

Technology White Paper
on
Reducing Viscosity of Crude Oil and Diesel Fuel
with Potential for Improved Fuel Economy
and Emissions Reduction

STWA, Inc.

October 2009

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Stock Symbol: **[OTCBB:ZERO]**



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REDUCING VISCOSITY OF CRUDE OIL AND DIESEL FUEL WITH POTENTIAL FOR IMPROVED FUEL ECONOMY AND EMISSIONS REDUCTION

INTRODUCTION

STWA and Temple University have developed a technology that reduces viscosity of crude oil and diesel fuel. We believe that this technology, we call Applied Oil Technology (AOT), could lead to more efficient oil pipelines and wells. Additionally, we have tested an extension of this technology we call Elektra that we believe could lead to improved fuel economy and reduced emissions in diesel and perhaps even gasoline engines. We believe that the potential costs savings from these technologies is in the billions of dollars.

Research done at Temple University has found the application of an electric field reduces the viscosity of the crude oil and diesel fuel. For example, in one set of tests, API 11 crude oil with a viscosity of 112,640 cp (centipose) decreased to 92,000 cp, a 17% reduction in viscosity after exposure to a 305 V/mm electric field for 35 seconds.¹ Additional tests on diesel fuel have delivered reductions in viscosity from 4.7 cp to 4.2 cp after the application of 1.0kV/mm for 2 seconds, a 9% reduction. Furthermore, diesel fuel with reduced viscosity has been fed through a fuel injector and research has seen that the reduced viscosity leads to a decrease in the size of the fuel droplets. Specifically, tests found that the number of droplets with a diameter less than 40 micrometers increased dramatically and that the number of the smallest droplets less than 5 micro-meters tripled. We believe that the ability to deliver such dramatic reduction in fuel droplet size should lead to more efficient combustion and therefore improved fuel economy and reduced emissions. We have since run a number of tests on engines and we are seeking partners to assist us in financing these engine tests.

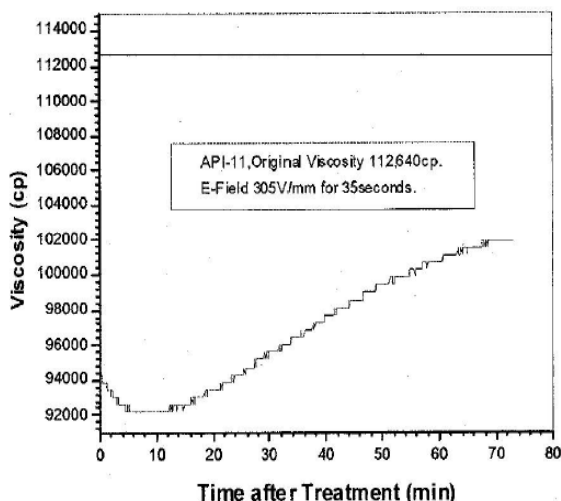


Figure 1. Viscosity of Crude Oil after Application of an Electric Field

HOW IT WORKS

The Elektra technology works by passing the crude oil or diesel fuel through an electric field created by electricity applied to a series of copper meshes. On September 19, 2009 at Temple University we conducted a series of tests that have been documented on video. In the third pass in this series of tests, a voltage of 45,800 volts at six micro amps was applied to the copper meshes. As a result, crude oil flowed 13% faster out of the Elektra.

Crude oil and diesel are fluids with dissolved particulate matter in them. Dissolved particles

¹ Temple University 2008 - Electrorheology Leads to Efficient Combustion

when rubbing together create drag within the fluid, increasing the overall viscosity and making it more difficult to pump and spray the fluid into droplets. We apply an electric field in the fluid flow, forcing particles to align in the direction of the electric field.

When this happens, the particulate matters' natural tendency to combine into clusters is enhanced, enabling the total surface area per unit of dissolved particulate matter to decrease, giving more volume within the fluid for the dissolved particles to move, reducing their inter-particulate friction, thereby reducing viscosity.

In the video of the September 19th tests, we show two passes through the Elektra system. In the first pass, we measured the difference in flow between the left and the right side of the apparatus with no voltage applied.

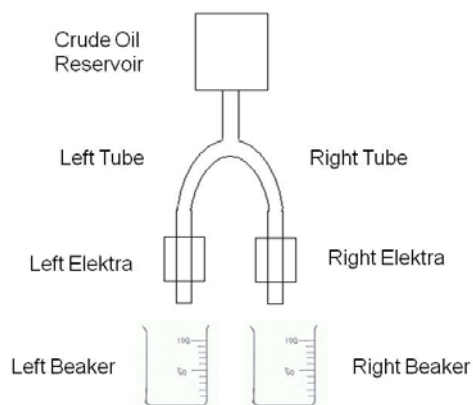


Figure 2. Elektra Test Apparatus

In the second pass, we turned the Elektra on by applying voltage and we measured the difference in flow between the left and the right side of the apparatus with the elektra turned on.

In this test, we documented that the Elektra improved the flow of crude oil by thirteen percent. Other tests with other grades of oil have resulted in improvements as great as 30%.²

CONCLUSION

We can provide video documentation of the improvement of crude oil viscosity discussed here. We have also greatly reduced the size of diesel fuel droplets emitted from a fuel injector and have extensive data captured from these tests.

With additional financing or strategic partner, we will:

- Reconstruct the diesel fuel injector test stand and capture the repeatable improvements on video
- Arrive at the precise Elektra geometry, voltage and current for repeatable reduction in diesel fuel droplets emitted by a fuel injector
- Apply prototypes to diesel engines and demonstrate fuel economy improvement and emissions reduction with a dynamometer.

The complete set of technical papers from Temple University are available on our website at www.stwa.com. For more information please call STWA at 1 (877) USA-STWA.

² Final Report: Reducing the Viscosity of Crude Oil by Pulsed Electric and Magnetic Field March 4, 2008

