QS Energy

Introduction

QS Energy develops and commercializes industrial-grade equipment to optimize the efficiency of the global crude oil pipeline infrastructure

Our Mission: Working in collaboration with leading energy companies, we deliver technologies designed to improve the performance and economics of the upstream, midstream and gathering sectors.

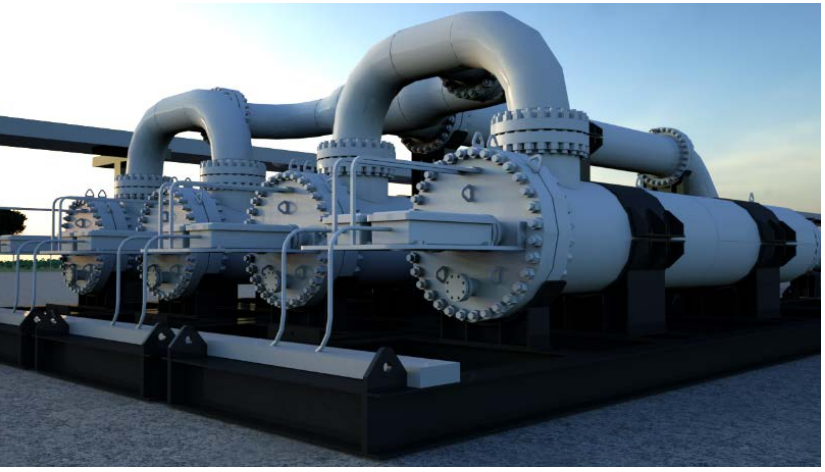
QS Energy

Supplier to the Global Energy Industry

QS Energy is a trusted partner of crude oil producers and transporters and the vendor of two high-value solutions to the industry

AOT™ (Applied Oil Technology) reduces the viscosity of oil by applying a low wattage electrical field to oil while in transit, allowing pipelines to operate at a lower pressure and transport crude oil more efficiently.

Joule Heat is a compact system for directly heating oil within pipelines at an estimated 60% better energy efficiency than conventional trace heating.



AISC CERTIFIED FABRICATOR

ASME U

ISO 9001 QUALITY ASSURANCE

QS Energy

Engineered to Deliver Innovation

How QS Energy Supports Today's Energy Renaissance

Research and Development

Laboratory testing, product development and prototyping at Temple University and field testing at the Department of Energy's Rocky Mountain Oilfield Testing Center (RMOTC) has driven development of our innovative solutions.

TEMPLE UNIVERSITY

Rocky Mountain Oilfield Testing CENTER

Industry Collaboration

Working collaboratively with engineering teams at leading oil producers and transporters, QS Energy designs, develops, manufactures and implements cutting-edge solutions for real-world assets and integrated systems.

Commercialization

Multiple deployments of our patent-protected industrial hardware under lease agreements on high volume commercial crude oil pipelines in Texas, Utah and Kansas are putting our viscosity reduction and crude oil heating technologies to work.

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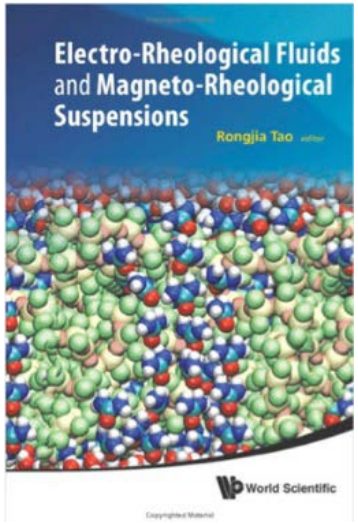
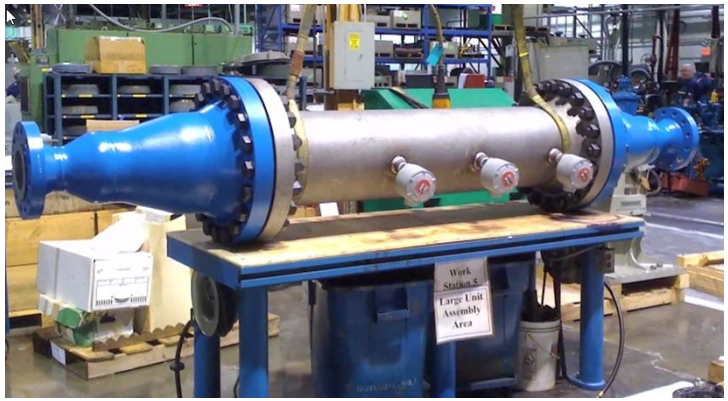
AOT Technology: From Lab to Oilfield

