ENGINEERING
TECHNOLOGY
INC.

ELECTROSTATIC DEHYDRATORS

. . . . . New Generation Ultrastatic™ Tri-Phase Electrostatic Treating

Engineering Technology, Inc. (**ETI**) manufactures and markets several types of Electrostatic Crude Oil Dehydrators, Coalescers, Heater Treaters, and Desalters. These include AC, single phase AC, AC/DC dual voltage, and Ultrastatic tri-phase units.

Process Flow Description/Operation

2000 bpd Crude Oil Desalter
for Diesel Topping Plant
British Petroleum Cusiana Field
Colombia, South America

The ETI coalescer and heater treater design incorporates horizontal and vertical fluid flow.

Figure 1 is a coalescer design displaying the fluid flow path through the unit.
Figure 2 is a coalescer design with degassing and freewater knockout removal.
Figure 3 is a heater treater design equipped with a firetube for heating the crude to the treating temperature.

The ETI electrostatic units use 100% reactance step-up transformers to obtain the required operating high voltage. The transformer is oil filled and can be supplied for different supply voltages. An external four position no-load tap switch is standard for optimum voltage selection. One side of the high voltage secondary transformer winding is grounded to maintain the same potential as the water phase within the vessel. The secondary high voltage is transferred through the vessel shell to the energized electrodes by an insulated high voltage feed thru assembly. The electrodes are located in the top of the vessel.

All three electrostatic designs use a high gradient field between the closely spaced grid plates for coalescing of small micron size water droplets and a lower gradient field from the bottom of the grid plates to the water phase for coalescing of large micron size water droplets. Oil flows vertically through vertical grids and out performs horizontal flow through horizontal grids or vertical grids.

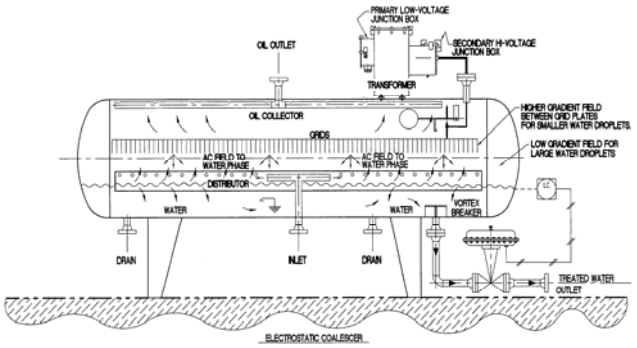


Figure 1.

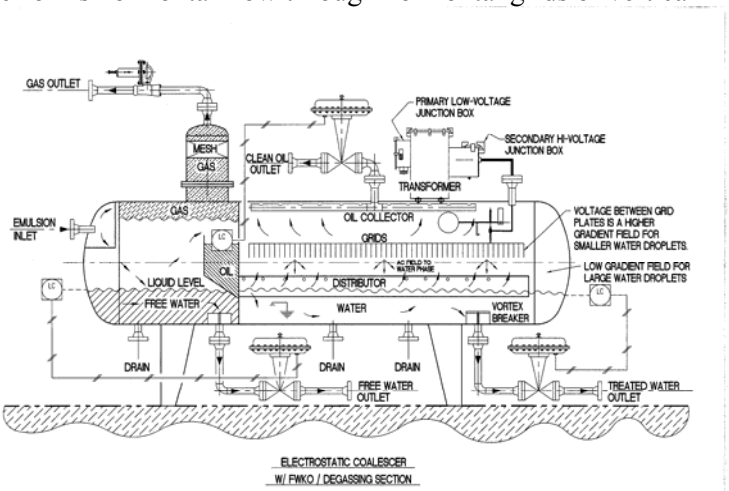


Figure 2.

