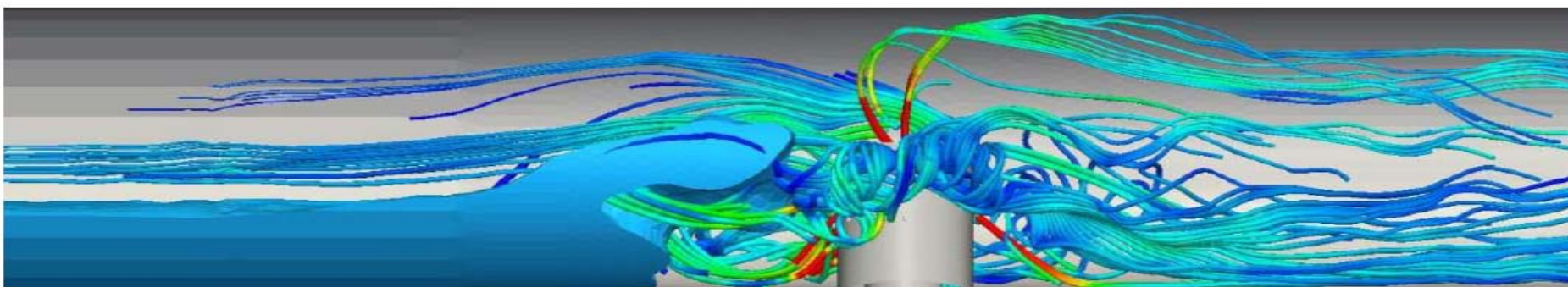




What is SmartMix™ Technology?



SmartMix™ Technology

Exceeding ISO 3171 / API 8.2

What is SmartMix™ Technology?



SmartMix™ is a game-changing mixing and sampling technology for water-in-oil, oil-in-water, or other immiscible fluids.

It is a “fast-loop” mixing, sampling, and analysis system, based on computer-controlled strong-jet / weak-jet dynamic interaction, a technology that was initially developed for the aerospace industry (liquid-fuelled rockets and jet engines).

Extensive development was done in OGM’s Flow Labs to create computer models of turbulent oil and water mixing.

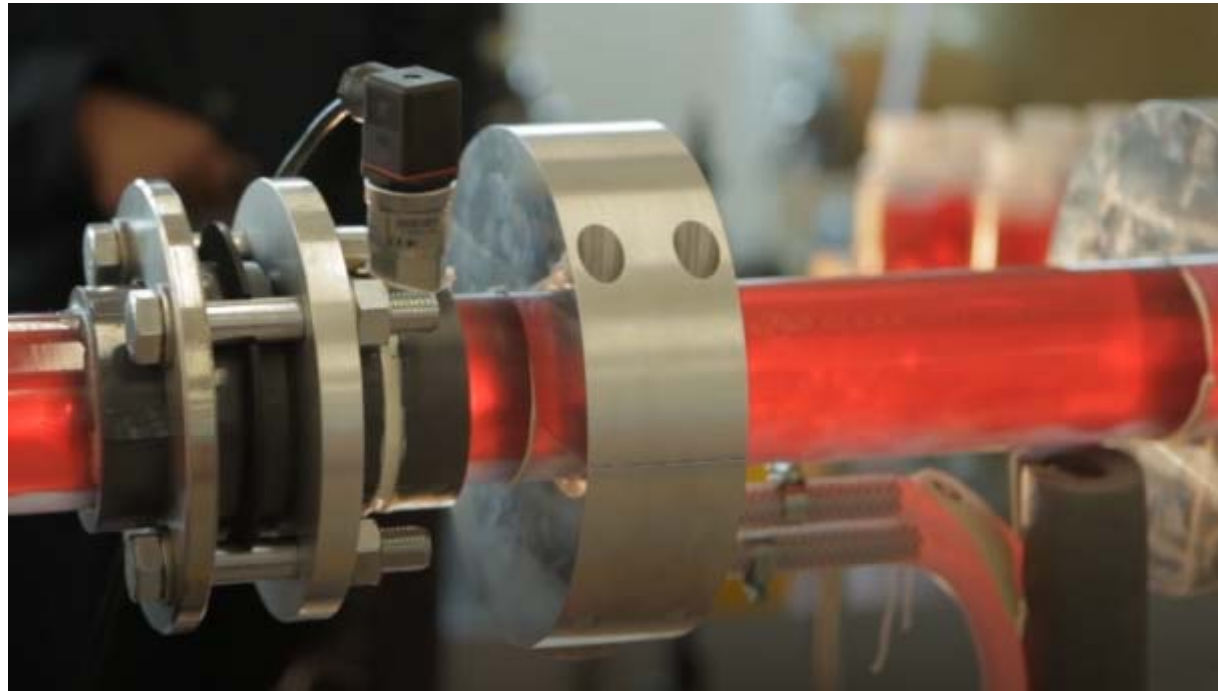
OGM’s smaller test loop is shown here:



