



Vortex Tools: NGL Technology Solution for Operators with Enhanced Recovery and Improved ROI

Vortex Tools, LLC (Vortex) introduced its spiral flow technology to the oil and gas sector in 2001 and supplies this solution throughout the U.S., Canada, Australia, and the Middle East. Over 1,600 Vortex tools have been sold to date.

The initial focus of this proprietary process was in lowering surface line pressures in marginal gas wells—reducing liquid drop-out, reducing freeze-ups in winter, and helping to mitigate against paraffin accumulation in prone areas like Oklahoma. After an extensive study at Texas A&M, an SPE paper (#84136) was published detailing the benefits of this patented technology in lowering the critical rate and extending the free-flowing life of a marginal gas well. After this, Vortex turned its primary attention to well-bore solutions.

In 2010, a Texas independent producer looked at the Vortex technology in a different application and has helped Vortex refocus its efforts in the recovery of liquids. With this application, Vortex is not just eliminating a problem, but generating substantial additional revenues for an operator from the efficient recovery of natural gas liquids (NGLs).

The initial plan (developed by the operator) involved the analysis of the current value of recovering liquids through pigging to the processing plant. After this initial analysis, the operator then developed a comparable recovery model that, given the high prices of NGLs at the time, hypothesized a field recovery solution using the Vortex technology would provide an economic benefit. The hypothesis proved to be true (NGL prices at the time were slightly less than \$50/barrel) and the results substantially outpaced the projected benefits.

Historic Recovery Solution

Recovery of NGLs from these condensate wells was in two stages. The majority of the NGLs were recovered at the wellhead and collected in production tanks. The remaining NGLs that dropped out during transportation in the gathering lines were recovered by pigging the line and recovering the liquids as a BS&W at the sales meter. Like most processing plant contracts, any NGLs that dropped out thereafter were apportioned to the operator on an “allocated basis,” where NGLs were allocated on the basis of the gas BTU measured at the meter (versus NGLs recovered at the first separator in the processing plant).

The Vortex Solution

The Vortex NGL solution is a field processing solution in which the beneficial spiraling flow developed by Vortex can maintain NGLs in a liquefied (as opposed to gaseous) form for long distances. Using the principles of a spiraling, organized flow, different components of a two-phase flow are separated by this “tornado in a pipe” and then travel as a separated co-flow for long distances (up to six miles measured in the NGL trial).

Using the Vortex Tool resulted in significant NGLs being collected (in a pressurized bullet tank) while affecting BTU only marginally (usually 7 to 12 BTU). In this application, the gas was 1,150-1,275 BTU. The higher the BTU, the more liquids were recovered. Like most processing plant contracts, the price for the NGLs in the operators’ own tanks (\$73/bbl) was substantially higher than what was allocated for NGLs recovered by the plant. NGLs from the processing plant at the time were based on \$42/bbl (after transportation and processing fees, shares, etc.). Of note: NGL revenues are often shared between operators on a theoretical (as opposed to actual) basis.

The results of the field trial were significant, with over 1.2 million gallons of additional NGLs recovered from three gathering lines in a single year, translating to over \$2 million of additional revenues. An average well line with Vortex paid for itself in less than 60 days (including the cost of the Vortex tool and associated propane bullet tank and installation).

There were additional “non-revenue” benefits like less pigging, reduced methanol use, an 80% reduction in glycol and filter use, reduced hydrate formation, and zero line freeze-ups on gathering lines with Vortex.

The NGL experience also led the operator to consider using the Vortex tool in new well flowbacks to enhance well recovery rates and improve well payback through reduced pit flaring. Vortex tools were also used to replace VRUs and to keep vapors in a liquefied form.

Additional Benefits: Less Line Freezing, Reduced Methanol Use, and Reduced Hydrates

2010/2011 was an unusually harsh winter in the East Texas area with ambient temps down to 9°F and gas temps as low as 34°F. With the Vortex tools in place, the operator saw significantly less cold weather problems on lines with Vortex Tools.

The words of the operator best describe these benefits:

“During last winter, the ambient temperature got down to 9° F. The gas temperature got as low as 34° F. With the Vortex tool in the line, water vapors were liquefied and formed a “slush” that the separators dumped to the water tank instead of forming hydrate blocks. We never froze up on lines with Vortex. The low ambient temperatures and the Vortex Tools helped the operator legally recover more NGLs in its tanks.

“We were still pumping some methanol, but not nearly as much as we had in the year before and the year before, it was not nearly as cold as this past winter.”

