DESALTING, DESALTERS, AND SALT IN CRUDE MONITORING IN PROCESS: AN OVERVIEW

Speaker: Dr. Maurizio Castellano
B.A.G.G.I Srl

Crude Oil and Heavy Crude Oil

Salt content in crude ranges:

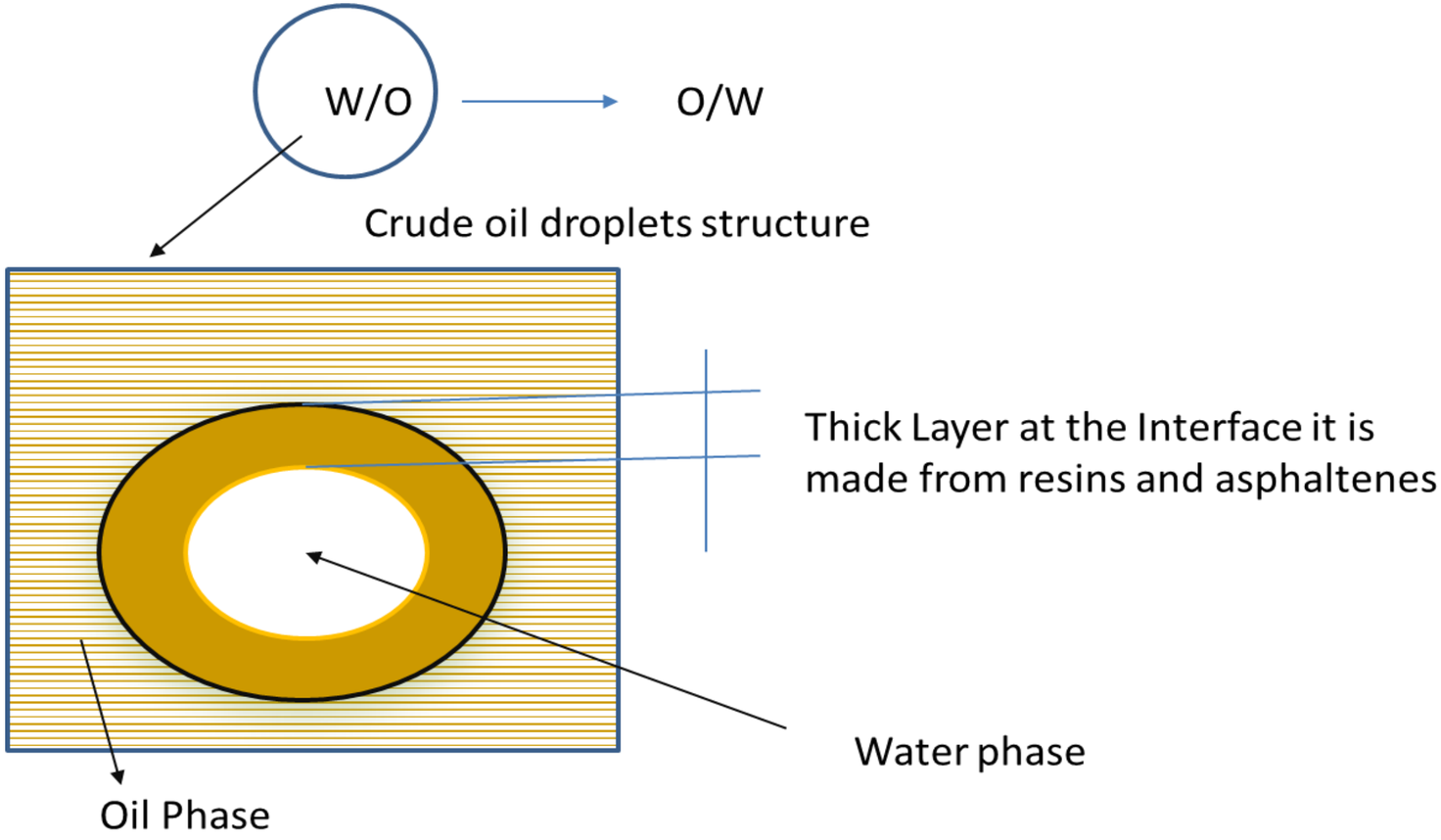
from 5,000 to 250,000 ppm of NaCl according to the water content one may find in Crude oil that contains only 1.0% water with a 15,000-ppm salt content has 55 lbm of salt per 1,000 bbl of water Free crude.