Actual SmartMix™ Performance



The following video shows the actual mixing performance of the SmartMix™ mixing system:



Click [HERE](#) to view the video on ECI's training website
(Once open, click the “play” arrow to start the video)

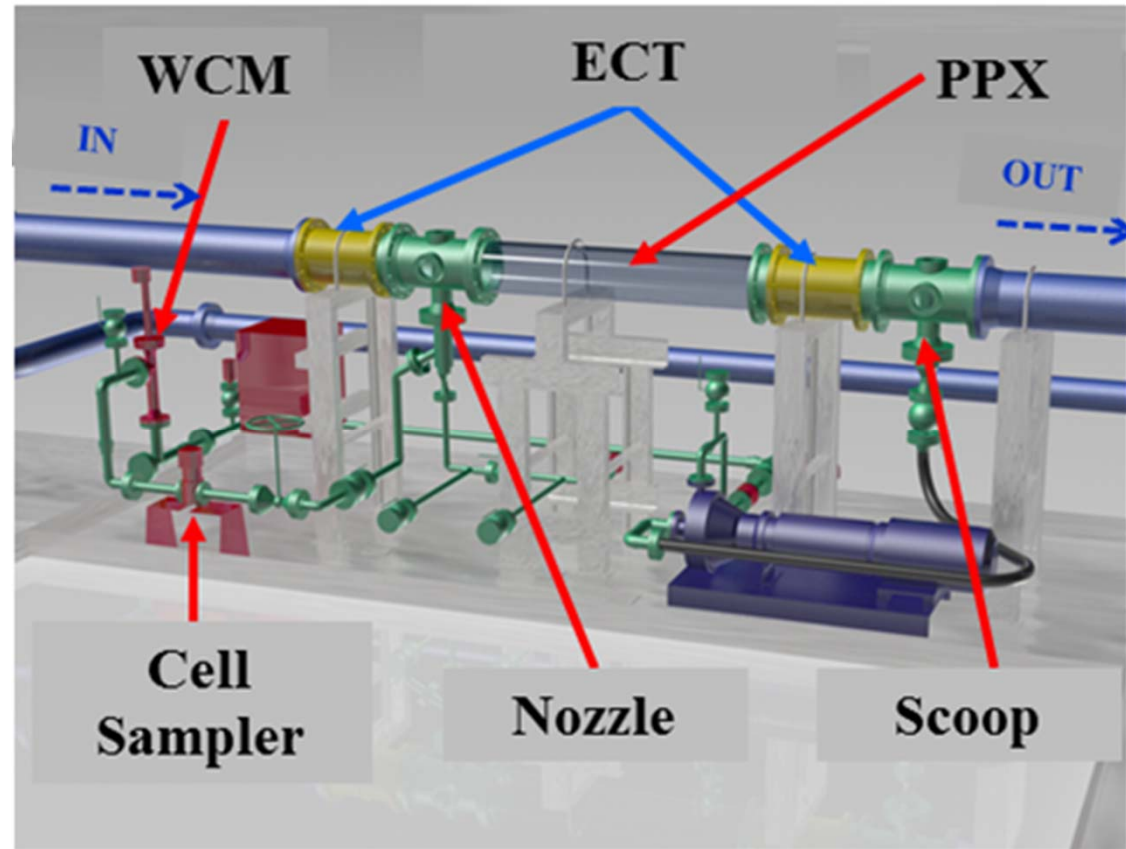
SmartMix™ Water-in-Oil Sampling System



This diagram shows OGM's smaller flow testing loop that allows viewing of the flow.

