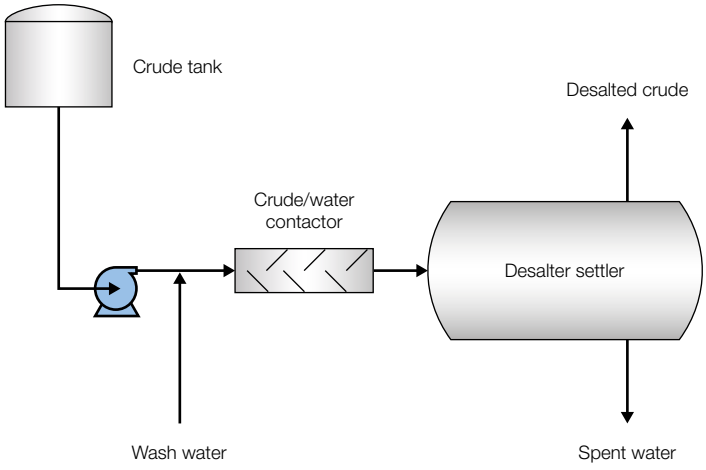
Sulzer Mixers for Desalting Crude Oil

Comparison of Sulzer SMV™ Static Mixer vs. conventional mix valves

Sulzer SMV™ static mixers are frequently used in combination with conventional mixing valves and orifice plates in neutralization and extraction processes which require co-current dispersive mixing. The Sulzer mixer is a cost-effective device that will improve efficiency and increase capacity. It can be easily retrofitted into most existing process lines.

Conventional mixing valves provide an instantaneous high shear field by constricting the fluid flow path. The residence time in this shear field is extremely short and often inadequate for a complete neutralization or extraction. Large pressure drops are thus required to generate sufficient interfacial area to compensate for the lack of contact time.

In addition, the mixing valve develops a wide drop size distribution with little or no radial mixing. The combination of high shear and wide droplet size distribution results in difficult phase separation. Expensive de-emulsifying chemicals and coalescing equipment are often required to achieve good separation.



Advantage when using Sulzer static mixers instead of mixing valves:

- Energy savings because of low Δp
- Less corrosion due to lower salt content
- Better oil quality due to less water in oil
- Less waste water treatment due to less oil in water

Extraction and neutralization efficiency depend primarily on:

Interfacial area

The corrugated plate design of the Sulzer SMV mixer combines excellent radial mixing with a uniform shear field over the entire length of the mixer. Small uniform droplets are created, resulting in large interfacial surface area and efficient mass transfer. The enhanced turbulence in the mixer also improves the mass transfer by reducing interphase surface resistance and continually renewing the interfacial area.

Residence time

The increased residence time in the shear zone of the SMV results in longer contact time between the two phases and higher mass transfer efficiency.

Concentration gradients

The excellent radial mixing of the SMV results in plug flow behavior. This optimizes the concentration gradient, which is the driving force for mass transfer.

In short, replacing conventional contactors with the Sulzer SMV mixer results in improved efficiency and lower pressure drop. However to also cope with bigger turn-downs, a combination of valve and mixer would be most beneficial. At full flow the valve remains fully open, whereas at reduced flow the valve provides a part of the efficiency.

Two references where mixers successfully replaced mix valves are described on the right.

Example 1:
Sulzer SMV mixers were compared with mixing valves in an existing refinery in Russia desalting the local crude oil. The line size was DN250 (10”) and it could be proven that using static Sulzer mixers SMV improve the process significantly. After the desalting process, the remaining salt content in the crude could be reduced by 50% compared with mixing valves and the water content in crude reduced by a factor 5. And the pressure drop when using Sulzer static mixers SMV dropped below 50% compared to the mixing valves. All this lead to a pay back time of only a few weeks just counting the energy savings. Additionally less crude oil being processed in lower grade products, reduced de-emulsifiyer chemical consumption and less corrosion in the atmospheric tower make the use of static mixers a beneficial step for oil companies

Example 2:
Sulzer SMV mixers were also used in conjunction with mixing valves in a two stage desalter in an US Midwest refinery. In this case the two mix valves were used to contact water and crude oil to extract the salt from the hydrocarbon. Each mixing valve required approximately 1.0 bar (15 psi) pressure drop to maintain the required extraction efficiencies.

The Sulzer SMV mixers were installed immediately downstream of the mixing valves in an attempt to lower the power requirement at the high flows and to increase unit capacity. It was at first thought that the mixer would not be able to operate over the entire flow range of the desalter. As it turned out, the refinery has since been able to run with the mixing valves wide open. At design rates the mixers were taking only 0.21 bar (3.0 psi) pressure drop each with excellent extraction efficiency and no separation problems. The payback of the mixer based on pressure drop (energy) savings alone was less than six months, while the associated capacity increases made the payback almost instantaneous.

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