Case Study

ADVANTAGES OF OIL/WATER SEPARATION USING CONCENTRATION CONTROL VS. INTERFACE CONTROL

Free Water Knock-Outs, Desalters and Dehydrators are just some of the applications in the oil industry where it is necessary to separate water and oil.

The density differences between water and oil causes water to drop to the bottom of a separation tank, and oil to rise to the top. When a desired amount or level of water has separated, it is removed through a water draw-off dump valve.

In some applications, costly emulsion-breaking chemicals, electrostatic precipitation and/or fire tubes are required to assist the separation process.

EMULSIONS

Emulsions are the most serious problem in oil/ water separation.

SIZE

Emulsion build-up is caused by mixing valves, crude properties (surface tension, viscosity, density), contaminants, vessel temperature, and retention time. Emulsion droplets are mutually cohesive and tend to form a growing pad.

DIRECTION

To avoid dumping oil with the free water, it is necessary to control emulsions such that they can only build above a control point. In other instances it might be desirable to force the emulsions to build below the control point.

TRADITIONAL CONTROL METHODS & THEIR PROBLEMS

Traditional methods of controlling the separation process involve the use of a Sight Glass, Float, and/or a Capacitance Probe.

IDEAL WORLD

Fig. ‘A’ shows these instruments working under ideal conditions. A 100 bbl vessel contains 60 bbl water and 40 bbl oil, separated with a distinct interface. (This situation rarely occurs in the real world, where we would expect to see an emulsion layer as shown in Fig. ‘B’).

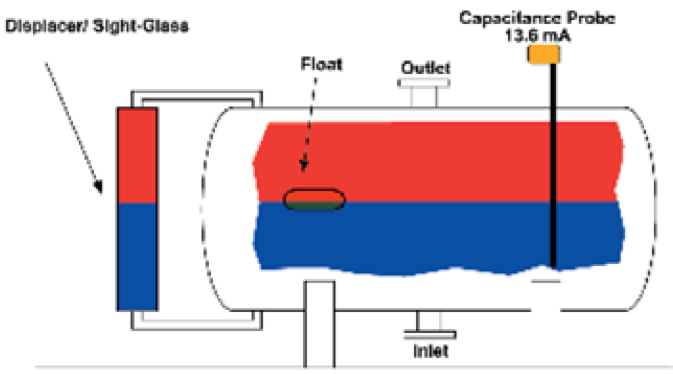

Fig. A - Ideal Conditions

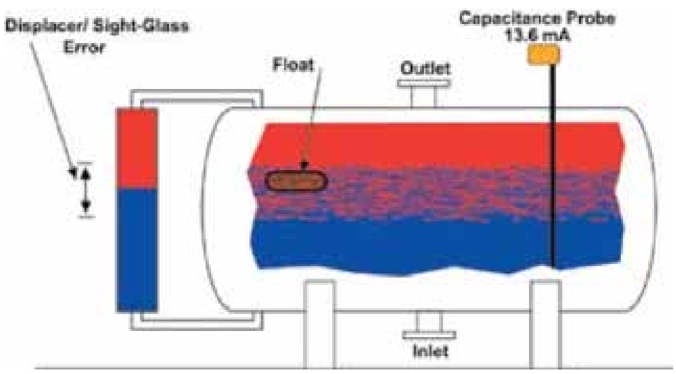

Fig. B - Small Emulsion Pad

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FLOAT ERRORS

Fig. 'C' shows what happens when the mixture extends upwards to the top of the vessel. If the mixture is in the water continuous phase, it will be dense enough to buoy up the float. If the float controls dumping, then hydrocarbons will unintentionally be dumped along with the free water.

CAPACITANCE PROBE ERRORS

A profiling capacitance probe estimates the overall % water in the vessel. It cannot give information to the operator on the size or behavior of the emulsion pad. The vessel in Fig.'B' has an oil continuous emulsion pad, but the capacitance probe shows no change in the water interface from 'A'.

Fig. 'C' demonstrates another problem with capacitance probes. They cannot measure oil in a water continuous mixture, and a high water-cut near the top of the vessel causes capacitance probes to read full scale.

THE SOLUTION:

CONCENTRATION CONTROL

The AGAR ID-201 gives a current output proportional to water content over the full scale of 0-100%. This enables operators to answer the two hardest questions in the industry: "How big is the emulsion pad?" and "In which direction is it growing?"

It also enables operators to control their interfaces accurately, in the desired direction, and make informed decisions as to the types and quantities of emulsion-breaking techniques they should use.

Fig. 'D' shows a typical AGAR probe installed at an angle of 45°. When used to control the dump valve, for example, it opens the valve when it detects 80% water, and shuts the valve when it detects 70% water. This ensures that the emulsion develops above the control point and allows only clean water to be dumped. The second probe ("ALARM") can have a lower set point and will activate an alarm, or an emulsion-breaking device such as a chemical pump if the emulsion rises too high.

Reversing the positions of the two probes and setting the control to 10-20% water would allow the operator to force the emulsion to build below the control point, leaving only dry product in the separators.

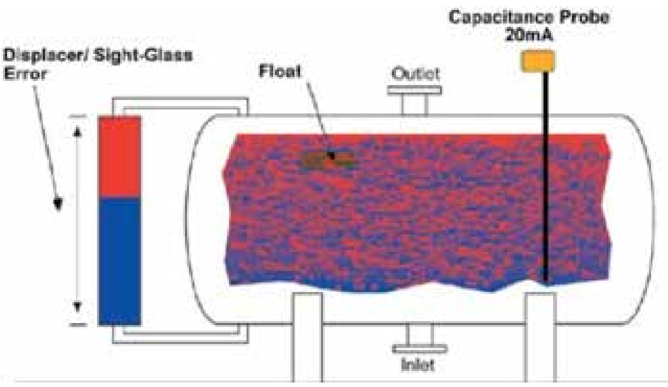

Fig. C - Large Emulsion Pad

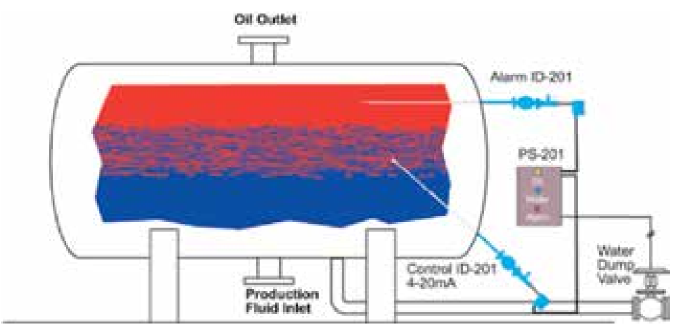

Fig. D - Present Methods/Solutions (Concentration Detection)