The observed flow is compared to simulated performance to verify model accuracy.

WCM - Water-Cut meters
ECT - Turbine Meter
PPX - Plexiglass Pipe



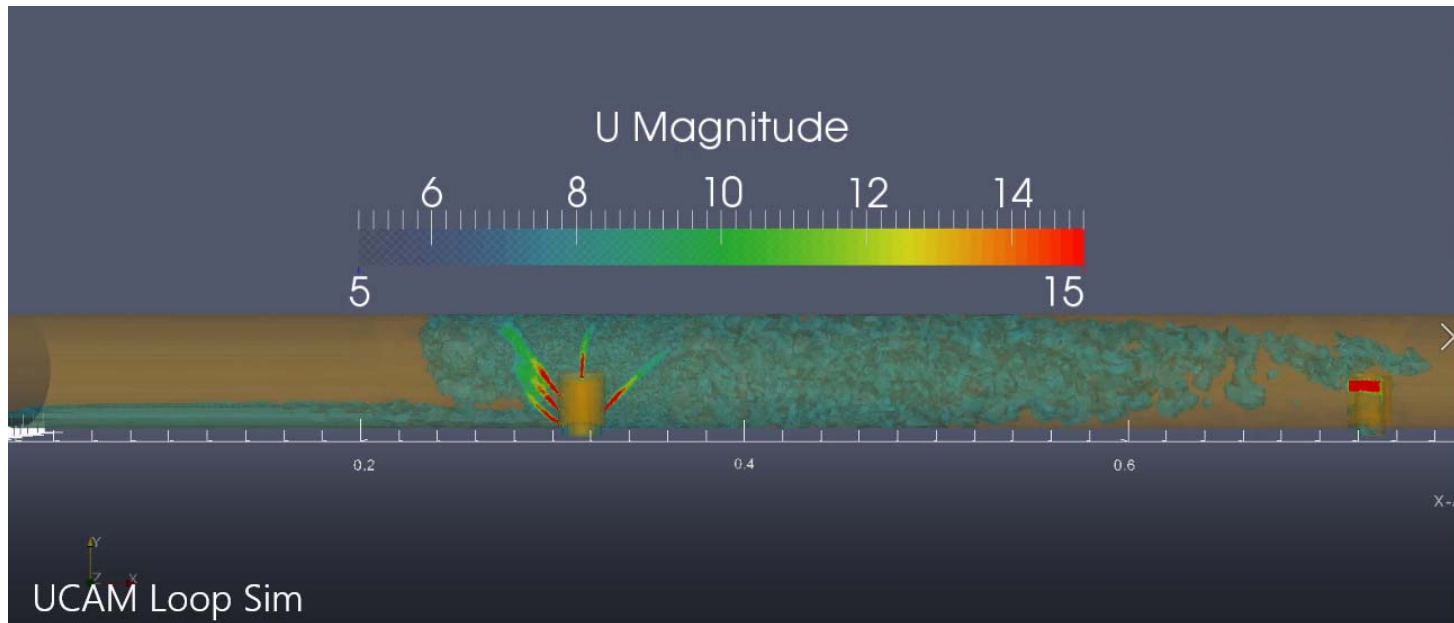
Calculated SmartMix Performance



We prepare a high-resolution simulation of mixing performance over the client's full operating range of flow, viscosity and composition.

