



VORTEX TOOLS: IMPROVING EFFICIENCY IN GAS WELLS IN THE UTICA AND MARCELLUS

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The Vortex technology is a simple to use, proprietary process that can be added to gathering lines and pipelines, utilized at the wellhead operations as an easy retrofit, or adapted for a new well. With significant elevation changes in gathering lines in the Marcellus and Utica formations, and wide temperature variances between summer and winter, Vortex can help efficiently move gas while preventing liquids drop-out at low spots.

Technology Overview

In simple terms, the Vortex tool develops a “tornado in a pipe.” This patented, proven process forces heavier liquid-bearing fluids to the outside of a pipe in a helical pattern while lighter gas is pulled to the center of the spinning vortex and travels at substantially higher velocities. This development of efficient two- or three-phase flow improves pipeline efficiencies and reduces pressure loss.



In long gathering lines with significant changes in elevation, Vortex prevents liquid drop-out at low points, thereby reducing freeze-ups in winter and

eliminating the need for drips or pigging. The organized Vortex flow also reduces slugging, which improves capacity at the gas processing plant. In paraffin-prone lines or those where chemical treatments are in use, the helical flow can improve chemical effectiveness, substantially reducing their use.

In addition to these optimization benefits, the deployment of the Vortex technology also enables the recovery of condensates and up to 10 times more natural gas liquids (NGLs) than conventional methods (see image 1). This increase in condensates and NGLs increases production revenues, especially important as oil prices dipped below \$80/bbl for the first time in a year in October 2014 (see image 2).

Vortex at the Wellhead

Vortex can be utilized to address freezing, hydrate formation, and reduce water vapor, as well as increasing values including NGL recovery, turning vapors to liquids, etc.

A challenge for the operator is to recover higher value hydrocarbons from the gas without creating delays in custody transfer. Refrigeration methods such as J-T skids or cryogenic processes are banned in most pipeline contracts. However, the rich NGLs entrained with the natural gas can be problematic when these liquids drop out in low spots in gathering lines. When temperatures reduce, liquids tend to drop out of the gas and as velocities reduce (as the well depletes), the problems with stagnant fluids in pipelines increase.

In many cases, the drop-out of liquids (water, NGLs, condensates, and light oil) cause spikes in flowline pressures, requiring increased compression and creating

intermittent production. The use of pigging or pressure spikes to evacuate liquids creates challenges at the process plant in terms of managing slugs of liquids. Vortex eliminates these challenges by delivering a constant flow of liquids, reducing slugging, and smoothing surface line pressures.

Vortex Removing Entrained Gas from Oil – Reducing Vapors at Production Tanks

Deploying Vortex on the liquid leg of the high-pressure separator helps reduce entrained gas from oil production and the fugitive vapors from production tanks. In a typical oil well, full-flow production (oil and gas) co-mingle at the tree and are conveyed to the high-pressure separator. At the separator, gas is removed and sent to sales. Oil (with residual entrained gas) passes from the high-pressure separator on the liquid dump line. By adding a Vortex tool prior to the low-pressure separator or Heater Treater, Vortex spins the remaining entrained gas out of the oil, thereby reducing gas in the production tanks.

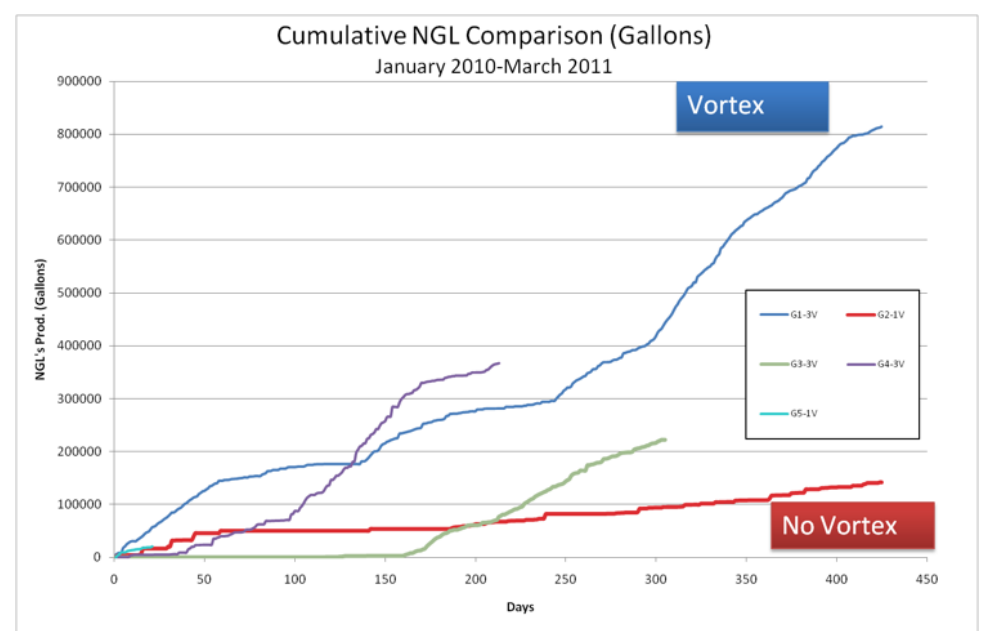
Vortex (at High Temperatures) Replace Vapor Recovery Units

