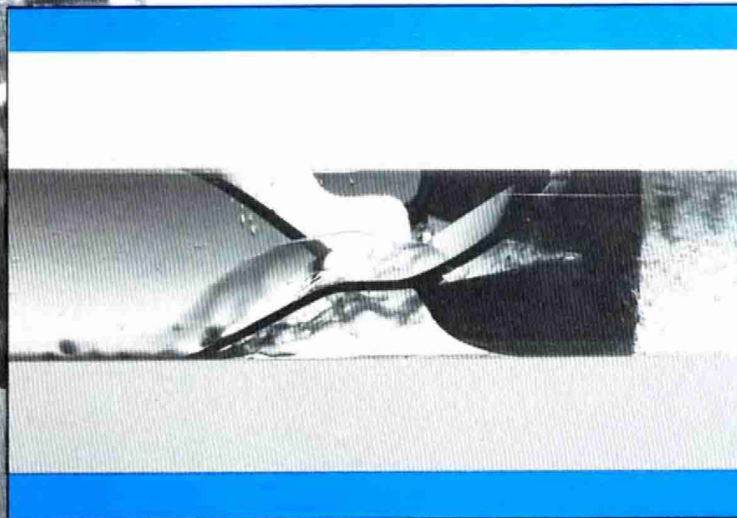


# CUSTODY TRANSFER

The Komax CT Mixer provides better mixing  
for reliable net crude oil measurements.



MIXING BY DESIGN

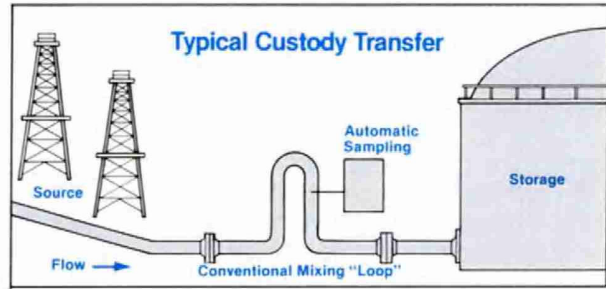


**KOMAX**®

## Accurate sampling requires effective mixing.

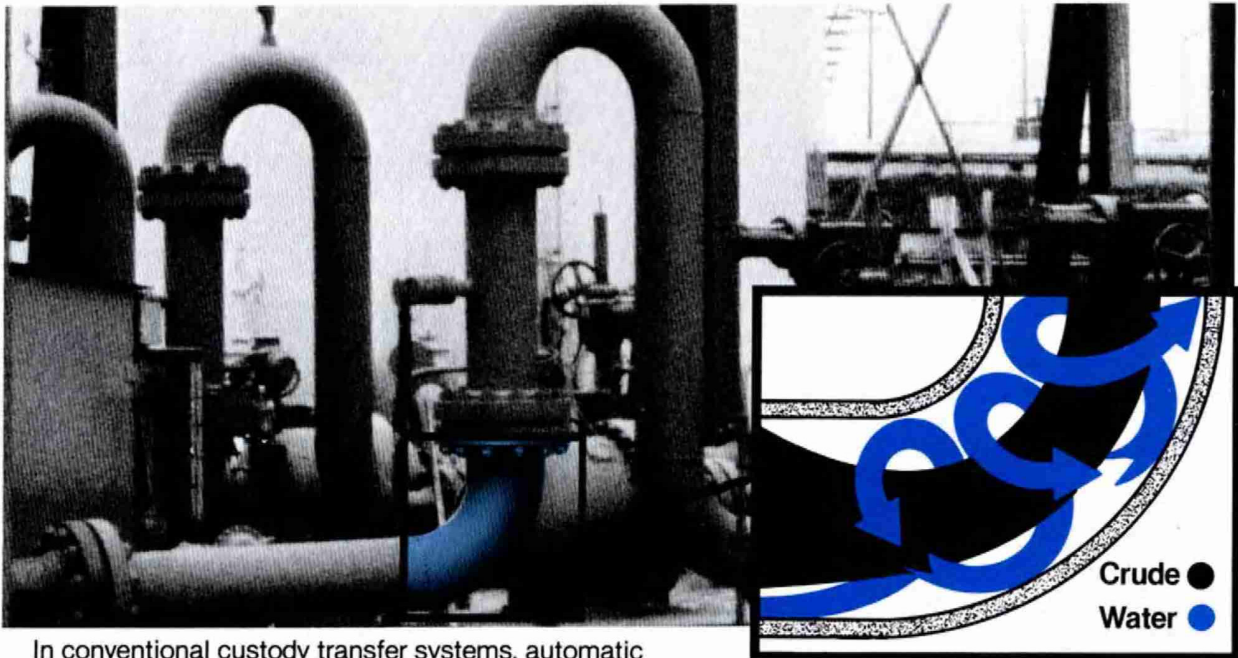
During custody transfer of crude oil from either ship to shore or facility to facility, it is *economically important* to detect the total percentage of sediment and water in the transfer. An allowance for these contaminants must be made in determining the final pricing.