This model is used to determine optimum sample and re-injection locations.

Optimum re-injection rate curves are developed for the whole operating range.



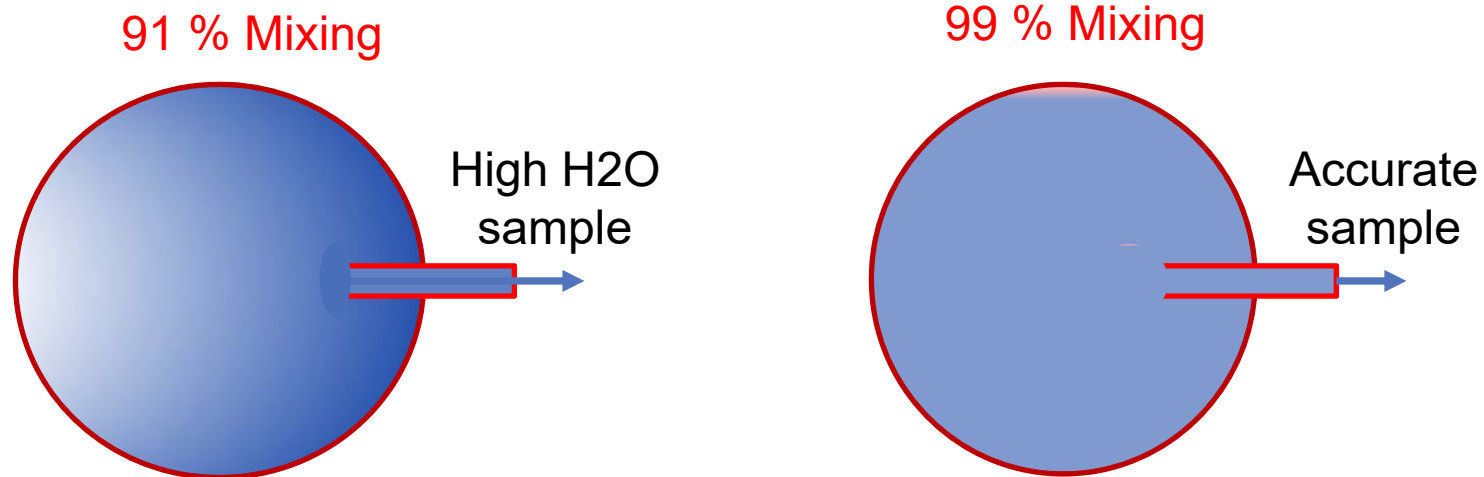
Click [HERE](#) to view the video of the simulated flow on ECI's training site

Scale-Up of Flow and Mixing Models is verified with our World-Scale Test Loop



Why is SmartMix™ a Better Solution ?

SmartMix™ technology allows for better mixing over pipe cross-sections than API 8.2 and ISO 3171 standards. These standard mixers typically achieve only 91% (C1/C2) while SmartMix™ may increase this to 97% or even 99%.



