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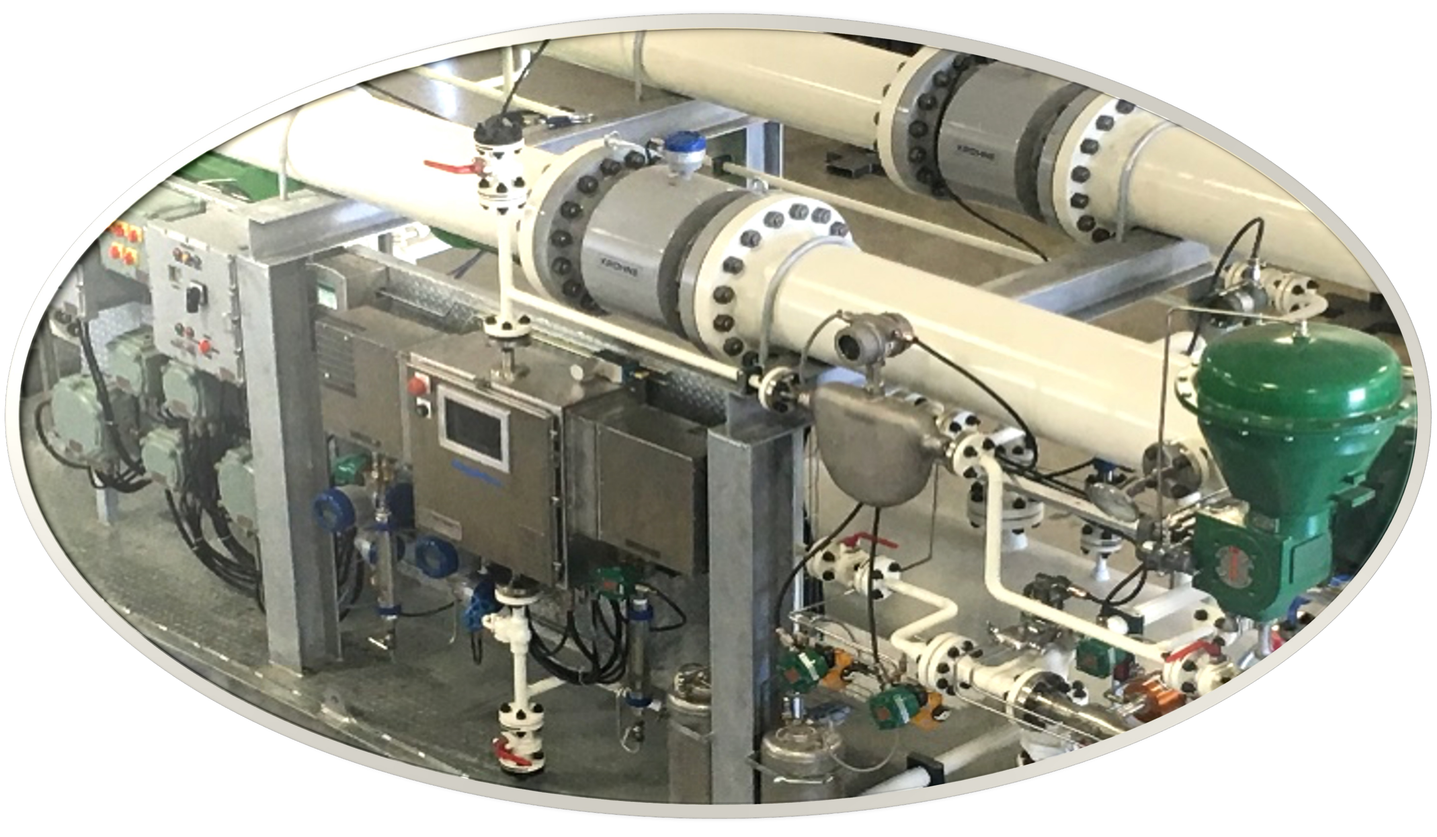
Inline Crude Oil Blending