TEMPLE UNIVERSITY College of Science and Technology

- AOT was co-developed with Temple University under a multi-year research grant
- Supervised by Dr. Rongjia Tao, chair of Temple's Physics Department and a leading expert in the study of electrorheological fluids and magnetorheological suspension
- Laboratory testing of hundreds of petroleum samples, ranging from heavy bitumen to superlight condensates, have proved AOT's efficacy





QS Energy has an exclusive licensing agreement in perpetuity with Temple University pertinent to AOT and related technology.

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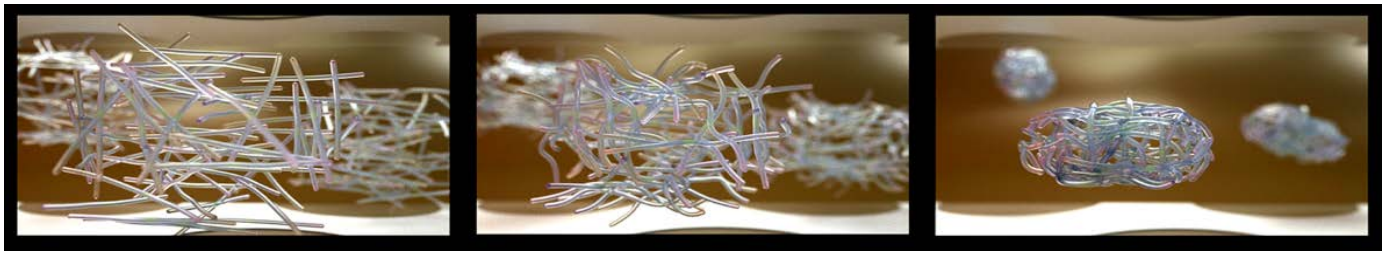
AOT: Patent-Protected Innovation

The Science Behind AOT

- AOT technology is based on the process known as dielectrophoresis
- Feedstock is exposed to electrical charge bath within AOT vessel(s)
- Change occurs in the molecular structure of paraffin and asphaltene content
- Paraffin and asphaltene bind into tight packets aligned in short chains
- Suspended particles travel in the direction of flow, decreasing viscosity
- Flow rate improves beyond the benchmark set by reduced viscosity alone

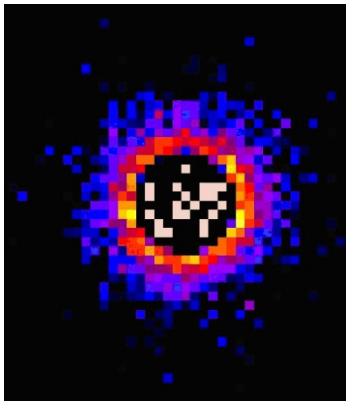


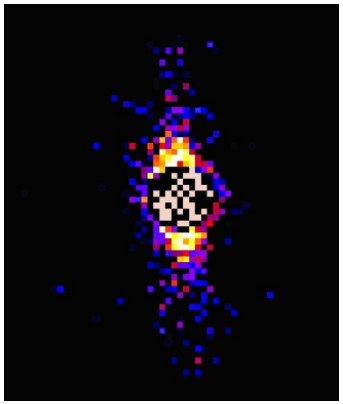
Computer generated representation of electric charge causing aggregation of particulate matter

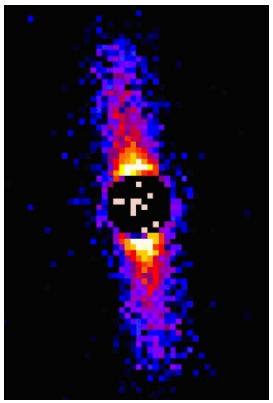
AOT: Patent-Protected Innovation

The Science Behind AOT

- Small angle neutron scattering at the NIST Center for Neutron Research verifies that short chains of particles aggregated along the field direction
- Small angle neutron scattering has confirmed the aggregation.
- With no electric field, the scattering is isotropic and sparse, indicating the particles are randomly distributed in the oil (left). Under an electric field (middle), the scattering reveals short chains of particles aggregated along the field direction.
- A stronger voltage field creates a prolate spheroid shape (right).