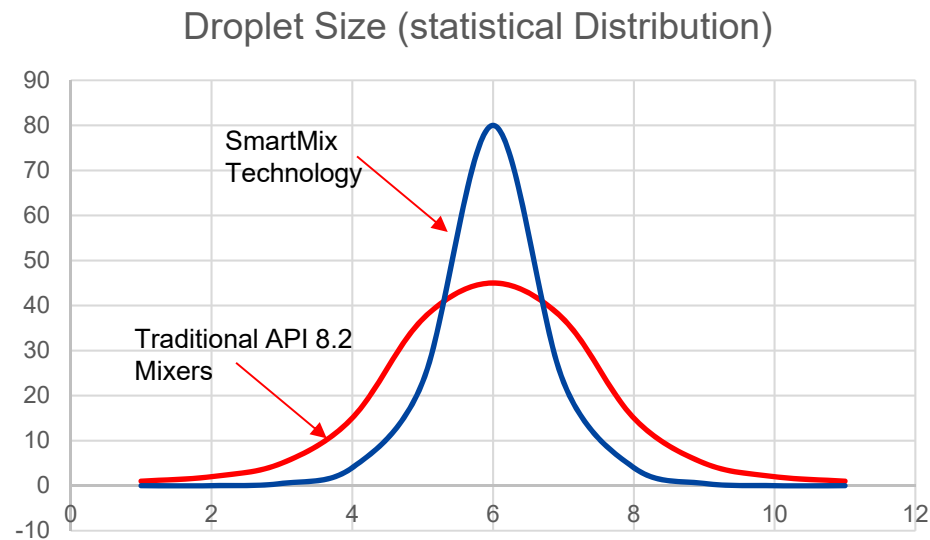
API 8.2 and ISO 3171 sampling systems may actually centrifuge the heavier water to the outside of the pipe, causing it to be over-estimated.

SmartMix™ improves the accuracy of both lab samples and online analysis since the pipe cross-section is completely mixed. This improved accuracy can result in large savings in custody transfer applications.



Droplet Size Control

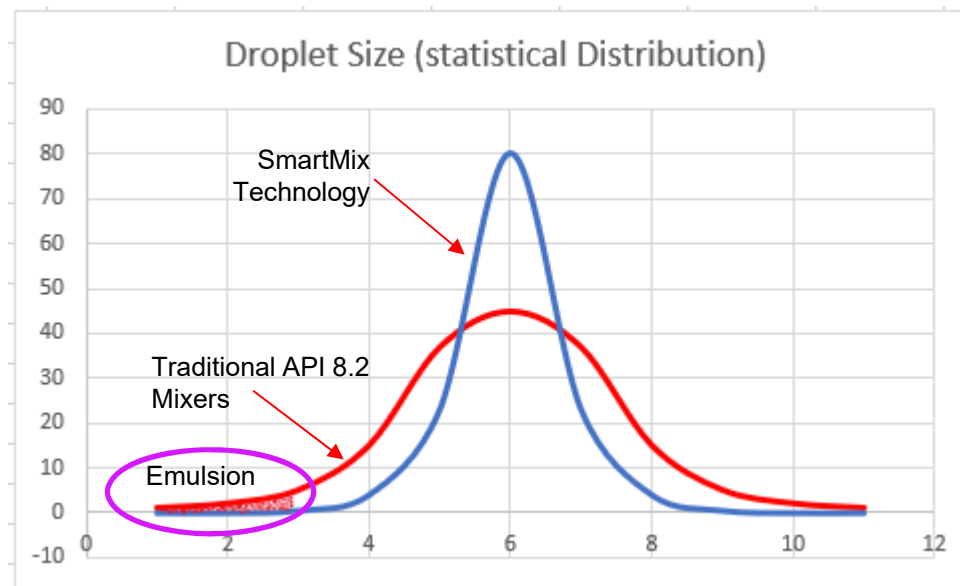
SmartMix™ can control droplet size (including both the mean and standard deviation) by controlling the speed and ratio of the mixing streams.



Our patented SmartMix™ technology continuously measures the crude properties (density, viscosity, water, temperature, etc.) and adjusts the mixing jets to maintain the selected droplet size and distribution curve.

Elimination of Crude/Water Emulsion

Because SmartMix™ technology uses controlled liquid-jet interactions, high shear forces that create oil/water emulsions are avoided.

