Hydro-Helical® Gas Separator Testing and Qualification Process

Slurry Loop Test

Slurry loop tests are performed to evaluate potential erosion generated in tools and systems when handling fluids with a high concentration of solids. This procedure is widely used in the artificial lift industry to perform accelerated erosion tests under laboratory conditions, providing information to the engineering team to validate or improve their erosion models, if necessary.

The sand slurry used in the test had a 1–1.5% sand concentration by volume. The sand used was 100# frac sand, which is the dominant proppant of choice for the Bakken shale play. The usage of this sand in the Bakken has proven to be our most challenging sand application yet.

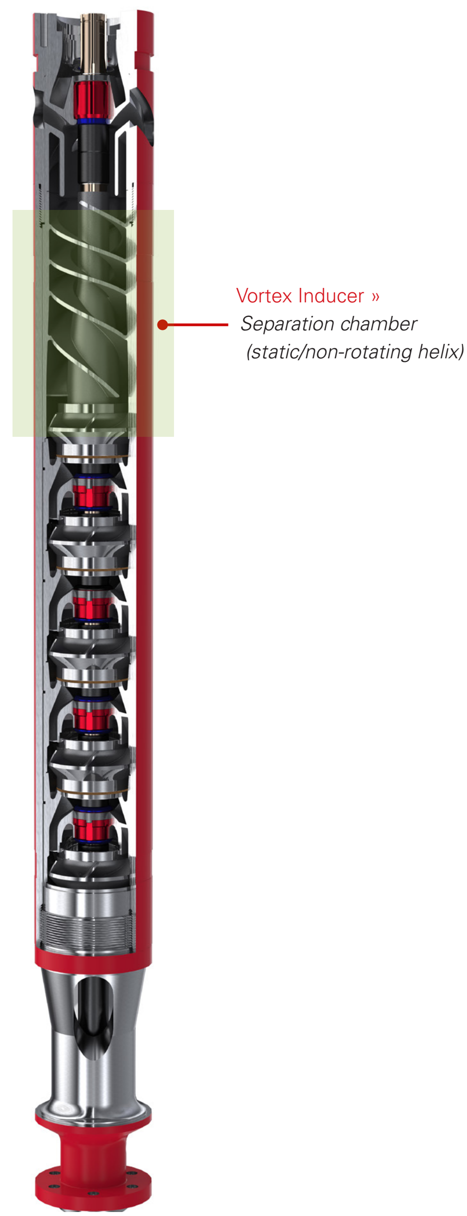
Test results showed minimum erosion in the main components of the artificial lift systems, without any significant impact to the Hydro-Helical gas separator tool's performance or integrity. This validates our erosion models, along with the material selection that was evaluated and implemented during the design stage of the tool.

Separation Chamber and Crossover Erosion Focus

The erosion issues of traditional gas separators are related to the separation component in the operation area of either the vortex, paddle wheel, or rotary parts. When sand is present with the production fluids, the spinning separation component's radial slinging of the fluids continuously erodes the chamber liner, eventually cutting through the separator's housing. Therefore, over time, these abrasive sand particles can cut through the walls and dislodge the equipment – dropping the motor, seal, and lower half of the gas separator to the bottom of the well.

The Hydro-Helical gas separator slurry loop test involved the entire gas separation device, and operated until failure of the pump upstream of the separator, to determine if the innovative separation component (the helix) intensified or reduced the erosion effects that are characteristic of a gas separator system. The pump attached to the Hydro-Helical gas separator during testing had significantly degraded head and flow, and this was the reason why the test ended.

Test results showed a significant reduction of erosion within the separation chamber area. The non-rotating design of the Hydro-Helical separation system all but eliminated erosion damage. The transition from the separation chamber to the crossover showed little to no erosive wear due to the smooth exchange of the fluid's flow path. The real improvement in erosion mitigation came from the "stationary" vortex.