AOT R&D and Prototyping Milestones

2008: In response to surging domestic crude oil production as a result of horizontal drilling and hydraulic fracturing activity in the nation's shale formations, QS Energy underwrites R&D at Temple University centered on the use of electrorheology to optimize flow of oil in pipelines.

2009 - 2010: Laboratory studies of the effects of a high intensity electric charge on oil samples from around the world provide data useful for construction of small scale AOT prototypes. Temple R&D and QS Energy engineering efforts result in 48 worldwide patents.

AOT R&D and Prototyping Milestones

2011 - 2012: First industrial-scale AOT vessel is fabricated and installed at Dept. of Energy oilfield testing center for rigorous testing and analysis on functioning pipeline. In collaboration with over a dozen engineering teams from crude oil producers, transporters and QS Energy's supply chain partners, the first industrial-grade AOT system is developed. The result is a 110-ton, four-vessel system capable of treating upwards of 500,000 barrels of crude daily.

QS Energy conducts field tests of AOT at Rocky Mountain Oilfield Testing Center

In 2011 the first full-scale prototype of a single vessel AOT system was placed on a 4.4 mile, 6 inch diameter closed-loop pipeline under an operating agreement with the U.S. Department of Energy in Wyoming.

Rocky Mountain Oilfield Testing CENTER

U.S. DEPARTMENT OF ENERGY

Test Results Prove Efficacy

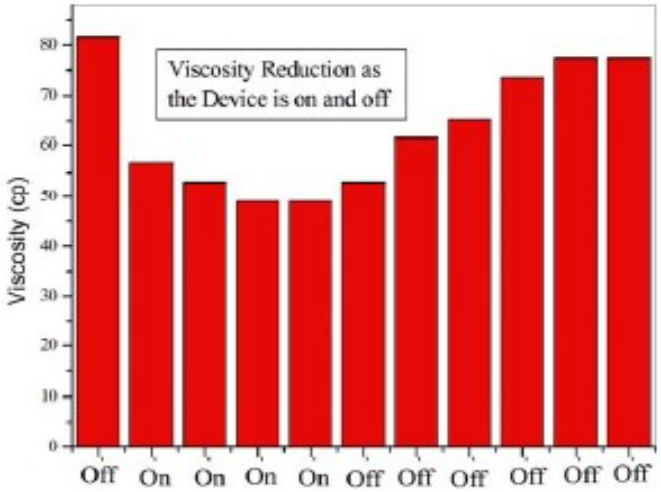
In a report published April 4, 2012, DOE field engineers documented that AOT **reduced viscosity** and **lowered pipeline operating pressure**, proving the efficacy of the use of electrorheology on commercial crude oil pipelines. **Friction** within the line was also reduced, contributing to **reduced drag** and **better flow**.

DOE VERIFIED VISCOSITY REDUCTION TEST RESULTS

Original viscosity of 118.1 cP
was reduced by 56% down to 51.8 cP

Due to these factors, pipeline pumping equipment also required less energy.

Full DOE report is available:
http://ir.stockpr.com/qsenergy/all-sec-filings/content/0012-002019.pdf



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AOT Commercialization Timeline

AOT deployed with leading North American pipeline operators

2013: Following fabrication and extensive regulatory review, AOT is certified to meet all necessary codes and regulatory compliance for use in hazardous location Class 1, Div. I. rated areas. QS Energy enters into an Equipment Lease Agreement with a $35B pipeline operator to beta test AOT on a primary north-south, mid-continent line.

2014: Analysis of AOT performance on $35B customer's pipeline by an independent testing lab documents efficacy in reducing viscosity and pipeline operating pressure and lowering pump station energy consumption.

2015: Installation of a single-vessel AOT system is completed on a primary condensate pipeline serving Eagle Ford Formation in South Texas, world's most active oil and gas shale production.