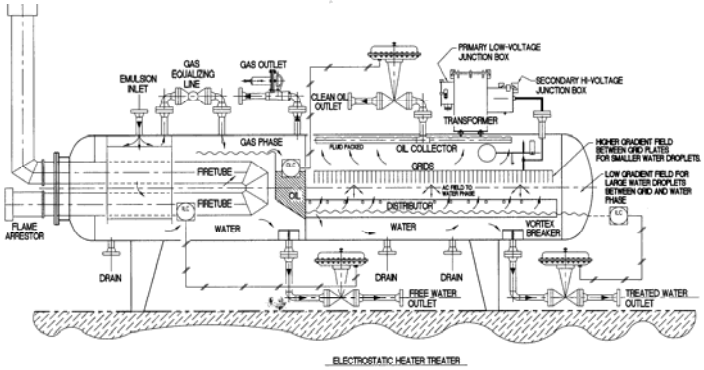


Figure 3.

Electrostatic Fields

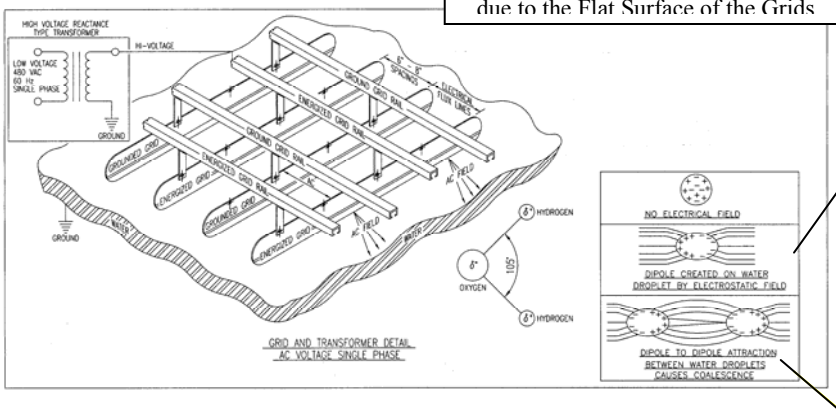
The electrostatic field accelerates the dehydration process by imparting electrical charges to water droplets that are present in the crude oil stream. The electrostatic process requires the stabilizing agents surrounding the water droplets be weakened by heat and chemical demulsifiers.

A water molecule consists of a central oxygen atom that has a partial negative character (δ^-) and two (2) hydrogen atoms each having a partial positive character (δ^+) (Figure 4). When a water droplet enters an electrical field, a dipole is created. A dipole exists when the ionic charges that are inherent in a droplet are separated so that the positive ions move to one end of the droplet while the negative ions move to the other end. When these dipoles are created the ends of droplets that are positive are attracted to the ends of droplets that are negative. This electrical attraction results in collisions between droplets. These collisions continue until the droplets coalesce large enough to settle into the water phase of the vessel.

AC FIELD

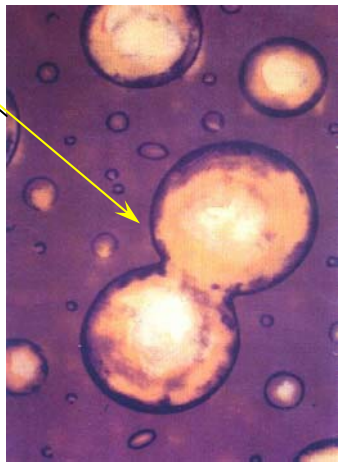
The AC field grid and transformer is shown in figure 4. The energized grid plates are insulated from the vessel shell by teflon insulators, where as the ground grid plates are attached to the vessel shell.

All electrical Flux Lines between the Grid Plates are of the same Gradient due to the Flat Surface of the Grids



Water droplets within an AC electrical field are shown below. The top sketch demonstrates a zero voltage output, where the droplet is spherical. The middle sketch illustrates an energized field, where the droplet elongates into an oval shape, with separated positive and negative charges. The dipole exhibits a magnet-like polarity The bottom sketch illustrates the polarized ends of the droplets attracted to the one another. Molecular vibration creates coalescence

Figure 4.



