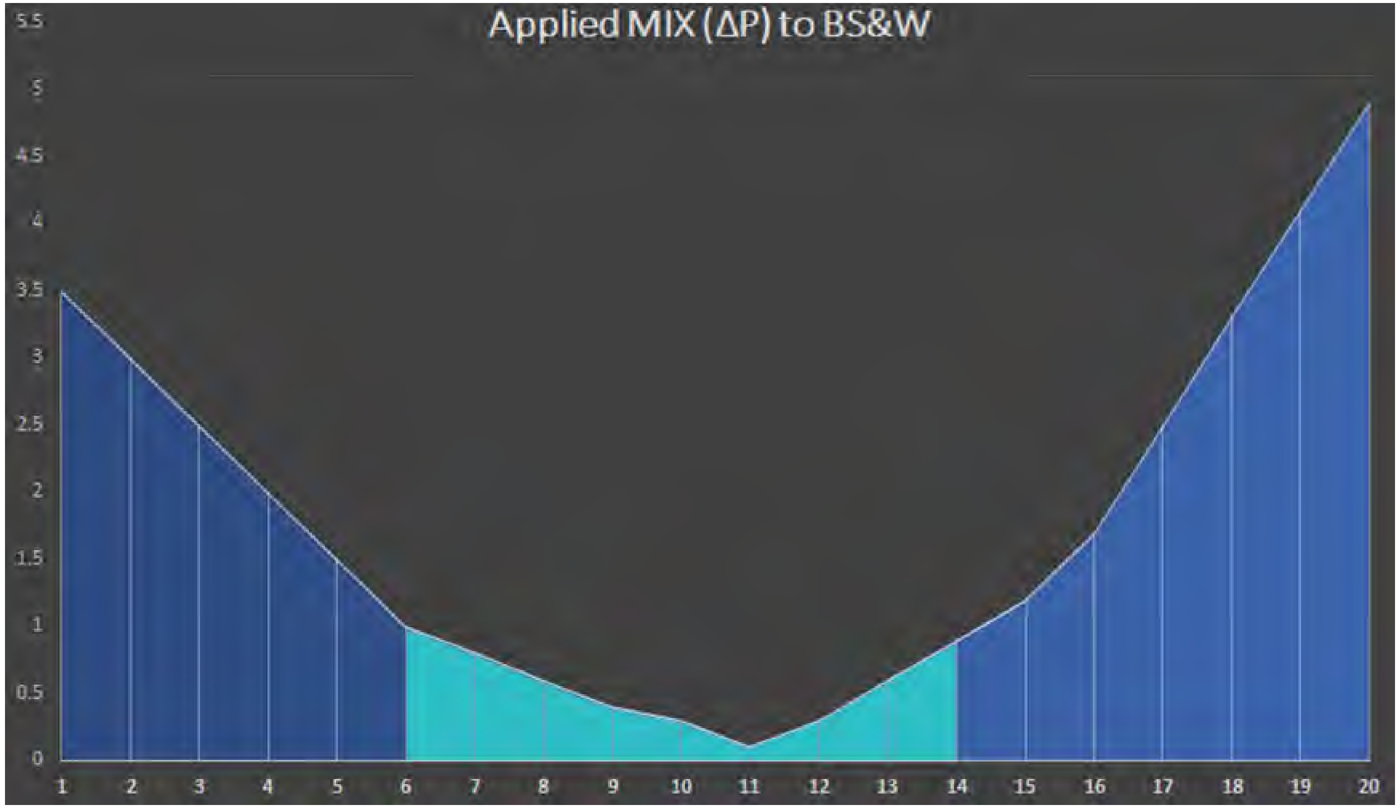




Some illustrations are the property of Neet Desalters while other photographs/illustrations are only examples used from Google.com and Bing.com

Mix Rate Relation to Desalted Crude

BS&W



ΔP



Some illustrations are the property of Neet Desalters while other photographs/illustrations are only examples used from Google.com and Bing.com

Optimum Salt Value (A)

$$A = \frac{(S_o + 0.01WS_w)f}{W + i}$$

- S_o= Salt Content of Raw Oil, PTB
- S_w= Salt Content of Wash Water, PTB
- W= Wash Water Volume Percent, bbls of Water Per 1000bbls Oil
- f = Final Water Content of Desalted Oil (as a percent)
- i = Initial Water Content of Raw Oil, (as a percent)



Optimum Salt Value and Process H2O Usage Efficiency

Process Water Usage Efficiency (E)

- S_o= Salt Content of Raw Oil, PTB
- s= Salt Content of Desalted Oil, PTB
- A= Optimum Salt Content as defined in prior slide

$$E = \frac{S_o - s}{S_o - A} \times 100$$



Optimum Salt Value

Interpreting Optimum Salt Value

- Effective determination of water content (both raw & desalted) is critical to the Process Water Usage Efficiency calculation
- High Process Water Usage Efficiency can still give poor salt removal if water carryover is high
- Low Process Water Usage Efficiency will always result in poor salt removal

$$E = \frac{S_o - s}{S_o - A} \times 100$$

$$A = \frac{(S_o + 0.01WS_w)f}{W + i}$$




NEET
REFINERY DESALTERS
IT'S WHAT WE DO
Electrostatic Desalting
www.neet-desalters.com
Toll Free 833-2-DESALT
TOM@NEET-DESALTERS.COM