The standard technique has been to employ automatic sampling systems to extract a representative sample for analysis from the flow of crude oil during transfer. The American Petroleum Institute points out that there must be "adequate distribution of free water at the sampling point to allow representative sampling." The API states, "The automatic sampler probe must be located at a point in the pipeline where the flowing stream is well mixed."<sup>1</sup>



Typically, a vertical "loop" or "trombone" has been used in the transfer pipeline, prior to the automatic sampler, to help mix or evenly disperse, throughout the crude oil, the periodic slugs of bottom water in the pipe. Only when truly effective mixing is achieved can reliable net crude oil measurements be obtained.

## Conventional mixing methods are not adequate.



In conventional custody transfer systems, automatic samplers have normally been mounted at the top or down side stream of the mixing loop as shown above. This sampler placement attempts to assure that a homogenous sample of crude and water will be taken approximately every 5 seconds for later analysis and *price adjustments*.

Since the automatic sampling probe projects about four to six inches into the crude oil stream with a small side opening of under one inch to receive the periodic sample of crude and water, it is extremely important that the sample is a truly homogenous blend of uniform droplets of water in the crude at all operating flows.

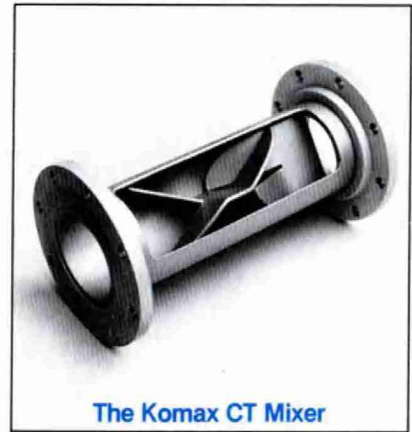
Right angle or 90° pipe elbows are not good mixers. Laboratory tests with oil and water have proven that at varying velocities the hydrostatic forces created by a right angle (90°) elbow at the bottom of the conventional mixing loop centrifuges a percentage of the heavier water to the wall of the pipe. This internal wall-streaming or barber-poling, illustrated above, allows a percentage of the water to pass the automatic sampler without being detected. The result can be *costly*.

<sup>1</sup>American Petroleum Institute, *Manual of Petroleum Measurement Standards*; Chapter B Section 2; 1980.