The chemical composition of these salts varies, but nearly always is mostly NaCl, with lesser amounts of calcium and magnesium chloride (approx: 70 NaCl; 20 $MgCl_2$; 10 $CaCl_2$ % Vol.)

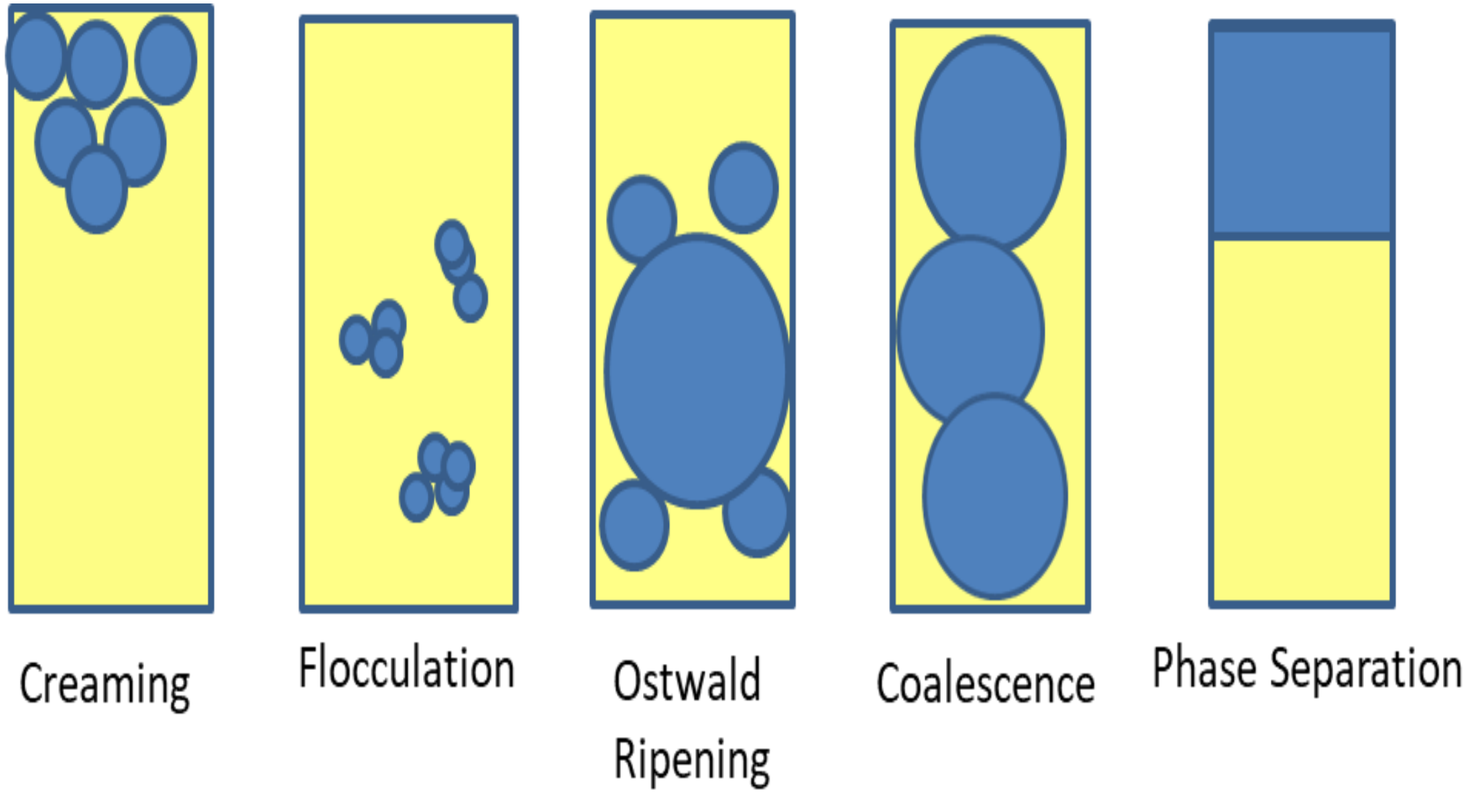