16,500 BOPD Electrostatic Coalescer
Elf Exploration Inc., Offhore Gulf of Mexico

AC/DC FIELD

The AC/DC field grid and transformer arrangement is shown in figure 5. All of the grid plates are insulated from the vessel shell. The grid plates are charged opposite polarities (positive/negative) by a rectifier package located in the transformer. Consequently a high gradient DC field is sustained between the opposite grid plates and a lower AC field voltage is imparted to the water phase within the vessel.

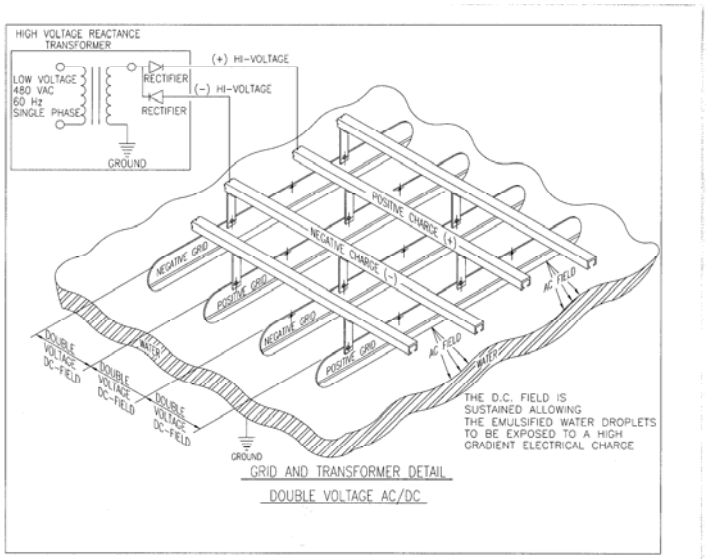
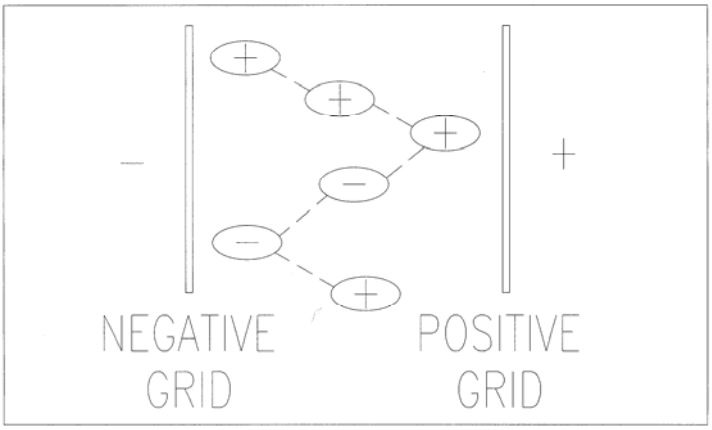


FIGURE 5.



As the droplets rise toward the oil outlet collector pipe, they encounter the AC field of the double voltage system, where large water droplets are coalesced. As smaller water droplets enter the sustained DC field between opposite grid plates, the water droplets are attracted to the grids of opposite polarity. As the water droplets approach the oppositely charged grid, the opposing charges within the droplet are stripped away, leaving a droplet of the same polarity as the grid. Since identical polarities oppose each other, the droplet is repelled toward the opposite grid. During this continuous attracting and repelling process, collisions of droplets occur. When they are large enough, gravity overcomes the sustained DC field and the droplets settle to the water phase.

40,000 BOPD Electrostatic Treater and 4th Stage Separator
BP Colombia, Cusiana EPS

ETI's New Generation Ultrastatic Tri-Phase Electrostatics

The Ultrastatic tri-phase grid and transformer arrangement is shown in figure 6. All of the electrode grids are electrically insulated from the vessel shell. The continuous voltage field is present in the tri-voltage electrostatic unit. Figure 7 represents the phase angle and the voltage gradient between the three (3) energized grids and between individual grids to ground.