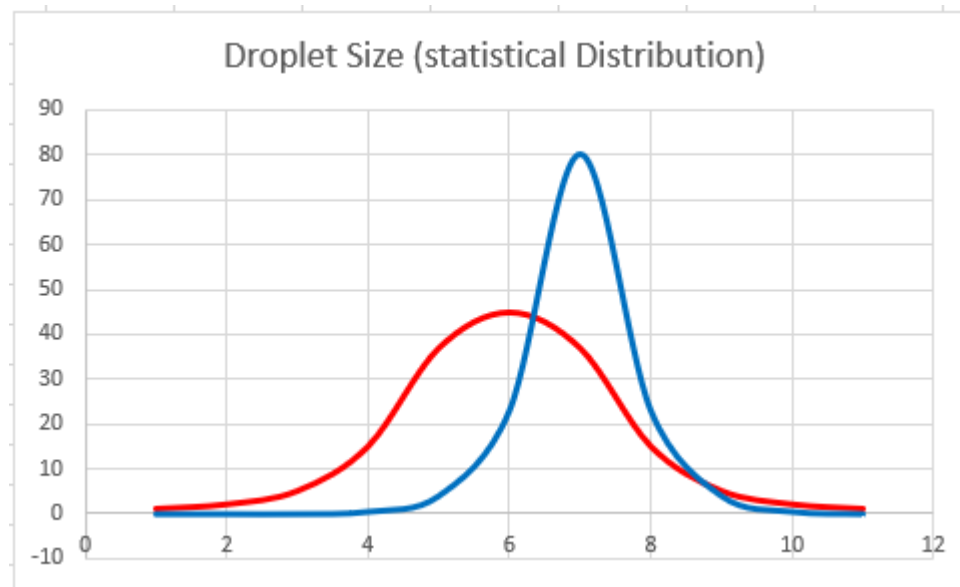


This reduces pressure drop and horsepower requirements compared to traditional mixing devices. The SmartMix™ system is a “full flow” device with little if any obstruction of the flow.

Control of Average Droplet Size



SmartMix™ technology also provides real-time control of the average droplet size.



This can provide significant benefits for downstream equipment like desalters, and may be used to eliminate mixing valves completely.

The distance downstream to where the mixture separates can also be regulated.

Lab Sampling and Real-time Records

SmartMix™ technology includes a composite and/or grab sampler to capture accurate samples for lab analysis.

However, since the SmartMix™ analyzers provide continuous readout, most laboratory testing can be eliminated.