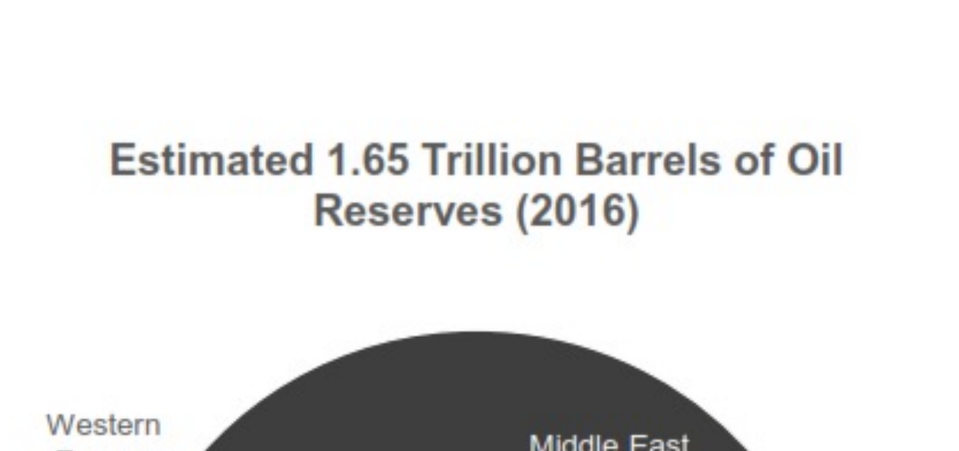
Tom Edwards

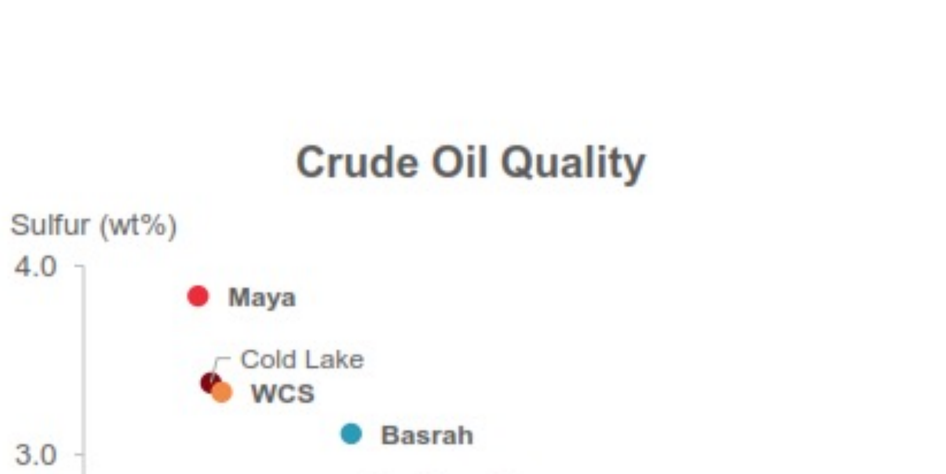
Tom.Edwards@technicsglobal.com

Crude Blending is an Important Part of the Efficient Refinery



Crude Feedstocks are Diverse





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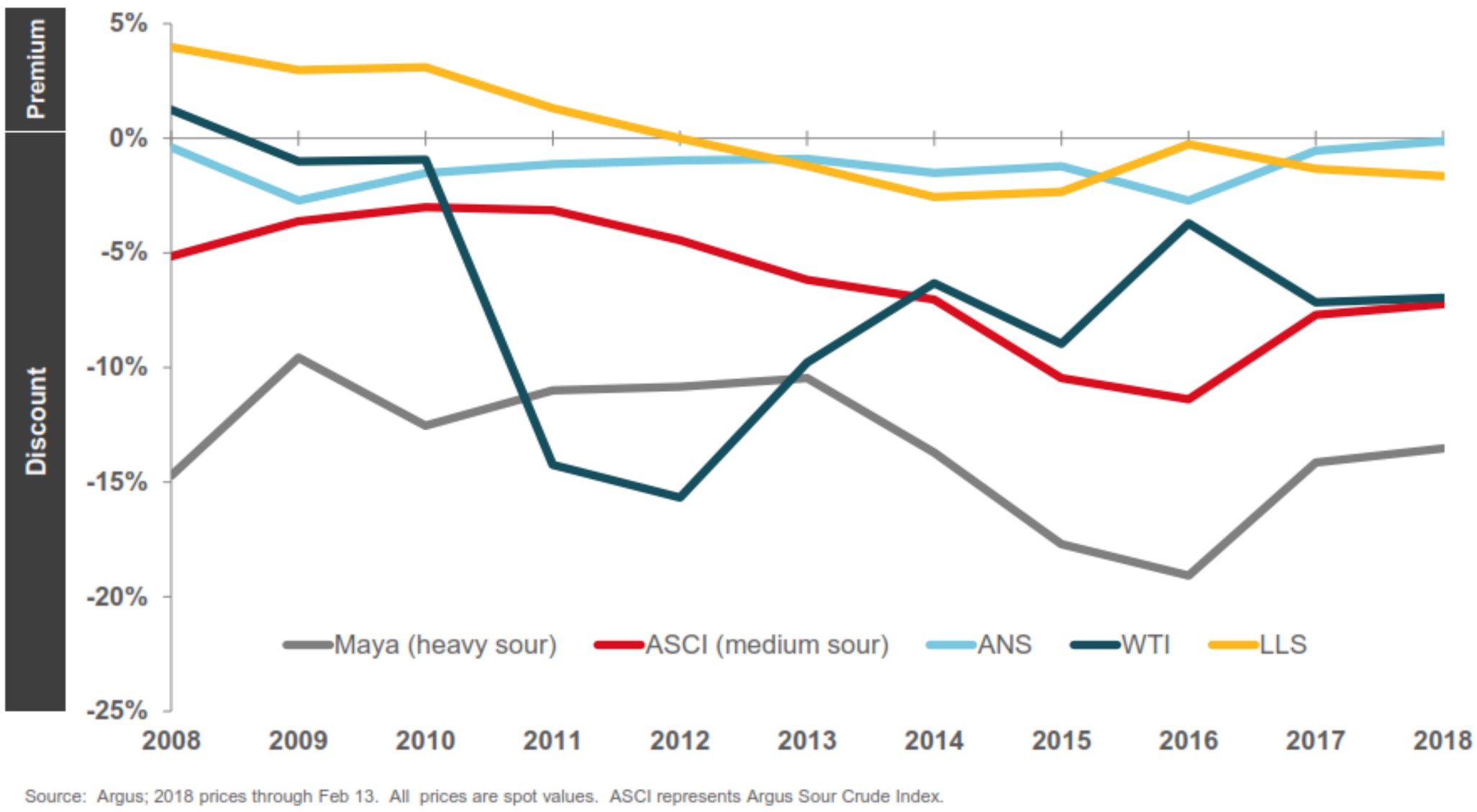
Crude Costs Vary with Quality



Source: Argus; 2018 prices through Feb 13. All prices are spot values. ASCI represents Argus Sour Crude Index.

