Increasing oil flow in the Keystone pipeline with electric fields

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Researchers have shown that a strong electric field applied to a section of the Keystone pipeline can smooth oil flow and yield significant pump energy savings.

Traditionally, pipeline oil is heated over several miles in order to reduce the oil's thickness (which is also known as viscosity), but this requires a large amount of energy and counter-productively increases turbulence within the flow. In 2006 Rongjia Tao of Temple University in Pennsylvania proposed a more efficient way of improving flow rates by applying an electric field to the oil. The idea is to electrically align particles within the crude oil, which reduces viscosity and turbulence.

To test this, Tao collaborated with energy company Save The World Air, Inc. to develop an Applied Oil Technology (AOT) device that links to oil pipelines and produces an electric field along the direction of the oil flow. Recent trials on oil pipelines in Wyoming and China verified that crude oil particles form short chains in an electric field. These chains reduce viscosity in the direction of flow to a minimum. At the same time the viscosity perpendicular to the flow increases, which helps suppress turbulence in the overall flow.

This past summer Tao and his colleagues also successfully tested the AOT device on a section of the Keystone pipeline near Wichita, Kansas.

"People were amazed at the energy savings when we first tested this device. They didn't initially understand the physics," said Tao. "A second

test with an independent company was arranged and found the same thing." Tests on a section of the Keystone pipeline found that the same flow rate could be achieved with a 75 percent reduction of pump power from 2.8 megawatts to 0.7 megawatts, thanks to the AOT device. The device itself uses 720 watts.

Once aligned, the oil retained its low viscosity and turbulence for more than 11 hours before returning to its original viscosity. But the process is repeatable and Tao and his colleagues envision AOT stations spaced along a pipeline, significantly reducing the energy necessary to transport oil. This work was published in January 2015 in *Physical Review E* and Tao will present the additional Keystone pipeline test results at the March Meeting 2015.

Previously Tao has also shown that the same technique applied with a magnetic field can reduce blood viscosity by 20 to 30 percent, published in 2011 in *Physical Review E.* With clinical trials, Tao says this could represent a future treatment for heart disease.

More information: "Suppressing turbulence and enhancing the liquid suspension flows in pipelines with electrorheology." absimage.aps.org/image/MAR15/M … AR15-2014-000852.pdf

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