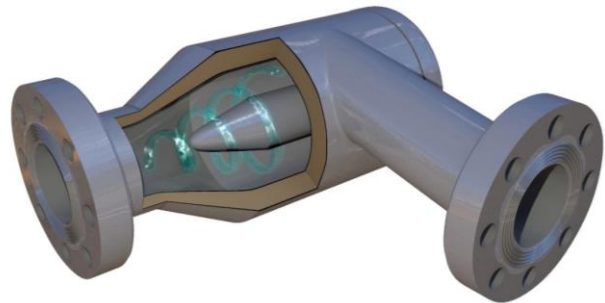
Technical Description of the Vortex Tools



As fluids enter the Vortex device, they are forced by a “bluff body” in the flow stream to spin rapidly, and the heavier liquid-bearing fluids are slung towards the pipe wall.

This organized flow will propagate very long distances (data supports over six-miles with a single tool). As a result of the liquid moving (like rifling on a gun barrel), the no-flow boundary at the edge of the central gas core is moving, resulting in a lower pressure drop due to friction.

Liquids (NGLs, condensates, and water) separate from the bulk-gas flow and travel closer to the pipe wall at lower velocities. Liquids tend to not drop-out at low spots in the flowline as velocities and temperatures decrease.



How Long Do the Vortex Benefits Last?

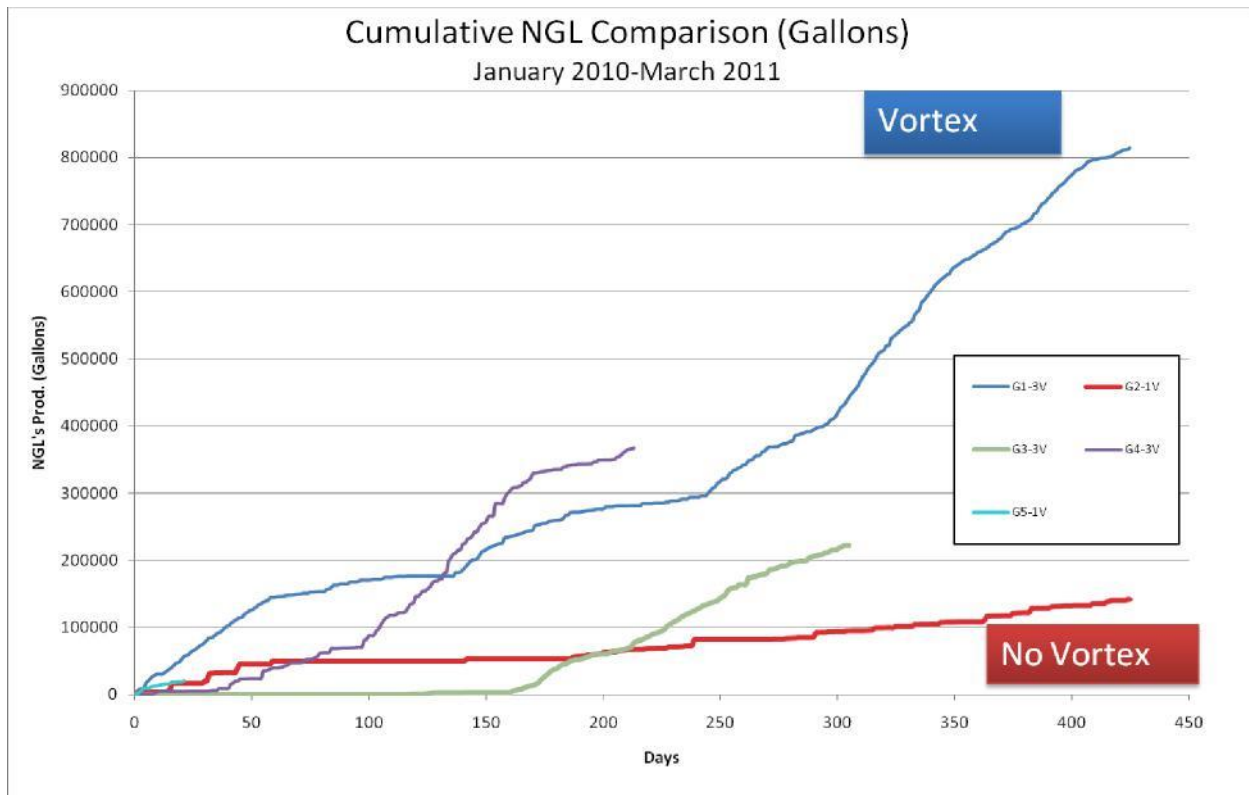
Vortex has developed a database of successful installations. Using this information together with specific customer data, Vortex believes that the benefits of the Vortex flow last several miles—even though the visual of the spiral disappears after a relatively short distance. The data suggested that the benefits, in most cases, diminish after 1-2 miles. However, in this case, the multi-phase flow benefits continued for longer distances:

“On one line in particular we know that the “spin” from the Vortex flow continued over six miles in a line that had many elevation changes from creek bores and wetlands bores. You can imagine the centrifugal action that would occur over that distance.”