Crude Sources are Ever Changing

- Sources are exhausted and new sources discovered
- As new pipelines are built, ports are opened, and import/export restrictions are lifted refinery crude slates change
- For example, recent US exports of Bakken crude to Latin America, Europe and Asia
- Discounted crudes offer cost advantage but need to weigh negative effects (added processing costs, different product slate, additional equipment maintenance)

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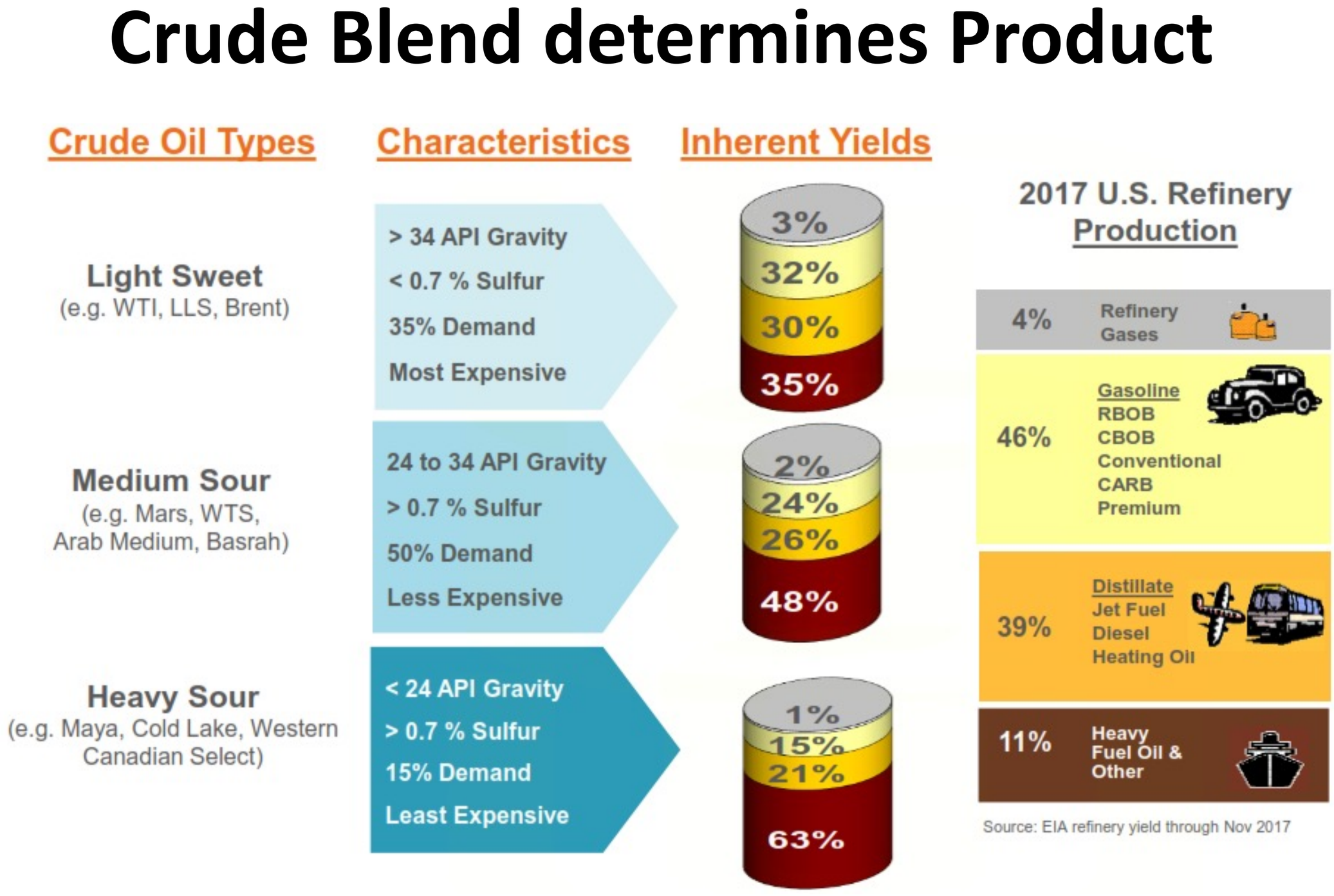
Crude Blend determines Product



Crude Blending Objectives for the refinery are to:

- minimize feedstock & processing costs
- maximize product revenues
- within refinery processing constraints

Refinery processing constraints include throughput limits, sulfur conversion constraints, pumping limits for viscous feed, corrosion (TAN), catalyst deactivation, etc.

Crude Blending is an important part of the efficient and profitable refinery.
Therefore the efficiency of the crude blending process is important.

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In-Tank is a well known blending method but it has a lot of shortcomings that include:

- Tank are expensive to build, operation of pumps/agitators are a utility expense, maintenance expense for pumps/agitators
- Long blend times
- Difficulty in Representative Sampling
- **L**ab analysis is not immediate
- Correcting off spec blends requires considerable rework
- Blend incompatibility leads to asphaltene precipitation/fouling. Tank cleaning is labor intensive and expensive. Not to mention that the tank is out of service .