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AOT: Proven ROI and Opex Benefits

AOT efficacy has been evaluated and verified by independent researchers and scientists

AOT performance documented on wide spectrum of oil ranging from API 14 to API 50.
Tested on U.S. crude oil samples from Eagle Ford, Uintah, Marcellus, Haynesville and Teapot Dome and overseas samples from Africa, Middle East, Europe and Asia-Pacific.

AOT Test Results on Closed-Loop and Commercially Operated Pipeline Deployments:

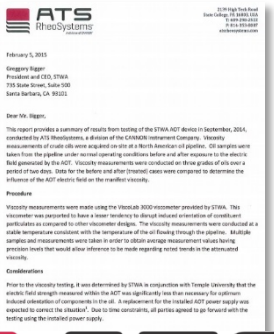

管道科技研究中心
PETROCHINA PIPELINE R&D CENTER

Report

AOT Viscosity Reduction Tests in China
Using Certain Chinese Crude Oil Samples

2012 年 6 月 26 日

PetroChina


ATS RheoSystems

ATS RheoSystems
A division of CANNON


ROCKY MOUNTAIN OILFIELD TESTING CENTER

RMOTC

PROJECT TEST RESULTS

STWA, INC.
VISCOSITY REDUCTION TECHNOLOGY

Prepared for:

Industry Publication

U.S. DEPARTMENT OF ENERGY

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Sample Test Case #1

40” 288-Mile Crude Oil Pipeline

Volume: 1.1 million bbl/d

No. of Pump Stations: 6

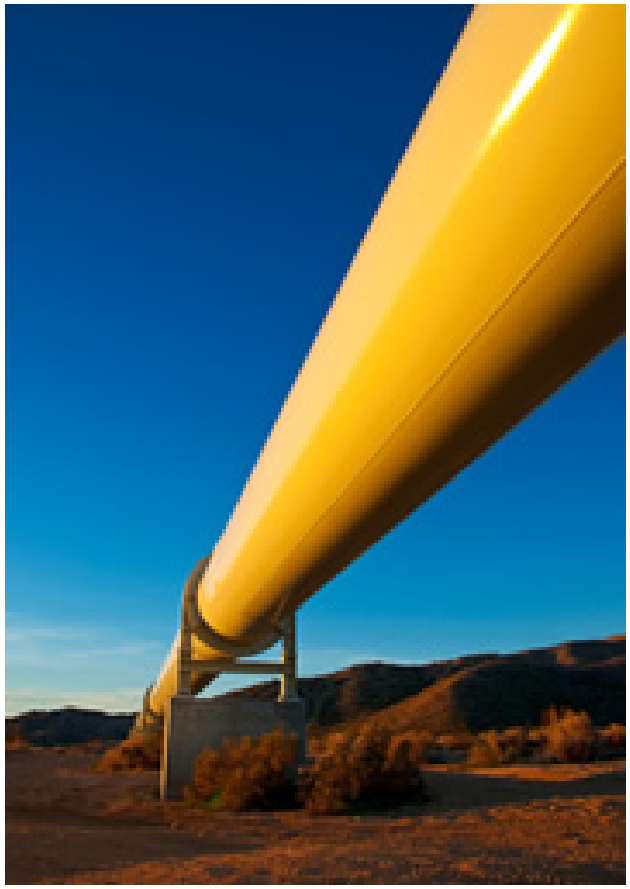
Elevation Gain: 1,300 feet

Average Density: 850 kg/m^3

Average Viscosity: 100 mPa*s

Tariff Price: $4.00/bbl

Cost of Power: $0.30 kWh



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Sample Test Case #1

AOT Test Results:

Viscosity Reduction: 10 - 25%
Capacity Increase: 1.1 - 3.5%
Capacity Flow Increase: 12,500 - 39,000 bbl/d
Overall Efficiency Improvement: 1.8 - 5.3% for the section following the installation. This equates to a
Reduction in Power Consumption: 350 - 1050kW
Back Pressure Reduction: 17 - 50psi relief in back pressure

Cost Savings: $75,600 - $226,800/month OPEX savings per pump station.