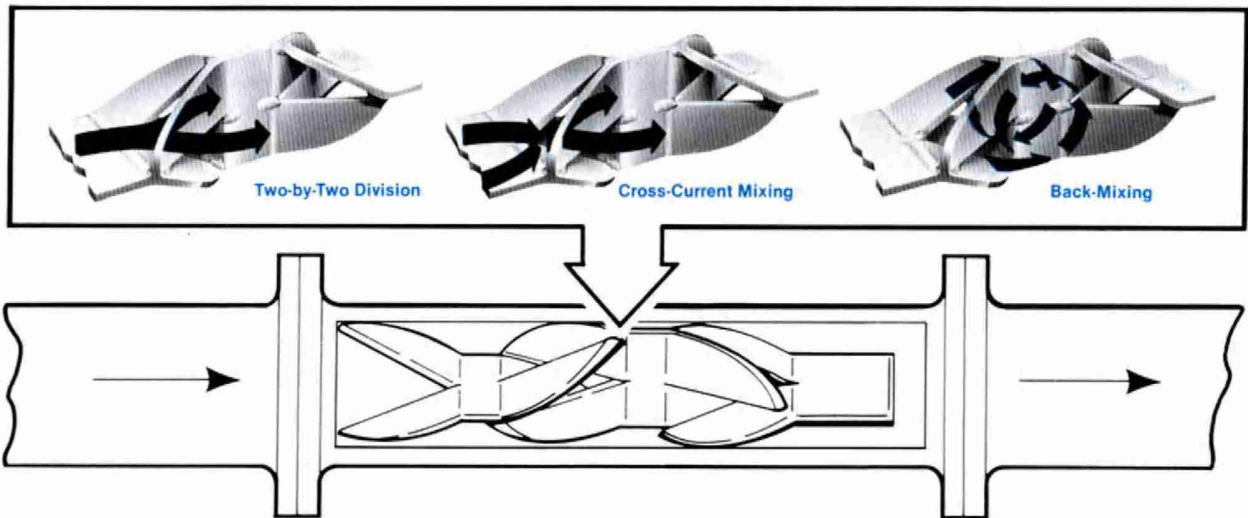
## Komax CT Motionless Mixers solve the problem.

Komax custody transfer (CT) mixers employ a simple, reliable design to provide the ultimate in mixing. Our motionless mixer is comprised of a fixed arrangement of mixing elements enclosed in a short section of flanged pipe. NO MOVING PARTS ARE USED. Transfer line flow provides the energy for mixing in the Komax motionless mixer. This provides up to ten (10) times more efficient mixing than any other device or method.

• The Komax CT motionless mixer achieves high efficiency through triple action mixing. The crude oil and water are mixed through two-by-two division (increasing geometrically with each element added), cross-current mixing which randomizes droplet distribution by direct stream impingement, and exclusive Komax back-mixing which improves turbulence and dramatically increases mixing efficiency. THESE THREE MIXING ACTIONS OCCUR SIMULTANEOUSLY IN EACH KOMAX MIXING ELEMENT.



### Triple Action Mixing

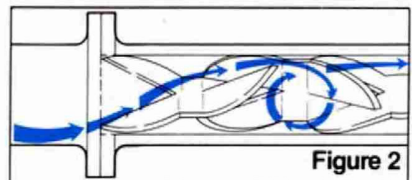
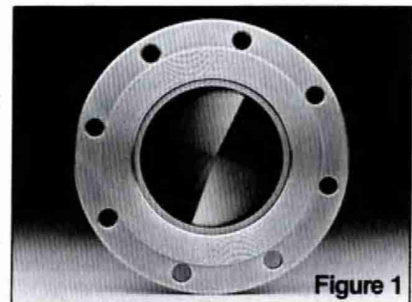


### Special features provide effective mixing.

The Komax CT mixer was specially designed to solve conventional custody transfer mixing problems. The CT mixer may be installed in a horizontal or vertical pipeline. In a horizontal line, the first mixing element is set 30 degrees off the centerline so the bottom mixing element ear acts as a ramp, forcing the bottom water up into the crude (see Figures 1 and 2). The internal vortices or back-mixing created by the Komax mixing elements also rotate the blend backwards from wall to wall of the pipe as shown in Figure 2. This exclusive back-mixing eliminates any wall streaming and produces a very uniform distribution and droplet size of the water in the crude.

A very important feature of the Komax CT mixers is the addition of a special, last mixing element that cancels all of the axial rotation of the flow downstream of the mixer. Violent rotation of the stream would cause the centrifuging problem (barber poling) of the water to re-occur.

The automatic sampler is located two to four pipe diameters downstream of the mixer. The resulting samples provide highly reliable net crude oil measurements.