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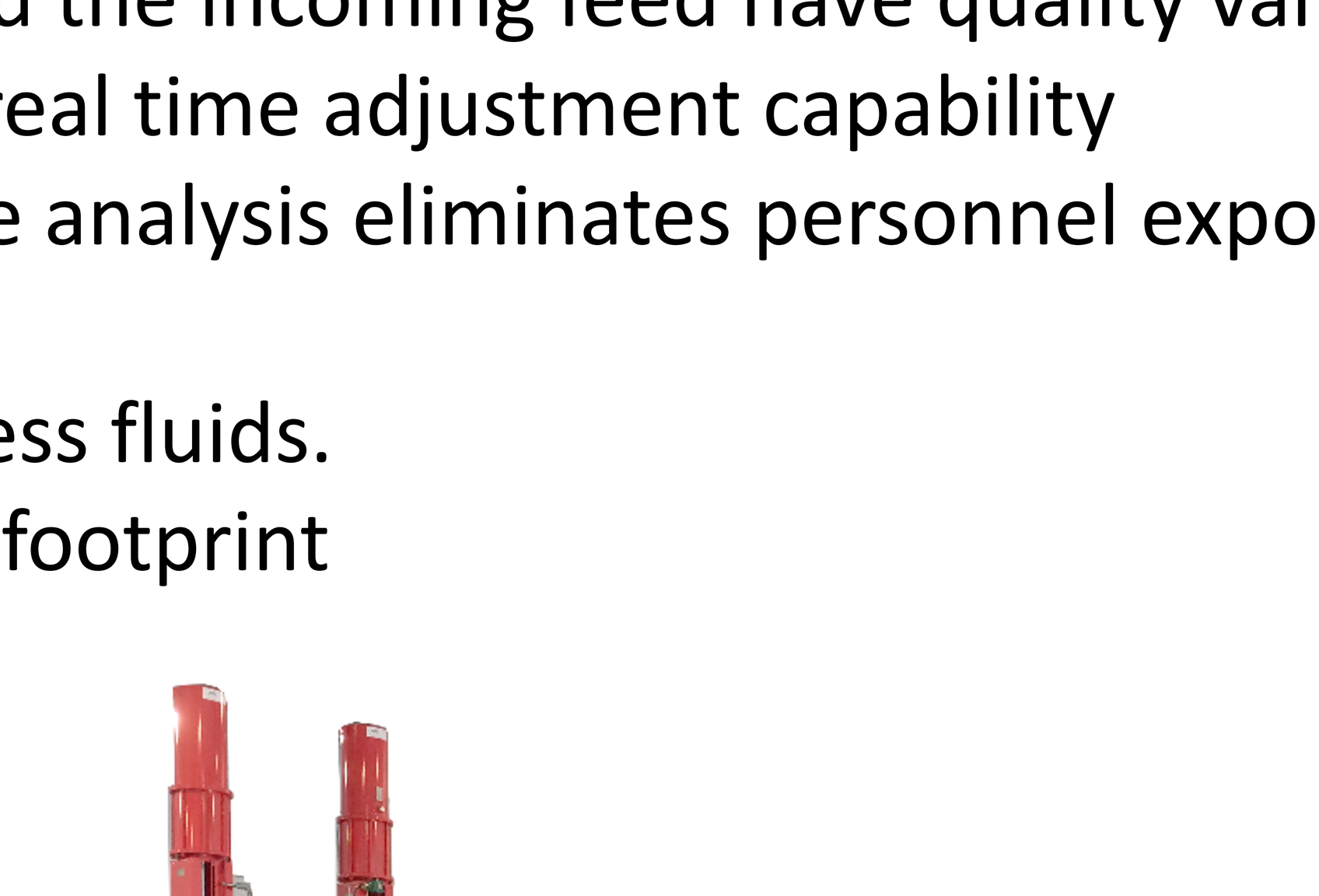
An Inline Blender has a lot of Advantages

- Less costly than tank blending both in capital, operating and maintenance.
- Crude residence time scale is minutes. Distillation unit feed can be altered in short time frame
- Automated through control loops and online analytical instrumentation
- Should the incoming feed have quality variability then real time adjustment capability
- Online analysis eliminates personnel exposure to the
- process fluids.
- Small footprint