– Customer quote (June 11, 2011)

NGL Test Program Results

Data was gathered on producing wells with and without the Vortex solution over a 15-month period. The following graph compares a gathering system with a Vortex tool on each of three producing wells to a gathering line without Vortex tools over that same 15-month trial period. The blue line (Vortex) shows the NGLs recovered with the Vortex tools—814,179 gallons—compared to the red line (pigging) where only 142,170 gallons of NGLs were recovered at the separator before the processing plant.



Here are the words of the operator in describing his experience with the Vortex tool in NGL recovery:

“As an operator, we installed a Vortex tool on a 6" line with 6MMcf/day of gas, 20 barrels/day of condensate and 10 barrels/day of water operating at about 600-700 psi. The spiral carried the entire line length of six miles. Our SCADA system allowed us to see graphically the production in the propane and water tanks. With the Vortex tool in place, it went from slug flow, or pigging to a steady, constant dumping of liquids, condensate and water into the tanks. The condensate gravity was typically 51° so we went into pressure tanks rather than lose half of the volume in flash to a production tank. The higher the volume/velocity, the more effective the tool is.

“The 20 barrels/day of condensate was from turning vapors into liquid with the Vortex tool. We then added the Vortex tools to three other pipelines with similar results. It amounted overall to an additional \$2,000,000 dollars in NGL sales in one year.”

In describing the consistency of the product delivered with the Vortex solution and the additional benefits seen, the same operator stated:

“We had relatively severe emulsion problems in East Texas with drilling mud and paraffin in a fractured carbonate reservoir. Bottom hole temps were from 260° to 360° F. Wellhead flowing temps were from 205° down to 160° F initially, then down to almost ambient later in the hyperbolic decline. We did use some chemicals but, this winter, we cut them back. Ambient temps got down to 9° F and the lines with Vortex did not freeze. To my knowledge, we never had a tank of NGLs turned down, over many tank batteries and made about 3,000 bbls/d of production with Vortex tools.”

Use of Vortex in Flowbacks and VRU Replacement

After witnessing the efficacy of the tools, the operator started thinking about other applications and provided the following comments:

Flowbacks: *“We put a Vortex tool between the high and low pressure separators on our well testing units. These wells are horizontal in fractured carbonates. They have a hyperbolic decline curve and start out between 10 and 20 mmcf/d with 1,000-5,000 b/d of condensate, and 2,000-4,000 b/d of water and 12.5-18.0# drilling mud. The wells used to take ten days to clean up enough to go through the production system. We could sell gas after the second day and recover some oil, with chemical treatment on the third or fourth day. The first two days were thru a hydraulic choke and straight to the burn pit.*

“With the Vortex Tool we were able to break the condensate/water/drilling mud emulsion so much more quickly that we went to sales in one day or less. On the first well that amounted to \$500,000 to sales rather than the burn pit, 18 mmcf/d gas and 4,600 bbls condensate. That, obviously, is the way it has been done since, saving/making literally millions of dollars rather than watch it all go up in smoke. Emissions were reduced tremendously as well, as a consequence of the Vortex solution.

VRU Replacement: *“With the high volumes, we were having a flash gas emissions problem, explosion and environmental risk at the production tanks. Vapor Recovery Units (VRUs), are expensive and have their own set of operational problems. We decided to try a Vortex Tool instead of a VRU. We had gone to a two phase HP sep, (900 psi), to a three phase LP sep, (60 psi), to the tanks with a VRU. Now, it is a two phase HP sep, (900 psi), with a Vortex Tool on the liquid discharge line, to a three phase HtrTrtr, (30 psi), and to the tanks.*

“The Vortex tool liquefies the flash vapors on the way to the HtrTrtr and they blend with the condensate to eliminate flash off of the tanks. The flash from the HtrTrtr goes to a LP compressor, which we had anyway and down the gas line. Our flash flare is from pilot light to 6” high at the most.

“Additionally, the flash is now sold at liquid prices instead of gas prices. By the way, on wells where this system was used, there has never been a load of condensate turned down because of BS&W where on wells without this system, there were one or two every other month.”

Summary

In these operations, the Vortex Tools made money by knocking out NGLs in the gathering lines, reducing line freeze ups, eliminating free liquids in gas meters, yielding better measurement, lowering maintenance and repairs, reducing free liquids through dehydrators, reducing glycol cost and filter cost, and greatly reducing production tank flash emissions.

Over 1.2 million gallons of additional NGLs were recovered from three gathering lines in a single year, translating to over \$2 million of additional revenues. An average well line with Vortex paid for itself in less than 60 days (including the cost of the Vortex tool and associated bullet tanks and installation). Additional “non-revenue” benefits like less pigging, reduced methanol use, reduced hydrate formation and zero line freeze-ups on gathering lines with Vortex also bolstered the value of these tools.

The Vortex tools are now a part of this customer’s new well completion program, with a surface line tool placed on each new flowline. The customer continues to look for new areas to benefit from the Vortex tools.

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