Water Amount and Salt Amount Effects

$$CaCl_2 + 2H_2O \rightarrow Ca(OH)_2 + 2HCl$$
$$MgCl_2 + 2H_2O \rightarrow Mg(OH)_2 + 2HCl$$

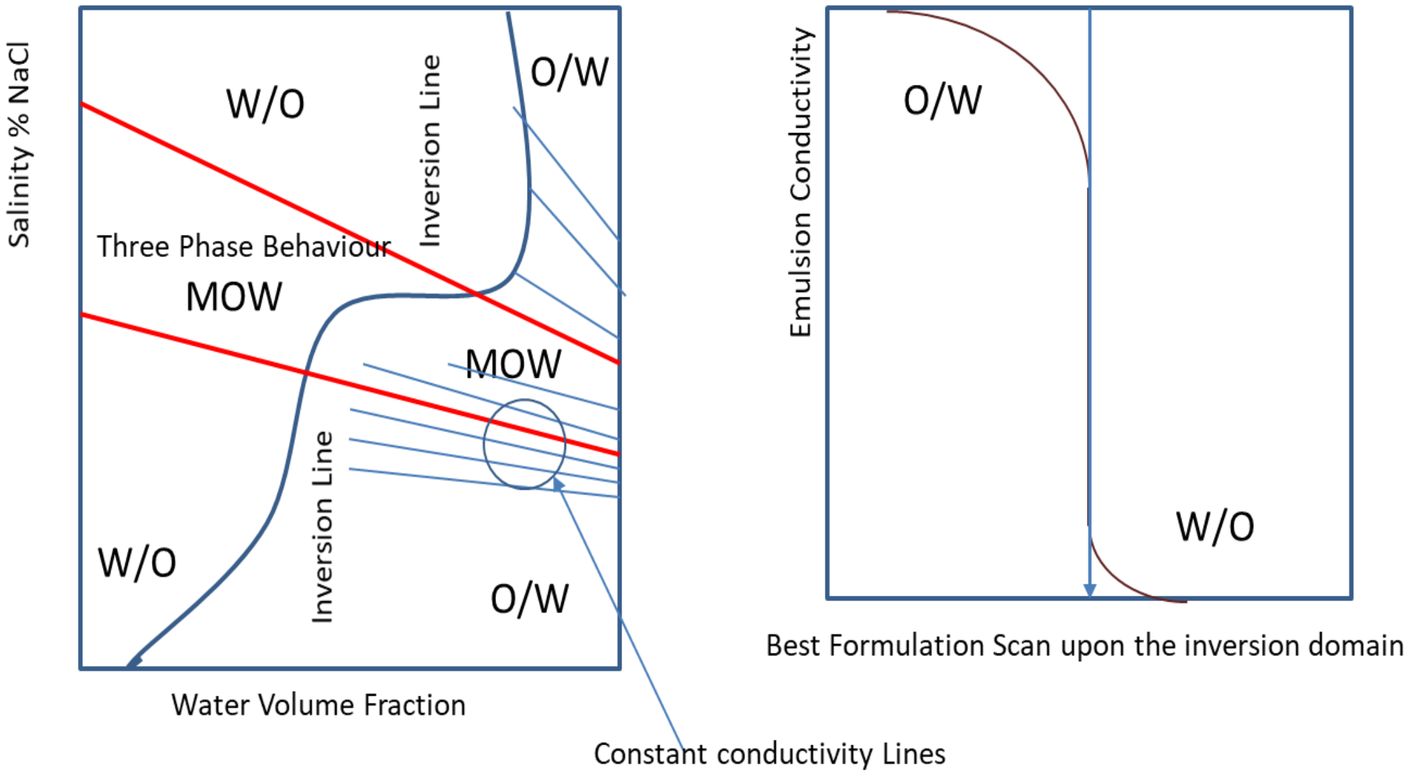
Emulsion technology: Stability, Demulsifying and Breakage