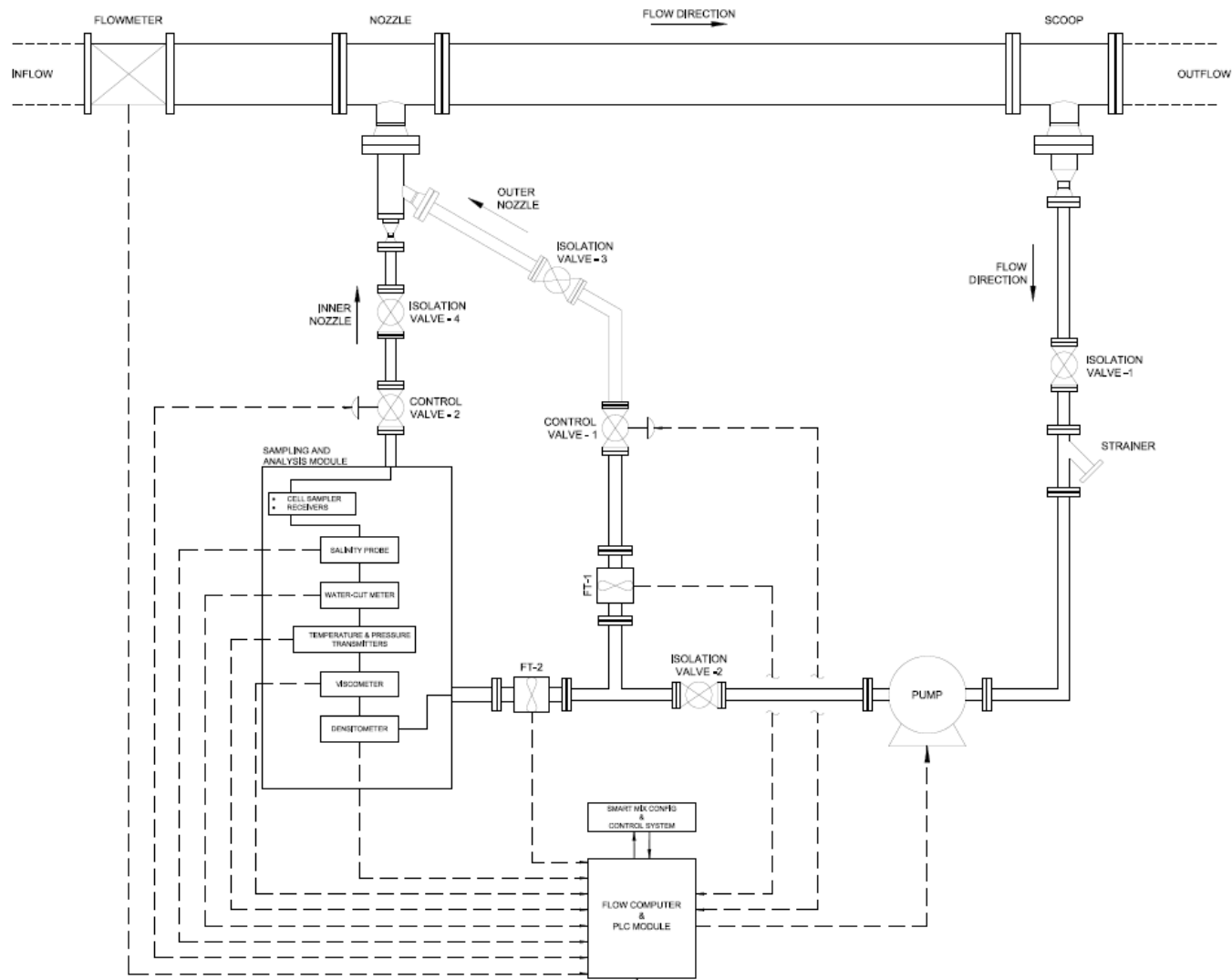
Continuous, real-time API, temperature, salinity, pH and water cut from a SmartMix™ system provides operators with more information and gives the crude oil purchasing group a better record of exactly what was delivered.

An optional “Simulated Distillation” analyser can be added to characterize crude TBP every 20 to 30 minutes.

SmartMix™ – Where are we now?



SmartMix™ System Internals



Benefits of Improved Crude Mixing

Consider two refineries receiving crude with a 2% Water Cut.

90% Mixing Efficiency* = Error of ~	180 MBSD \$5.8 MM/yr.	425 MBSD \$13.6 MM/yr.
95% Mixing Efficiency* = Error of ~	\$2.9 MM/yr.	\$ 6.8 MM/yr.
97% Mixing Efficiency* = Error of ~	\$1.8 MM/yr.	\$ 4.3 MM/yr.
99.8% Mixing Efficiency* = Error of ~	\$113 K/yr.	\$ 268 K/yr.

* API 8.2 and ASTM D4177 state that a ratio of (Water Concentration at top of pipe) to (Water Concentration at bottom of pipe) above 0.9 indicates good mixing. This is shown on top line (typical current situation).

However, SmartMix™ can improve this ratio from 0.9 to 0.97 with a potential reduction in uncertainty of \$4.0 MM/yr and \$9.3 MM/yr for these two refineries.

With 4% or 6% W.C. (max. API crude specification) these amounts double or triple.

Other Benefits of Improved Mixing

A SmartMix™ system may be used to optimize crude tank mixing
Monitor crude variations (mix only to the extent needed)
Detect water “slugs”

A SmartMix™ system may be used to optimize the operation of a desalter
Reduce salts, water, chemicals and power costs

A SmartMix™ system may be used to improve crude tower operation
Water balance
Real-time API measurement

A SmartMix™ system may be used to reduce piping and crude tower corrosion
Real-time salinity values (detect desalinators breakthroughs)
Match inhibitor to real-time water content