CASE STUDY

North American Pipeline Operator Reduces Energy Consumption by 90% and Increases Shipments

Intelligent Throughput Optimization solution enables automated tuning of system in real-time to prevent hydrate and liquid formation

CHALLENGE
Maximize propane shipment in natural gas pipeline while minimizing risk, cost, and environmental impact.

SOLUTION
Deploy Intelligent Throughput Optimization* solution to prevent liquid and hydrate formation, using real-time data and a science-based strategy.

RESULTS
+ Reduced energy consumption by 90%, saving USD 1.5 million/year, while achieving 20% increase in propane throughput

REGION

PIPELINE OPERATOR SOUGHT TO OPTIMIZE DELIVERY

Formation of hydrates in gas pipelines presents operators with significant challenges, such as clogged pipes, reduced process flow, and equipment damage. Chemical injection and heaters offer solutions but increase cost and emissions. The situation is exacerbated because these remedies are invariably used in excess of requirements because the operator has been, until now, "flying blind". The operator, not knowing better, errs on the side of caution to provide a safety margin and ensure stability—enabling the system to deal with worst-case conditions that rarely materialize.

The operator of a North American high-pressure natural gas transmission pipeline system was transporting propane entrained in natural gas to boost profits. As the concentration of propane in natural gas rises, so too does the temperature at which a liquid can form. Similarly, a drop in temperature can lead to formation of liquids in the pipe, reducing throughput, overburdening separators in compressor stations and potentially causing damage. Therefore, the maximum amount of propane entrained in the natural gas was limited by an estimated minimum temperature the gas would experience while passing through the pipeline. That temperature was rarely, if ever, achieved.

At certain receipt points on the pipeline, the injecting facilities provided the propane-rich natural gas to the pipeline at higher pressures than the pipeline pressure. In dropping the pressure of the natural gas to match the pipeline pressure, the temperature of the gas dropped due to the Joule Thomson effect. Based on the design criteria, which assumed worst-case water concentration, this drop in temperature resulted in the potential formation of hydrates. To combat the risk of hydrate formation, two 500,000-Btu/h heaters operated 24/7—ensuring that the temperature remained above the worst-case hydrate formation temperature. Even after the temperature drop across the pressure control valve.

SENSIA'S SOLUTION ADDRESSED CHANGING CONDITIONS IN REAL-TIME

Leveraging world-class technology from parent companies Rockwell Automation and Schlumberger, Sensia's Intelligent Throughput Optimization solution increases the profitability of new and existing midstream infrastructure. It enables operators and control systems to "see inside" the process in real-time and understand the fluid's phase envelope and hydrate formation temperature based on current composition. This crucial information enables operating optimally for the prevailing conditions—maximizing throughput while minimizing risks—instead of working conservatively based on conditions at the limits of the process design.

Operators can make manual adjustments based on real-time recommendations made by the intelligent solution to prevent liquid and hydrate formation. Or, alternatively, they can opt for autonomous adjustment through closed loop control. An edge controller provides quick response time and reliable operation. It runs process simulation software for thermodynamics and fluid characterization and executes the adaptive control strategy to maintain the fluid in the appropriate phase, while using physics-based real-time advice from the Intelligent Throughput Optimization calculations. The result is more stable and efficient operation, reduced energy expenditure, lower emissions, and greater throughput.

INTELLIGENT CONTROL INCREASED SHIPMENTS AND LOWERED ENERGY CONSUMPTION

The Sensia solution enabled the operator to understand that the native gas temperature and actual water concentration of the gas passing through the pressure control valves was almost always such that no hydrates could form – even without the use of the heaters. By using this information to only run the heaters when there was a real potential for a hydrate to form, the operator was able to reduce use of heaters by an astonishing 90%. Saving USD 1.5 million and eliminating 500 t of CO_2 emissions per year.

At the same time, the Sensia solution also provided a real-time indication of the maximum amount of propane that could be carried without liquids forming, based on the coldest downstream temperature. Understanding in real-time the phase envelope of the gas, and in particular how much propane could be added, led to approximately a 20% increase in propane shipments.

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