Emulsions Stability - W/O-O/W interchanging phase



Transition Behaviour in Crude Oil Phase Emulsions



The electrolytic conductivity changes drastically inside the three phase region Indicating that the emulsion inversion takes place. The exact formulation wherein the phase inversion is located depends mostly by the **Water to Oil ratio**

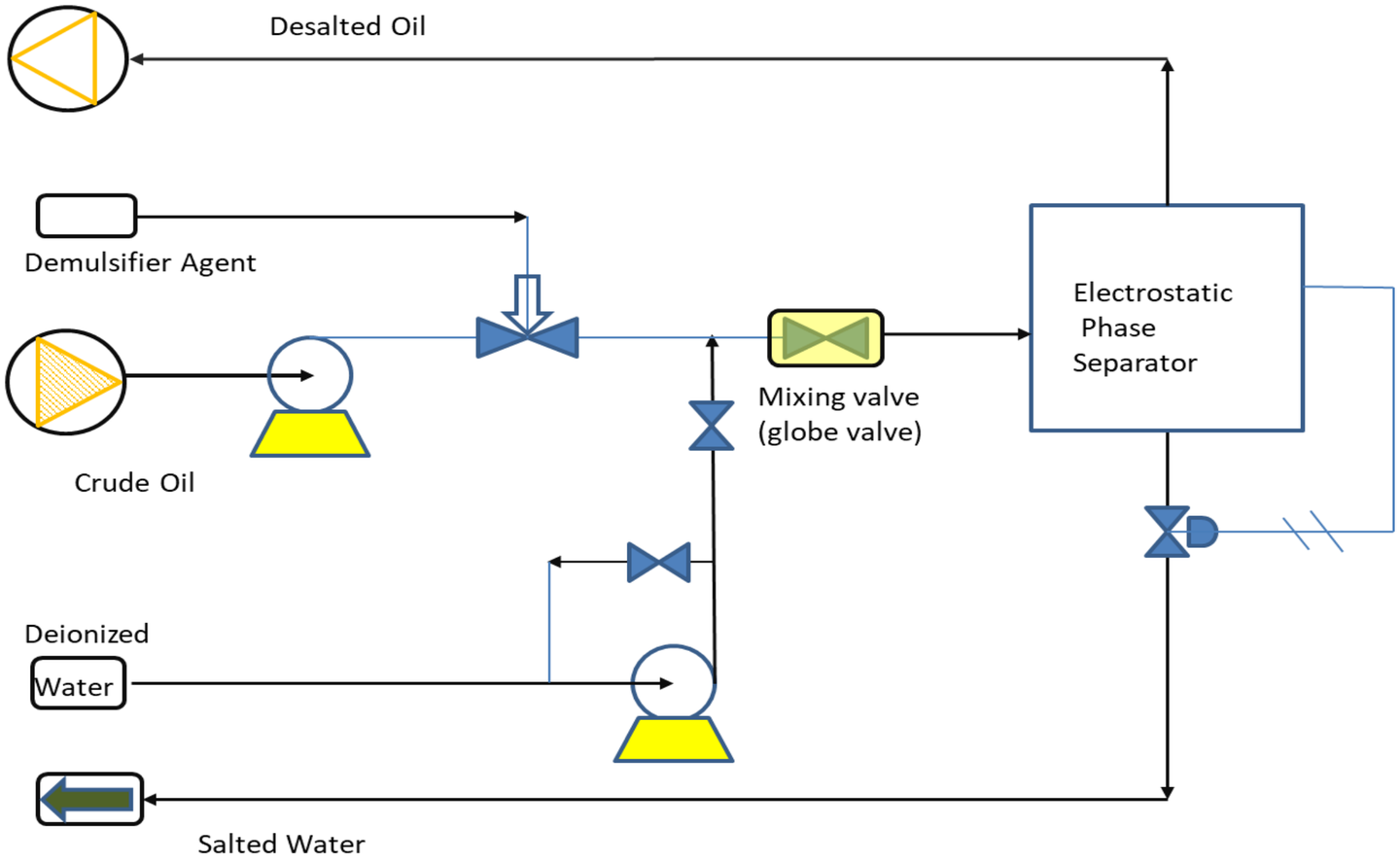
Demulsifier Classes and Demulsifying Process