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In the stationary vortex, however, the relative velocity was lower, and turbulence was reduced because of gentle flow passages, reducing erosive wear and significantly improving the tool's reliability.

Field Testing

The Hydro-Helical® separator system failed trials were chosen on a well-by-well basis, with consideration of deployment and a focus on problem wells for the customer.

Wells with heavy gas concentrations, sandy conditions, and very high gas slug problems were targeted in order to test the tool in the most demanding applications possible.

Over seventy-five units have been installed to date, and none have been pulled due to separator failure. of the units pulled (for issues unrelated to the separator), many have been reinstalled and operated. Teardowns on several used Hydro-Helical gas separators have also been conducted. Inspections on these tools for sand/debris erosion revealed no issues regarding significant erosion wear.

Limited Erosive Wear

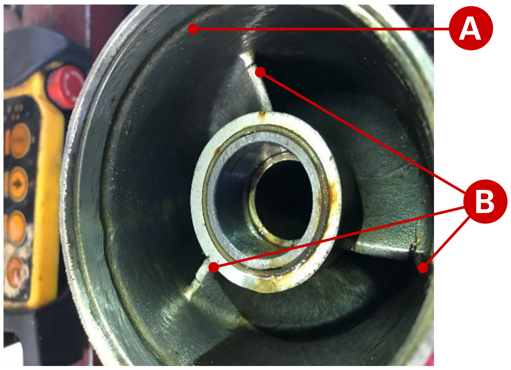
Separation Chamber » *View from the bottom, inside the crossover*

Separation Chamber » *View from the top of the helix, looking down*

Separation Chamber » *View from the bottom, inside the crossover gas exit ports*

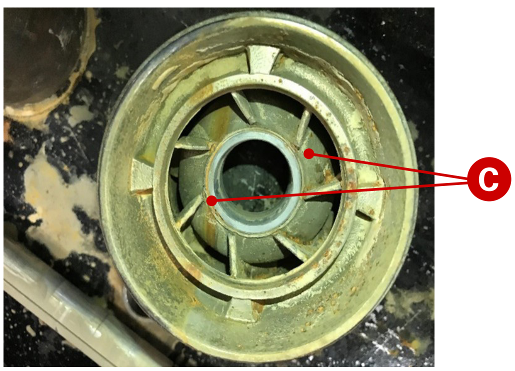
Separation Chamber » *Close-up view from the top of the helix, looking down*

Separation Chamber » *View of the bottom of helix*

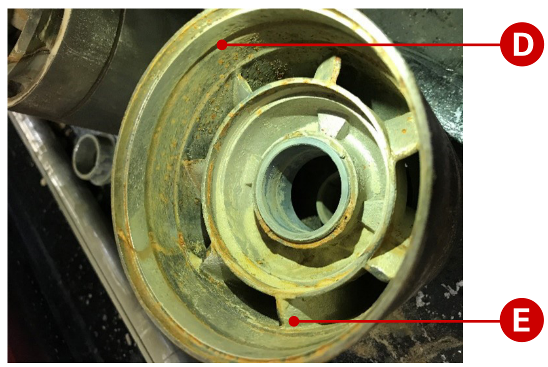


Separation Chamber » *View of the flow diverter (top impeller)*

Separation Chamber » *View of the upper-most diffuser, looking down*



Separation Chamber » *View from the bottom of the upper diffuser*



A. *Approximately .03 erosion ring in the liner of the helix where the flow-diverting impeller operates (wall thickness is .187) common in all the fluid moving stages*

B. *Slight wear of the leading edge of the helix vanes*

C. *Slight wear on the trailing edge of the vanes*

D. *Approximately .03 erosion ring in the liner where the lower impeller operates (wall thickness is .187), which is common in all the fluid moving stages*

E. *Slight wear of the leading edge of the helix vanes*

For more information, contact your local Halliburton representative or visit us on the web at www.halliburton.com/summitesp

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