ROI: $2,250 - $7,500/day increase in tariff revenue

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Sample Test Case #2

48” 46-Mile Crude Oil Pipeline

Volume: 900,000 bbl/d

No. of Pump Stations: 1

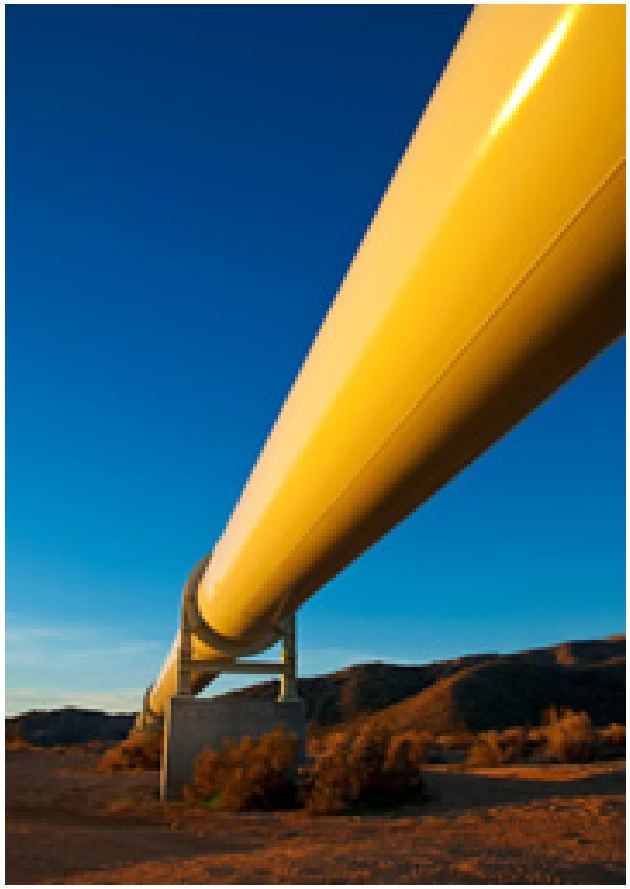
Elevation Gain: N/A

Average Density: 850 kg/m^3

Average Viscosity: 50 mPa*s

Tariff Price: $1.00/bbl

Cost of Power: $0.30 kWh



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Sample Test Case #2

AOT Test Results:

Viscosity Reduction: 10%-25%
Capacity Increase: 1.0 – 2.4%
Capacity Flow Increase: 7,200 – 21,600 bbl/d
Overall Efficiency Improvement: 1.7 - 5.4% for the section following the installation. This equates to a
Reduction in Power Consumption: 350 - 1050kW
Back Pressure Reduction: 11-16 psi relief in back pressure

Cost Savings: $30,000 - $462,000/month OPEX savings per pump station.

ROI: $7,000 - $21,000/day increase in tariff revenue

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AOT: Versatile & Customizable

AOT delivers measurable performance improvement and operational benefits:

Increased maximum flow rates
Reduced pump station power consumption
Optimized flow assurance
Crude concentration increase due to reduced use of additives
Bottleneck and chokepoint prevention

Solid-State Viscosity Reduction for Upstream and Midstream Applications

Pipelines:

Primary Pipelines
Gathering Lines
Feeder Lines

E&P:

Gathering Systems

VLCC/ULCC:

Bunker Fuel Enhanced Combustion
On-loading/Off-loading
Single Point Mooring/Marine Terminals

Offshore:

Cold Environments
Hydrates
Paraffin Deposition

Subsea:

FPSO Systems
Floating Vessels/Floating Platforms
Processing and Boosting Systems

A new generation of heat technology for oil pipelines

Developed by QS Energy and fabricated and assembled entirely in the United States, Joule Heat is a highly energy-efficient crude oil heating system that delivers optimal heat conductivity and performance using less power than other traditional heat systems.

Specifically developed to treat a wide spectrum of feedstock and designed to withstand extreme weather conditions, Joule Heat is electrically powered, compact and adaptable to a variety of environments, from pipelines and oil fields to marine, rail and truck offloading facilities.

QS Energy

Industry's First Direct Heat System

Energy efficient electric heat technology

Despite the obvious need for a highly energy efficient heating system designed to deliver optimal heat conductivity, there have not been significant technological innovations in crude oil heating technologies for many years. Until now.

Better Performance, Greater Efficiencies at a Lower Operating Cost

Delivers optimal heat conductivity
Heats oil directly and uniformly with intense electric charge
Compact form factor, highly adaptable
Treats a wide variety of feedstock
Estimated to be twice as efficient as existing technologies

"The primary motivation for providing innovative heat solutions was a direct result of lengthy discussions with E&P entities, pipeline operators and state government officials that centered on the inefficiencies of existing heat technologies."