Low Molecular weight demulsifiers/ Vs High molecular weight demulsifiers:
Oil soluble blends of several polymer components
Polyfunctional Demulsifying Agents:
1) Flocculants
2) Coalescers
3) Wetting Agents
4) Cosolvents
Chemical Composition
Cationic Molecules
Polyamines and their quaternary salts
Anionic Molecules
Poly alkyl benzen sulphonates
Non ionic Molecules
Polymerized alkoxilated poly glycols;
Poly glycole esters
Alkoxilated phenol-formaldehyde resins

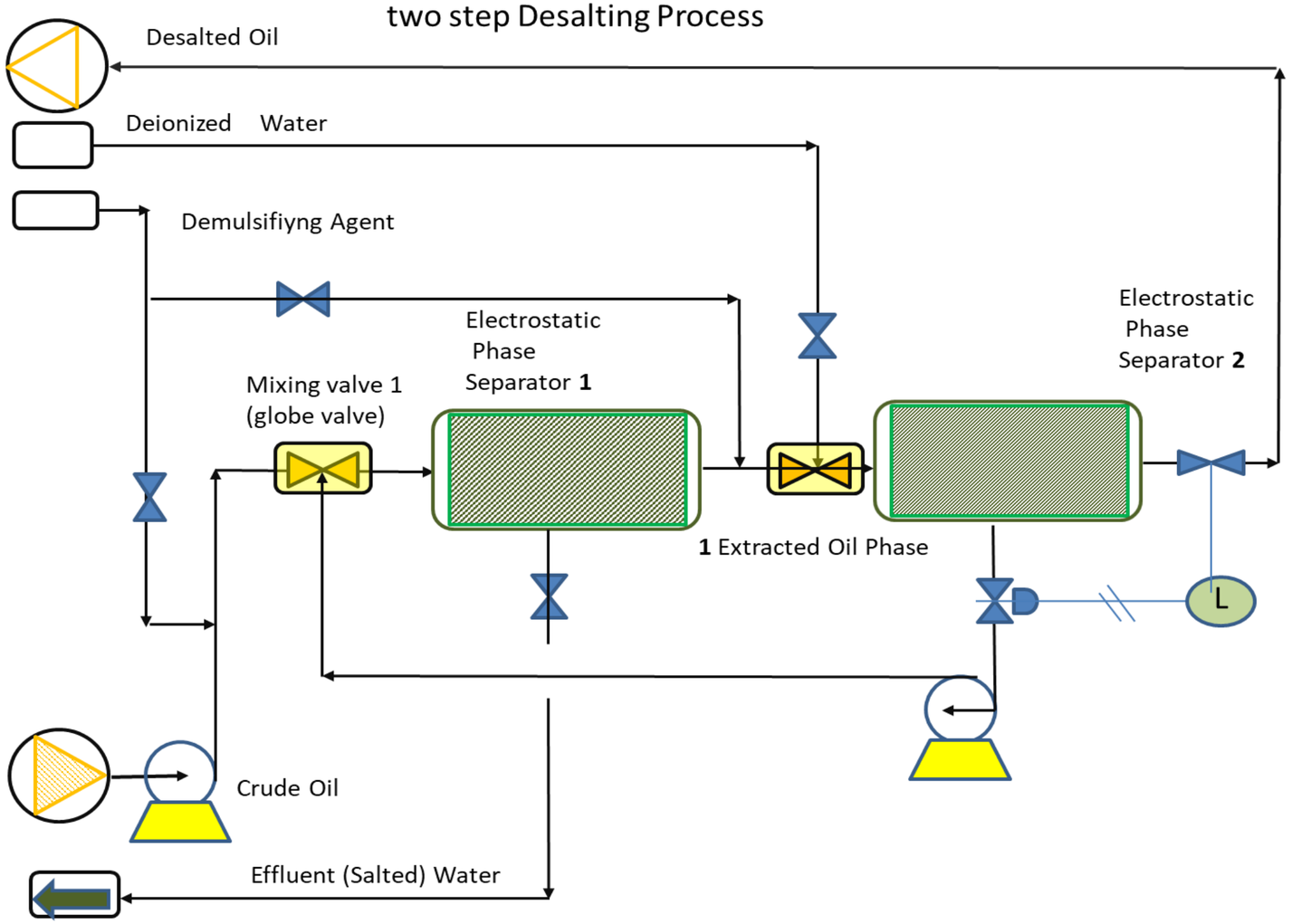
These compounds are adsorbed at the interface of droplets just onto the thick layer made from resinous products and asphaltenes. The demulsification process cannot be thought of as the reverse of emulsification. It involves settling, flocculation and disrupting of the stabilized layers before coalescence. The best demulsifier obtains the highest results with minimum water trapped in Crude oil (200- 500 ppm Water)