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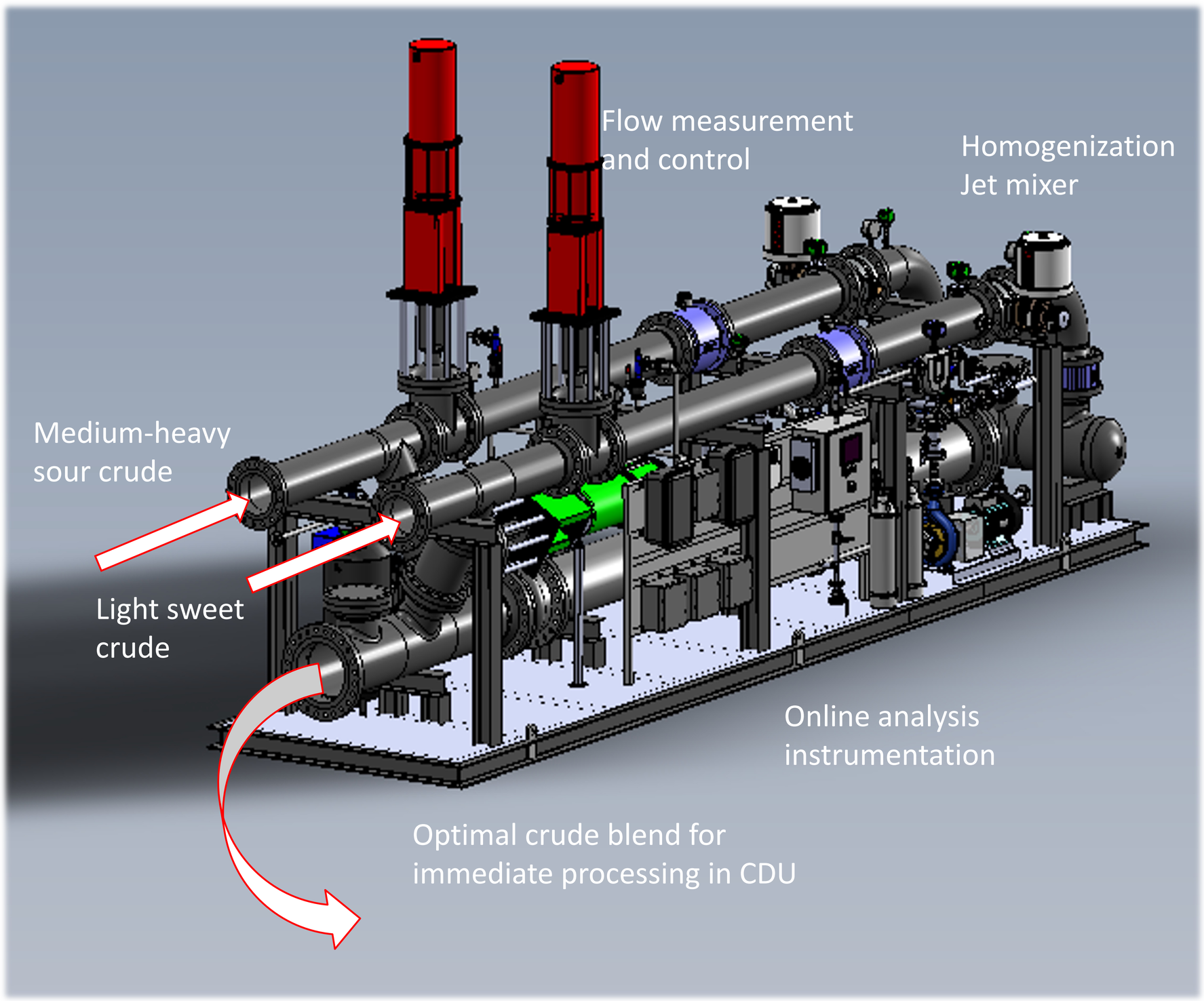
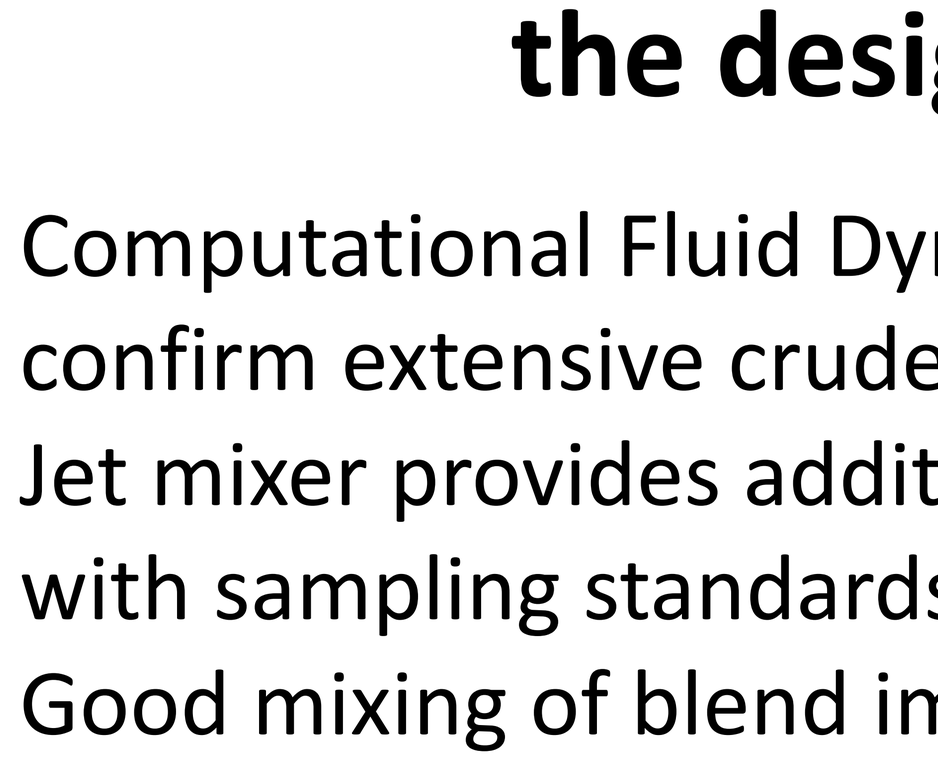
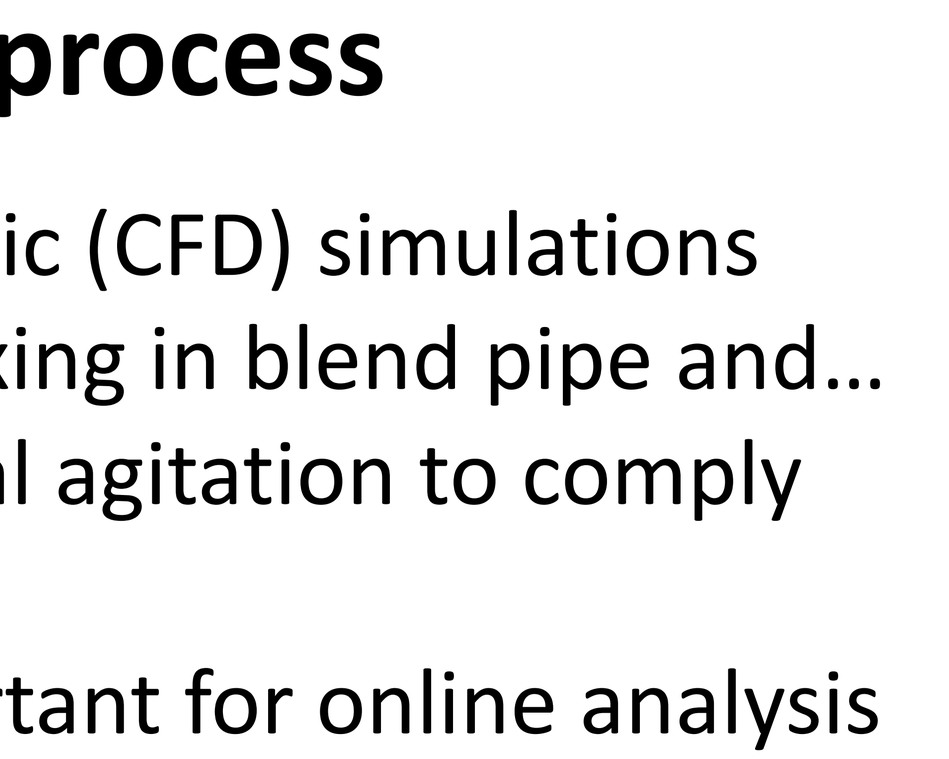
Elements of the Inline Blender