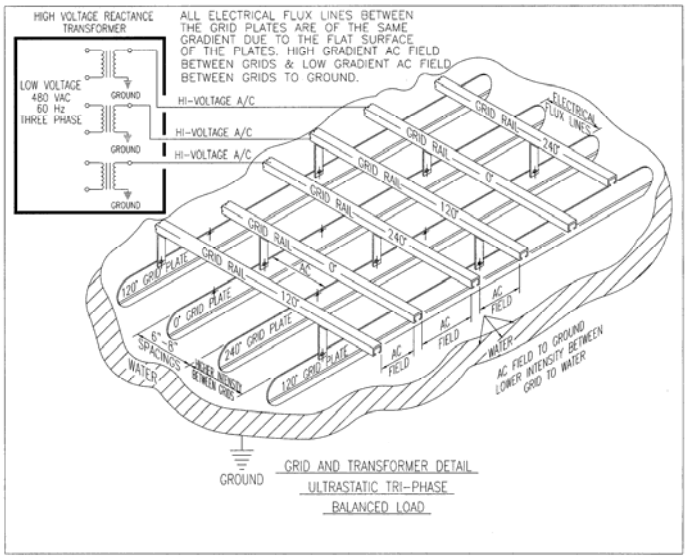


Figure 6.

ADVANTAGES

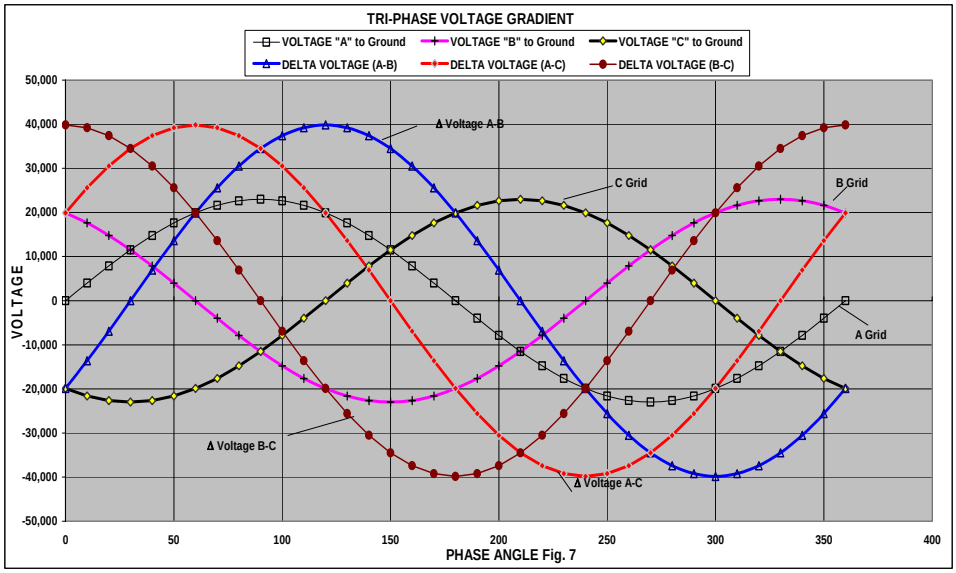
AC - Single Phase Electrostatics

1. More cost effective electrical system
2. Will dehydrate a higher percent (%) inlet water/oil emulsion when compared to a unit of dual voltage design
3. Will dehydrate to a lower BS&W content when compared to units using a rod type grid system

ADVANTAGES

AC/DC Dual Voltage Electrostatics

1. Operate at lower process temperatures
2. Higher design capacities/smaller vessel sizes
3. Less operating cost



ADVANTAGES

Ultrastatic Tri-Phase Electrostatics

1. Balanced load for electrical system
2. All grids energized to ground
3. Higher voltage between grids for lower levels of dehydration
4. Higher capacity than single phase electrostatics (fewer null voltage nodes in grid system)

10,000 BOPD Electrostatic Heater Treater
ARCO Oriente – Villano Development
Oriente Basin, Ecuador

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