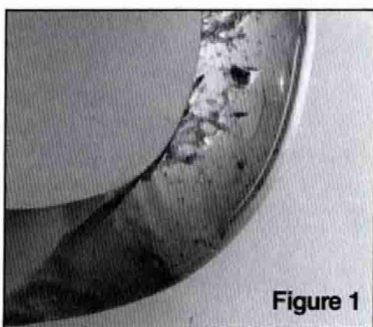
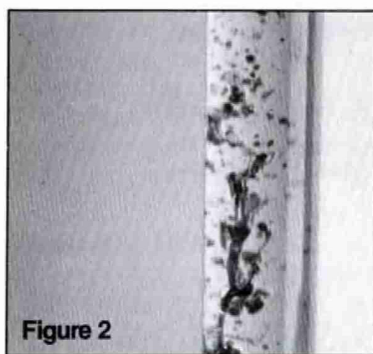
## Compare the mixing performance.

There is a very noticeable difference in mixing effectiveness between the Komax CT Mixer and the conventional "loop" method. This difference is easily seen in laboratory tests conducted to simulate actual custody transfer conditions.

A mixture of oil and water was pumped through both the Komax CT Mixer and a conventional "loop" apparatus. Clear mineral oil (SG .880-.895) was used to simulate crude oil. Dye was added to the water for photographic purposes.

During typical custody transfer, flow rates range from one (1) to over ten (10) ft./sec. During startup of crude transfer a significant problem occurs at low initial velocities. The largest percentage of unmixed water is typically passed at these lower flow rates. The accompanying photos illustrate mixing efficiencies at approximately 1.5 ft./sec.

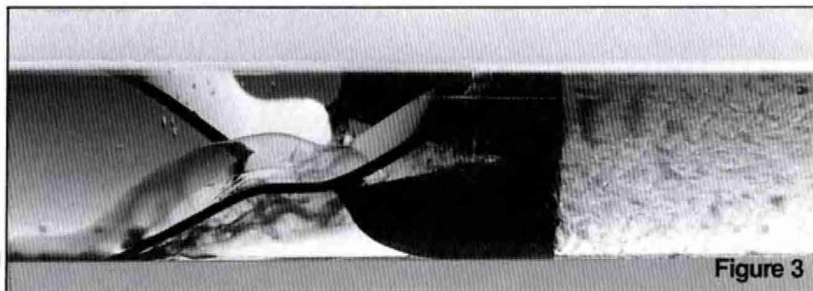
Figures 1 and 2 (respectively) show the 90° elbow and vertical pipe section in a typical "loop" arrangement. Notice the "barber pole" of the free water occurring in Figure 1 as the heavier water is forced to the pipe wall. The result in Figure 2 is extremely non-uniform



water droplet size and distribution. Efficient mixing has not occurred.

The dramatic improvement in mixing efficiency with a Komax CT Mixer is seen in Figure 3. Notice how the water droplets are lifted away from the pipe bottom and wall for mixing with the oil. Note the uniformly sized water droplets leaving the Komax CT Mixer, and how these droplets are evenly distributed from wall to wall. Now there is an adequate distribution of the free water to assure that a truly representative sample *will* be taken.

As you can see, the difference *is* dramatic. And Komax CT mixing performance is **INTENSIFIED WITH INCREASED VELOCITY**. You can be assured of superior mixing throughout the full flow range during custody transfer.



## Switching to Komax is the answer.

Major oil companies worldwide are installing Komax CT Mixers instead of costly conventional "loops." The result, of course, is efficient mixing, reliable net crude oil sampling, and cost savings.

The Komax CT Mixer represents a low capital investment and requires no replacement parts.

See for yourself why leading oil companies are switching to Komax for mixing during crude oil transfer. Contact Komax for a demonstration of the CT Motionless Mixer.

Compare the results. Switch to Komax.



**KOMAX SYSTEMS, INC.**  
MIXING BY DESIGN

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KOMAX Motionless Mixers are manufactured under U.S. patents 3,923,288 and 4,034,965. Other U.S. and foreign patents pending.  
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