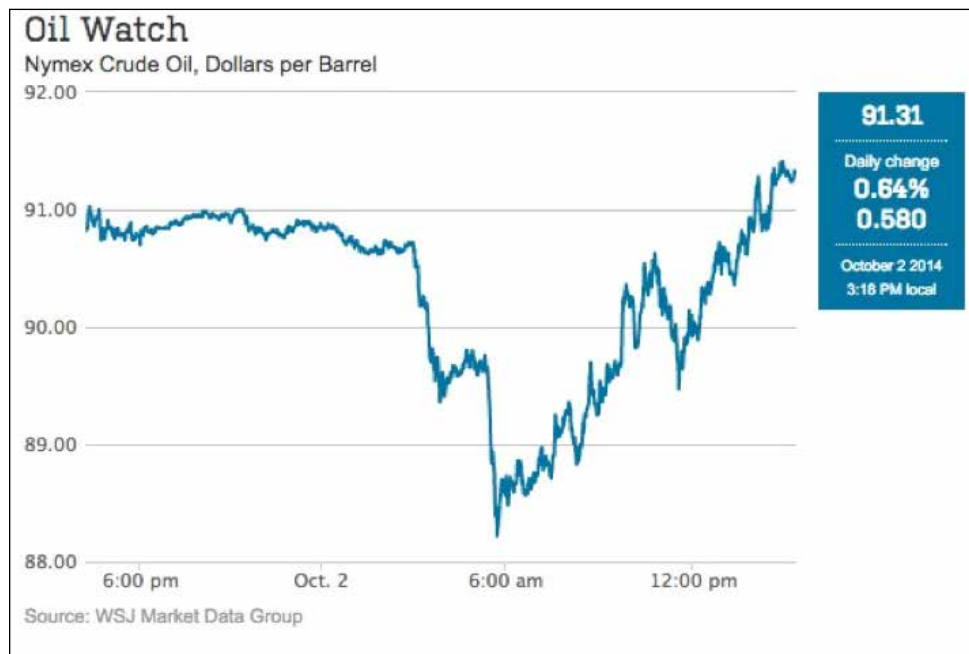
With Vortex, operators are able to spin volatile organic compounds (VOCs) back into oil. By spinning vapors back into oil and condensates, Vortex surface tools (see image 3) allow the operator to cost-effectively replace vapor recovery units with an environmentally responsible and low-cost solution. The stable spinning flow creates less turbulence, better separation of fluids and vapors, more volume/more value, and the (flash) gas can go back through the low-pressure separator to be compressed and sent to sales (if available). Vortex reduces vapors (by making them liquids) so there is minimal gas to flare. What little does go to the flare is cleaner.

Vortex is ideal for higher temperature locations where managing gas vapors is more problematic. In one such hot-climate install, according to the customer, even with 103 °F ambient daytime temperatures, the vapors off the production tanks were negligible (and in air quality compliance) on every install with Vortex.

Vortex Tools to Recover Condensates and NGLs from Pipeline Gas

By adding a Vortex tool after wellhead separation, rich natural gas passes into the gas pipeline where the gas, condensate and NGLs are separated in the organized flow. The liquids and gases can be separated at the plant by conventional separation.





Vortex can be installed at the beginning or end of the gas pipeline, maintain organized flow over long or short distances, and can be installed horizontally or vertically without impairing performance.

Operators have seen benefit (in terms of increased hydrocarbons like NGLs, condensates, etc.) in lines as long as 6.5 miles and as short as 8 feet. Vortex separation occurs immediately downstream of the device and the co-flow (of liquids and gases) continues for long distances without significant drop-out of liquids at low spots due to differential temperatures/elevation changes.

At the gathering line discharge, NGLs discharge to a bullet tank under pressure (120 PSI minimum to maintain NGLs as liquid), and the gas goes to the processing plant or pipeline

To the gas processor, the biggest benefit in using Vortex may be to maintain a constant flow of liquids. With the organized Vortex flow, liquids are delivered to the processing plant in a continuous stream as opposed to the intermittent slugs seen with conventional flow.

Reduced Freezing with Vortex

Hydrate formation in gathering lines is also reduced with Vortex. Production gas is typically 130-210 °F at the tree in E. Texas, but gas will freeze at only 55 °F. We have seen benefit in preventing hydrate formation on lines with Vortex during winter in Wyoming and seen a reduced need for methanol and pigging.

The Texas operator confirmed he is getting 70% more liquids with Vortex, along with reduced emulsion, reduced de-emulsifier, chemicals use, and no freezing. Lines with Vortex have not frozen since install, whereas lines downstream (without Vortex) have continued to show freezing problems during cold weather.

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