Desalter Technology

One step Desalting Process



Desalter Technology
two step Desalting Process



Desalting Plant Parameters

1) A common W/Crude Oil emulsion may contain up to 25% water cut.

2) Water can be reduced to 0,1% in weight and 5.0 P/TB of salt can be taken as a limit to remain in the oil at the end of treatment.

3) The operation of a mixing valve is carried out by a simple globe valve where an operator would set the differential pressure across the valve to be as high as possible ensuring better mixing of both fluids.

4) The main aspect that needs to be considered is the pressure drop, whose value is about 10-50 psi and varies according to the flux through the valve (automatic differential pressure controllers could be used).

5) In addition to the mixing valve, upstream premixing device could be used, such as spray nozzles at the point of water injection or static mixers, between the water injection point and the mixing valve.

6) High delta pressure in the mixing valve promotes smaller droplets, which is positive because it improves the contact among the phases; however, very small droplets could yield a more stable emulsion, which could cause problems in the separating vessel.

7) A desalter feed temperature of 70°C should be allowed in the design of very voscous oils. According to several data.

8) The required demulsifier concentration could reach 100 ppm.

9) For refining purposes, a salt concentration of maximum 1, 5 PTB (pound of salt measured as NaCl per thousand barrels) is desired.

10) The washing water as a volume percent of the crude oil processed could oscillate between 3 and 10%, depending on the API gravity of the crude oil.
the heavier the crude oil, the more the water required.

Either AC or DC fields may be used and potentials from 12, 000 to 35, 000 volts. The attraction force (*F*) between the water droplets is given by:

$$F = \frac{Ks\, d^6 \varepsilon^2}{S^4}$$

where ε is voltage gradient, *d* is droplet diameter, *s* is the distance between drops centers and Ks is a constant for the system.

Finally, after coalescence, water droplets settle according to the well-known Stock's law:

$$\text{Settling Rate} = \frac{K(\rho_w - \rho_{oil})d^2}{\mu_{oil}}$$

where *k* is a constant, d is the droplet diameter, *ρ* is density, and *μ* is viscosity.

Salt in Crude Analysis

ASTM D 3230: 0-500 mg/Kg Crude or 0-150 lbs/ 1000 bbl as chloride concentration in volume Conductivity method

ASTM D 3264: 0-500 mg/Kg Crude or 0-150 lbs/ 1000 bbl as chloride concentration Silver Electrode Titration Method

A) Determination in Xilene-Acohol solution by Standard Calibration in non aqueous system
B) Determination after extraction in boyling xilene and water mixture followed by titration
C) Possible no ASTM determination by IEC and AA
D) Lab and Process Chance of measurement

Thank you very much for your attention

Questions?