CFD Analysis is an important part of the design process

- Computational Fluid Dynamic (CFD) simulations confirm extensive crude mixing in blend pipe and…
- Jet mixer provides additional agitation to comply with sampling standards
- Good mixing of blend important for online analysis accuracy used in feedback crude control





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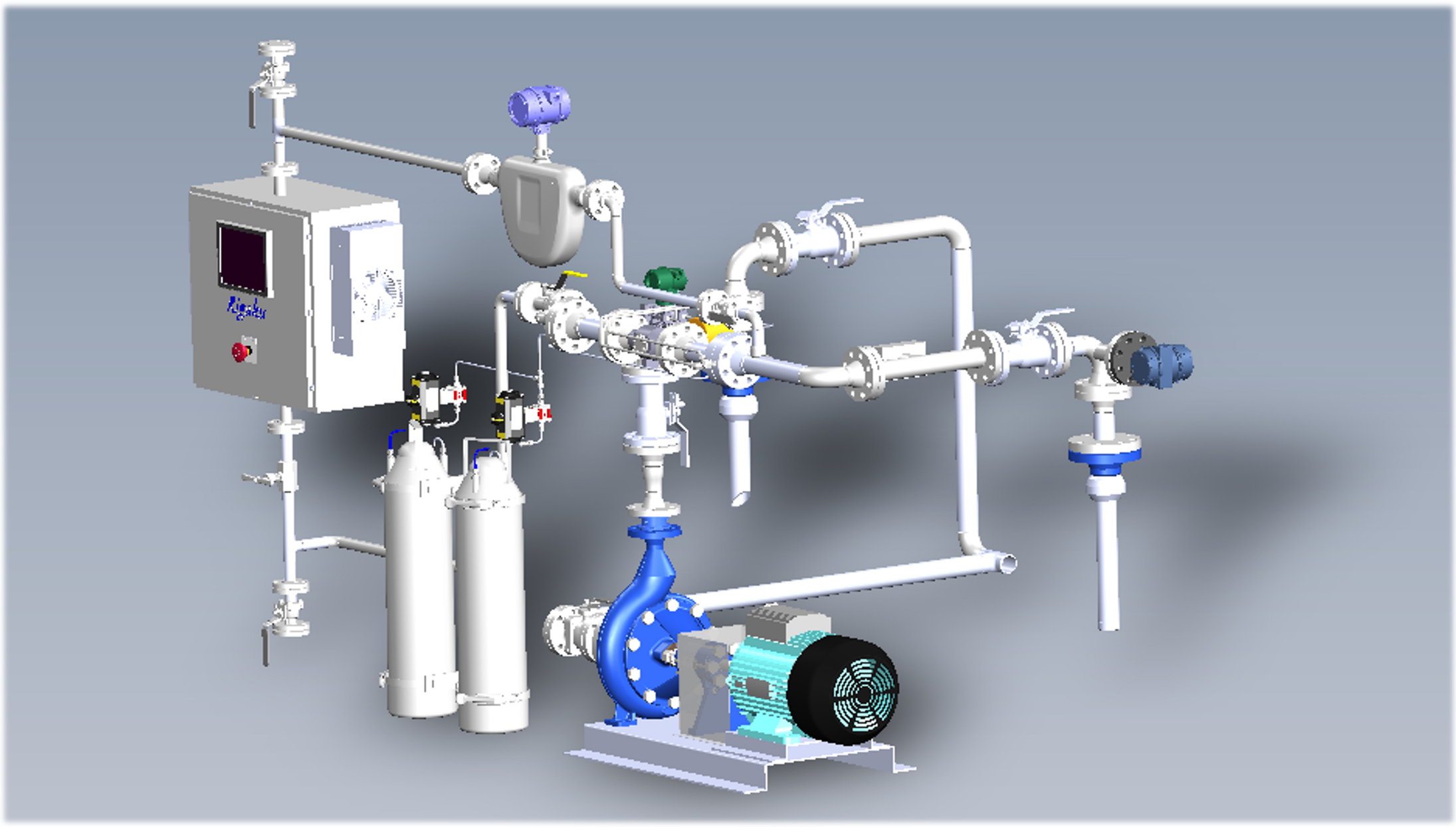
Online Analysis is a Critical Component

Real-time analysis of crude blend in the pipe

- Density, Sulfur, Water, Viscosity
- Blender feedback control of flow using analysis results

Has Advantages over laboratory analysis

- Eliminates time consuming sample collection and lab analysis
- Equipment operators run online equipment, receive data in real-time



