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AUTO PIG

Shale Production Aided by Automated Pigging System

By Roxy Mounter

Shale production, for both natural gas and crude oil, is conducive to internal corrosion failures on gathering pipeline systems. Continuous pigging programs are the most economical and practical method of reducing the risk threat for the occurrence of internal corrosion failures, maintaining effective flow efficiencies and flow throughput. If the pipeline is not pigged frequently the line will become susceptible to corrosive acids that eat away at the internal surface of the pipeline.

According to Pipeline and Hazardous Materials Safety Administration (PHMSA), "Approximately 299,000 miles of onshore gas transmission pipelines and 171,000 miles of onshore hazardous liquid pipelines move natural gas, crude oil and petroleum products throughout the U.S. every day." Corrosion from lack of pigging elevates the probability of public risk from hazardous gases and liquids. This risk can affect the environment and surrounding populations; putting them at risk for injuries and fatalities from fires or explosions caused by ignition of the bi-product.

Shale Play Growth Projected

According to long term market studies, all indications are the importance of the shale gas market is not going to diminish in the future. For example, a 2011 report issued by ICF International on behalf of the INGAA Foundation, predicted in total United States and Canada shale gas production will jump from 2010 levels of about 13 billion cubic feet per day (Bcf/d) to 52 Bcf/d by the year 2035. The report also anticipates more than 400,000 miles of new gathering pipe will be constructed in North America by 2035. Growth is not limited to North America; shale gas plays are also among the fastest growing production areas worldwide.

As liquids-rich unconventional resource plays are continued to be developed, there are multiple challenges and implications for midstream system infrastructure, particularly around pigging and integrity. This is especially true for shale plays producing rich gas (also known as wet gas), which contains significant levels of liquefiable hydrocarbons (like ethane or propane) along with methane gas. Liquids can accumulate at low elevation points along gathering systems where the high liquid concentrations in the gas streams cause significant issues with slugging, high differential pressures (liquids loading) and corrosion. In addition, crude oil containing high levels of paraffin and other flow reducing contaminants (frac sand, chlorides and spent chemicals) present flow restriction issues in these midstream pipeline systems. Many factors contribute to the overall performance and flow efficiency of pipeline systems that may include the elevation profile, flow volumes, product quality and temperature, which all pipelines must be evaluated on an individual basis.

Routine pigging removes liquids from the line, offers control on the volume of liquids that are removed at any one time and sustains well production at consistent capacity. In most cases, pigging frequency should be based on flow efficiency over time, rather than a set time schedule.

As liquids-rich unconventional resource plays continue to be developed, there are multiple challenges and implications for midstream system infrastructure, particularly around pigging and integrity. This is especially true for shale plays producing wet gas, which contains significant levels of liquefiable hydrocarbons that can lead to corrosion.

Pigging Systems Improve Shale Play Production

An automated pigging system is defined as a method or system for staging and launching single or multiple pigs in an automated or semi-automated pigging system. An automated pigging system is typically used to address the following issues in a midstream system: wet gas lines, crude oil line, fracking contamination, unpredictable fluid production, internal corrosion, enhanced safety and environmental exposure. The high number of lines to be pigged and the need to pig these lines frequently may require the installation of multiple pig launchers. Automation of pigging systems offers compelling economic benefits when compared to traditional manual pigging systems. As a result, the precedents are still undefined; producers and gathering companies are still seeking scalable solutions to these issues.

By drawing upon experience gained, WeldFit Energy Group developed a horizontal automated pigging system, which loads multiple pigs at one time and combines all four pigging functions: liquid removal, cleaning, batching and inspection. The SureLaunch Automated Pigging System releases any type of pig individually at pre-set intervals through use of a horizontally oriented screw jack launch system. The system also enables operators to launch a single cleaning pig, batching pig or inline inspection tool in a manual mode of operation if desired. The shale play pipelines are not typically regulated like transmission pipelines, however, nevertheless the ability to continuously remove valuable liquids and maintain their integrity is equal to that of transmission pipelines.

Traditional manual pigging systems are both time- and labor-intensive. A typical pigging system requires the opening and/or closing of three major valves; the draining and venting of a barrel and the opening and closing of a closure door. In some cases, it can take up to four hours for a single crew to load and launch a single pig, which does not include the time to receive and remove the pig. Beyond the time and labor constraints, there are also wear and safety considerations that must be made. Opening and closing valves several times a week can increase the risk of valve seat failure, increased maintenance and replacement costs. Frequent cycling of the launcher and receiver barrels can also create unnecessary safety risks that may include cyclic fatigue of the systems and additional exposure to hazardous gases that are produced in many of the shale plays.

Routine Pigging Increases Throughput

In order to prevent liquids from accumulating and to maintain continuous production levels, routine pigging is required. Routine pigging removes liquids from the line, offers control on the volume of liquids that are removed at any one time and sustains well production at consistent capacity. Routine pigging also removes contaminants associated with wet gas, including paraffin, asphaltenes, iron oxides, water, hydrogen sulfide and carbon dioxide. Pigging frequency should be determined based on the specific characteristics of a pipeline system, which pigging may be required as often as several times a week, or in some cases, three times a day. In most cases, pigging frequency should be based on flow efficiency over time, as opposed to many pigging programs that are based strictly on time.

PHMSA states that 24 percent of transmission pipelines and 20 percent of gas transmission pipeline failures are caused by corrosion. Corrosion can be reduced with fre-

quent pigging to manage the integrity of gathering pipeline systems. Increased throughput and revenue associated with efficiently operating the pipeline is measureable by the increase in percentage of flow increase. A recent case study on a natural gas gathering line in northwestern Oklahoma, resulted in a 4.5 percent efficiency increase, due to pigging four times per day. The flow rate increased from 25 to 30 million cubic feet per day (MMcf/d) removing 1,000 to 1,200 barrels by pigging every six hours.

THROUGHPUT EFFICIENCY		
Flow Rate, Actual	MMcf/d	25
Flow Rate, Maximum (Theoretical)	MMcf/d	100
Flow Rate Efficiency	(%)	25%
Efficiency Increase (through Pigging)	(%)	4.5%
New Flow Rate	MMcf/d	30
Savings with Efficiency Increase	$/day $/year	$990 $361,350

Additional efficiencies, as a result of frequent pigging, can be attributed to improvements in reduced compression costs. As pigging frequency increases and pressure drop is minimized, less horsepower is consumed. Less horsepower equates to reduced fuel costs to power compressors.

Looking to the Future

There is every reason to expect that the scope and needs of the shale gas market will continue to grow. As the existing shale plays mature and new plays come on line, increasing production flow and manpower efficiency, while decreasing operating and maintenance costs will be critical keys to success. Pigging solutions such as the automated system described here can help operators meet the daily challenges encountered in the field. The automation of pigging systems has proven to be successful in the shale plays where the automated pigging systems can be monitored through operator SCADA and remote monitoring systems, in addition to operational data that may include line pressures and flow rates. The integration of multiple monitored data sets can assist with operator with maintaining optimum flow efficiencies by comparing the theoretical differential pressures compared to the actual differential pressures to establish the appropriate pigging frequencies from the performance based conditions of the pipeline system.

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