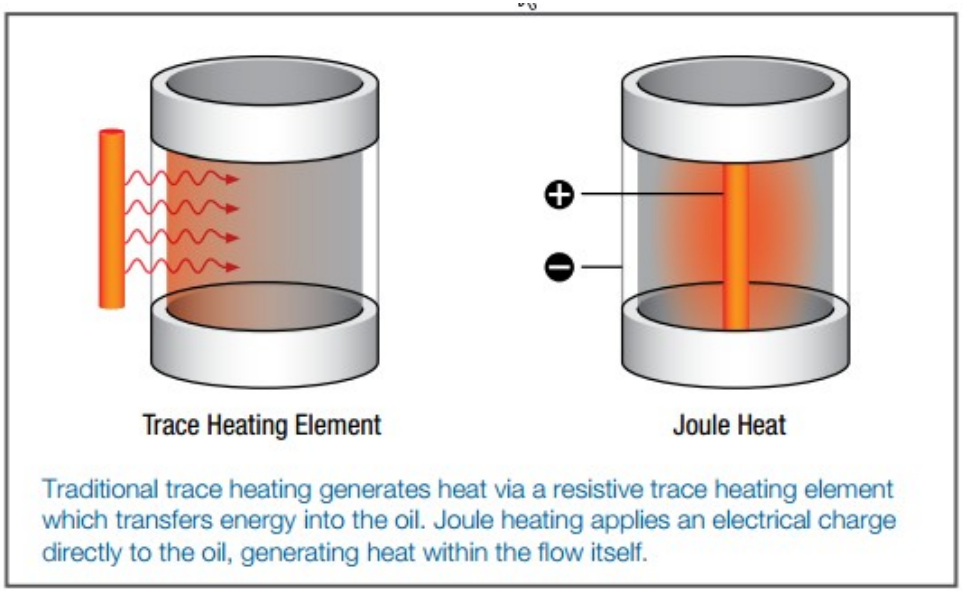
Greggory M. Bigger, Chairman and CEO of QS Energy

An inside-out approach to industrial heating

Joule Heat subjects the oil to a direct and intense electric field that increases oil temperature uniformly without interrupting flow. Preliminary testing of Joule Heat suggests efficiencies of over 60% when converting electrical energy into internal energy in oil, compared to efficiencies of approximately 30% typical in trace heat systems. A beta test deployment on a line serving the Uintah Basin in Utah is expected to be completed in Q2 2015.

How It Works:

Traditional trace heating generates heat via a resistive trace heating element which transfers energy into the oil. Joule heating applies an electrical charge directly to the oil, generating heat within the flow itself. Joule Heat is designed to operate on low-flow "feeder" pipelines which are ubiquitous throughout the massive upstream sector.



Traditional trace heating generates heat via a resistive trace heating element which transfers energy into the oil. Joule heating applies an electrical charge directly to the oil, generating heat within the flow itself.

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100% Solid State, Low Maintenance

Enabling a leaner, sustainable energy industry

Traditional trace heating systems rely on the use of an electrical resistor to heat the oil which results in extremely poor efficiencies and loss of heat into the pipeline material. Joule Heat brings new efficiencies to a wide spectrum of applications, including gathering lines, offloading stations, onboard ships and other sectors of the global crude infrastructure.

“The introduction of a highly energy-efficient feedstock heating system designed to deliver optimal heat conductivity and performance using less power than other systems could be a game-changer in an otherwise stagnant equipment category.”

Greggory M. Bigger, Chairman and CEO of QS Energy

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Solutions Capable of Being Customized to ExxonMobil's Specific Requirements

QSE has developed two patent-protected technologies to optimize crude oil pipelines

Our flagship product **AOT™ (Applied Oil Technology)** reduces the viscosity of oil by applying a high intensity electrical field to oil while in transit, allowing pipelines to operate at a lower pressure and transport crude oil more efficiently. **QSE Joule Heat** is a compact system for directly heating oil within pipelines at an estimated 60% better energy efficiency than conventional trace heating.

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Thank you

Contact us for more information

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Safe-Harbor Statement

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