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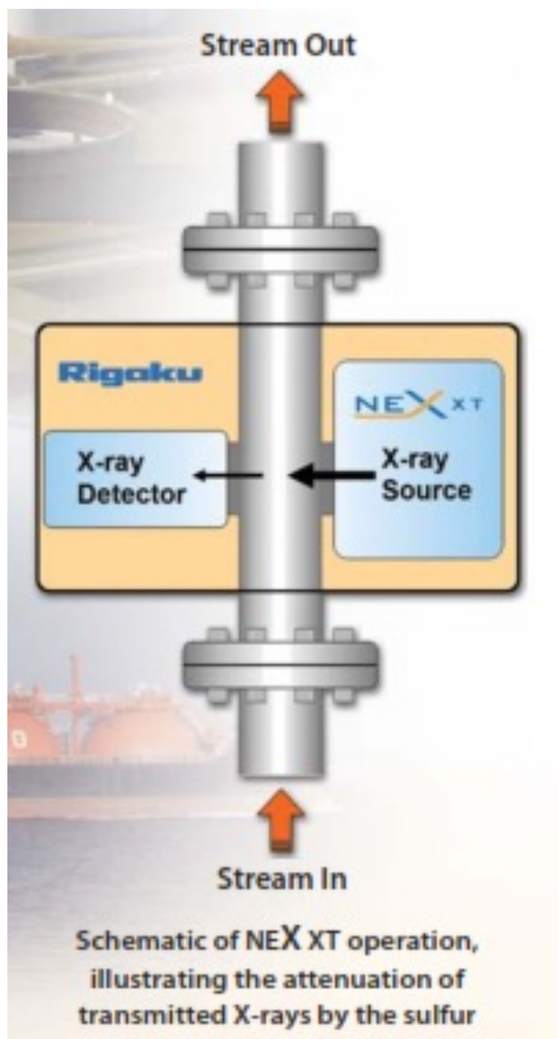
Sulfur Analysis

- X-ray transmission technique is not affected by sample opacity
- Sulfur range from 200 ppm to 6 wt% of crude
- Analysis time as short as 1 second
- System contains no radioisotope sources and does not require routine maintenance



Schematic of NEX XT operation, illustrating the attenuation of transmitted X-rays by the sulfur content of an oil stream

Density Analysis

- Providing precision density and temperature for custody transfer and concentration measurement
- Calibration Range 300-1300 kg/m^3
- Very Accurate ±0.1 kg/m^3

Vibrating Fork Viscosity Measurement

- unique and rugged design directly measures both dynamic viscosity and density, allowing a true measurement of kinematic viscosity, which is the preferred parameter in many industries.

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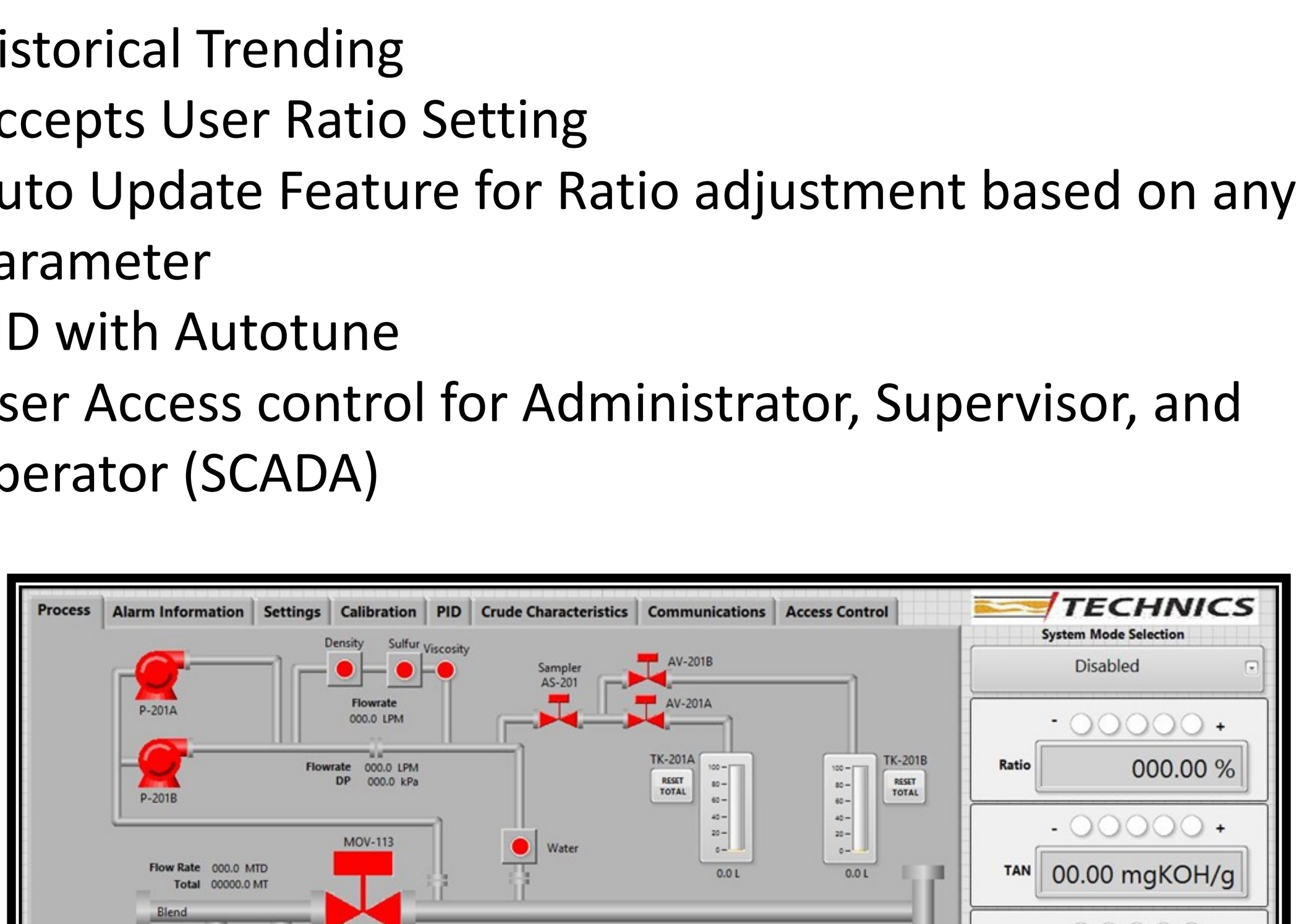
A Sophisticated and Robust Control System

- Linux embedded real-time operating system with 1.33 GHz dual-core Intel Atom processor, 4 GB nonvolatile storage, 1 GB DDR3 memory
- Graphical Representation on Local HMI and DCS
- Hi/Lo Warning and Alarm Settings
- Excellent Proportional Control
- Serial Data Retrieval
- Historical Trending
- Accepts User Ratio Setting
- Auto Update Feature for Ratio adjustment based on any one parameter
- PID with Autotune
- User Access control for Administrator, Supervisor, and operator (SCADA)



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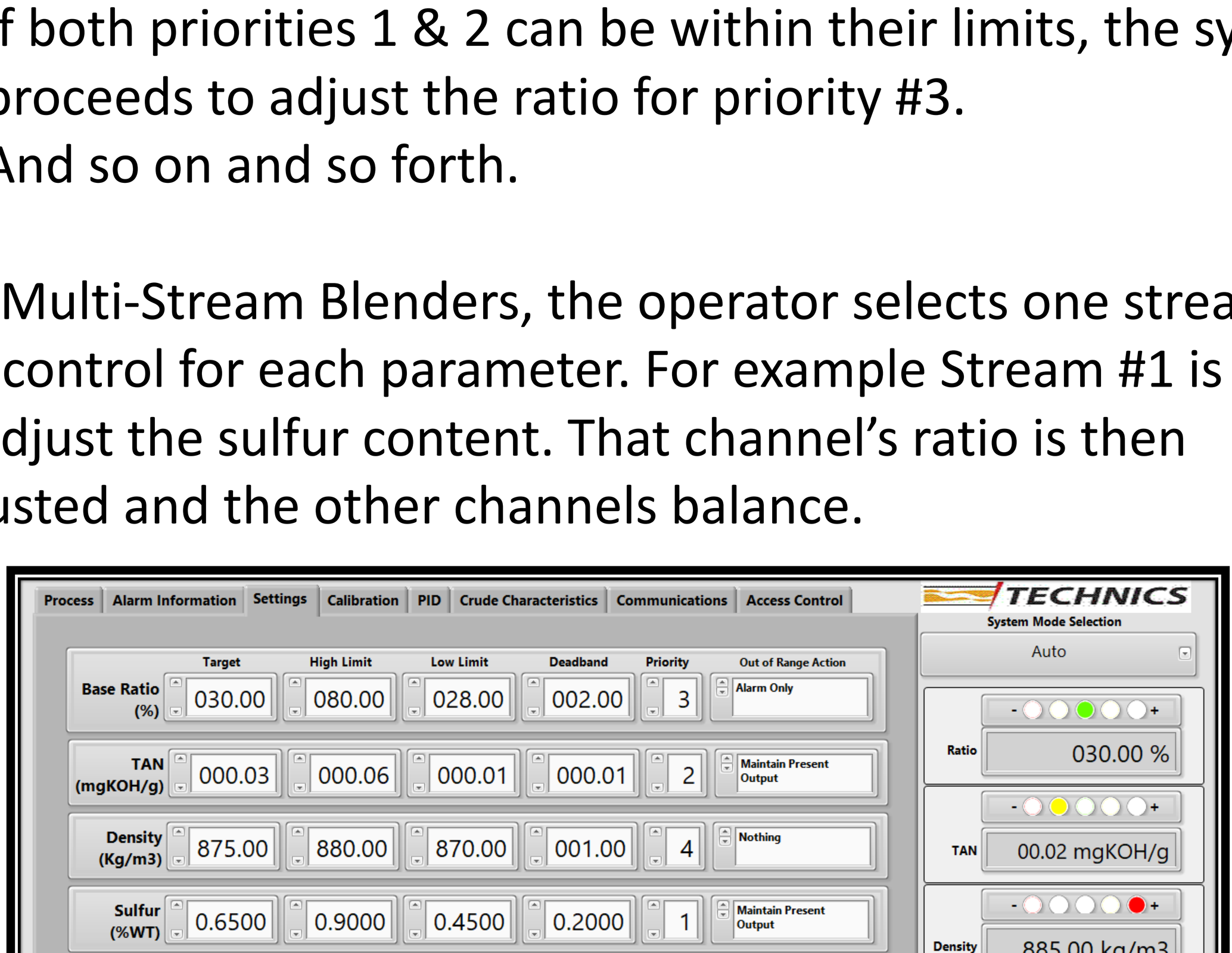
Real-Time Optimization with the Logos Auto Adjust Feature

1. Ratio is first changed to bring the parameter with priority 1 within its deadband.
2. Once stable, the ratio is adjusted to bring parameter with priority 2 within its range.
3. If priority #1 should fall outside its High/Low Limit, the auto adjustment is stopped and the system returned to the last good ratio.
4. If both priorities 1 & 2 can be within their limits, the system proceeds to adjust the ratio for priority #3.
5. And so on and so forth.

For Multi-Stream Blenders, the operator selects one stream as the control for each parameter. For example Stream #1 is used to adjust the sulfur content. That channel's ratio is then adjusted and the other channels balance.



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Technics has an Array of Solutions for the Oil & Gas Industry

- Inline Blenders for Refined Product (Gasoline, LPG, etc.)
- Inline Blending of Butane Into Gasoline
- Online Sampling & Analysis
- Chemical Injection Skids.
- Metering Skids and LACT Units
- Lubricant Blending Processes from skids to complete plants.