DEWATERING UNPIGGABLE GAS GATHERING LINE WITH ELASTOMERIC PIG

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Abstract

Making infrastructure modifications to install launchers and receivers on gas gathering lines will typically cost 5-6 figures per line. The ability to pig gas gathering lines without making such modifications could offer flow assurance and corrosion prevention without the associated cost and downtime.

In this paper we describe the successful use of an elastomeric pig to dewater a gas gathering pipe in Colorado with no launcher or receiver, resulting in the complete restoration of flow in a pipe that had suffered from a differential due to water accumulation in low spots. The pig was inserted at a temporarily dropped spool and removed through a blowdown valve making use of its ability to be extruded through reduced bore piping.

Introduction

Gas gathering lines are the veins that carry the lifeblood of shale gas. Water accumulation in low points has the double effect of restricting flow and a source of corrosion. The ideal way to restore full flow and peace of mind is to pig, however it is common for gathering lines to be constructed without pig launching and receiving facilities.

The cost to modify the beginning and end of line to install launchers and receivers can stretch to 6 figures per line, thus pipeline operators are regularly forced to concede that pigging is not an option and there will be water in the lines.

Description of Elastomeric Pig technology

Aubin's EVO-Pig has been used for over a decade now, previously under the name L-Gel Pig. It is a highly elastic solid body pig formed by the chemical crosslinking reaction between two engineered liquids. Its rubberized physical properties allow it to form an excellent hydraulic seal, making it ideal for displacing liquids out of pipes.

Aubin achieves this seal through the design of each individual EVO-Pig, making the size slightly larger than the ID of the pipe – "oversizing". The EVO-Pig is therefore required to squeeze upon entering the pipe, increasing in length such that the overall volume remains constant. EVO-Pig retains a "memory" of its original shape, so there is a restoring force constantly acting outwards onto the pipewall as depicted in Figure 1.

This "memory" acts for diameter reductions of up to 50%. Upon reaching a threshold of shear for example when encountering a reduction greater than 50%, EVO-Pig tears apart with relatively low differential pressure. This effect was used to an advantage in this case study, with the EVO-Pig being extruded through a small blowdown line.

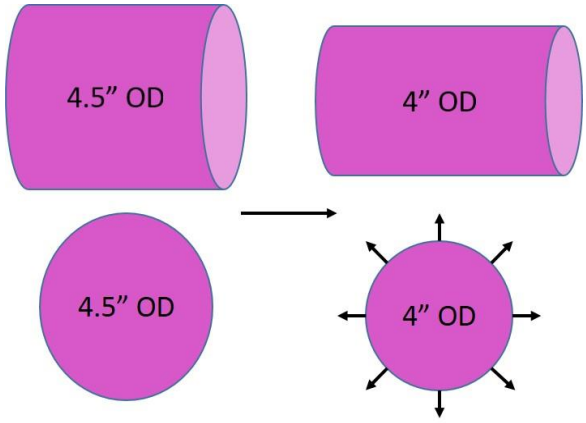

Figure 1: Over-sizing of EVO-Pig (left) results in an outward radial restoring force when confined in a pipe (right), ensuring a constant seal.

Description of Challenge

A BP San Juan Facilities Engineer in Durango CO, USA, approached Aubin with an issue in an unpiggable gas gathering line. The 4" diameter, 2,400 ft line transported produced natural gas from the one wellpad to another (Figure 2). Leaving Pad 1 the pipe crossed a gorge, descending around 100ft before returning back up to the same height at Pad 2. A differential pressure of 10psi was being observed between the two points, thought to be due to the accumulation of water in the low spot. The Facilities Engineer wanted to restore full flow to the pipe by pigging the water out but had no launching or receiving facilities to perform a traditional pigging operation.

Figure 2: Pipeline between launch point at Pad 1 and receiving tank at Pad 2.

Launch site

A location was identified on Pad 1 for launching EVO-Pig. There was a 1.5m spool downstream of a mainline valve that could be temporarily removed, highlighted in red on Figure 3. This would allow EVO-Pig to be inserted into the line before reinstalling the spool.

Figure 3: Removable spool at Pad 1 acting as launch site for EVO-Pig.

Receiving site

Another mainline valve was identified at Pad 2 (Figure 4) that could be used to isolate the short 2,400ft section, with a standpipe blowdown line coming off at a tee. Isolating this spool and venting through blowdown valves allowed this spool to be temporarily removed.

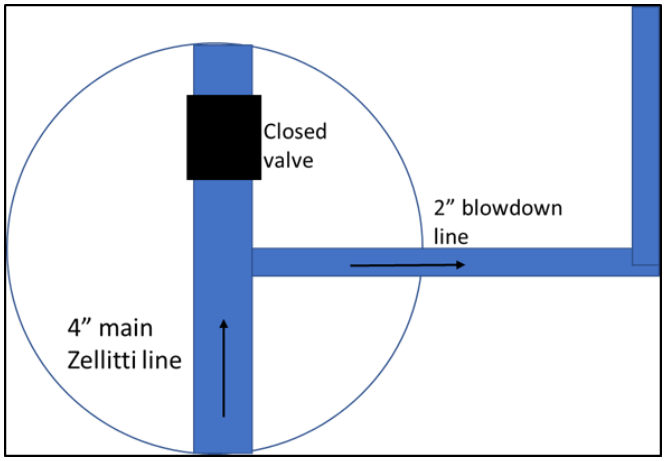

Figure 4 (left): Underground mainline valve at Pad 2 allowing 2,400ft section to be isolated.

Figure 5 (right). Standpipe, plumbed to temporary receiver tanks

A temporary tank was placed on Pad 2 close to the blowdown line standpipe and plumbed in with 2" piping to act as a receiver for the EVO-Pig and the water it would displace. Figure 5 shows the temporary pipework attached to the standpipe.

EVO-Pig manufacture / moulding

A canister was fabricated with dimensions per (Figure 6) with main body 11" length by 4.5" diameter. A 1.4" taper at the bottom/front of the canister reduced the ID down to match the 4" ID of the pipe. A flange was welded with bolt pattern to match the 4" ANSI B16.5 #300 flange at the insertion site.

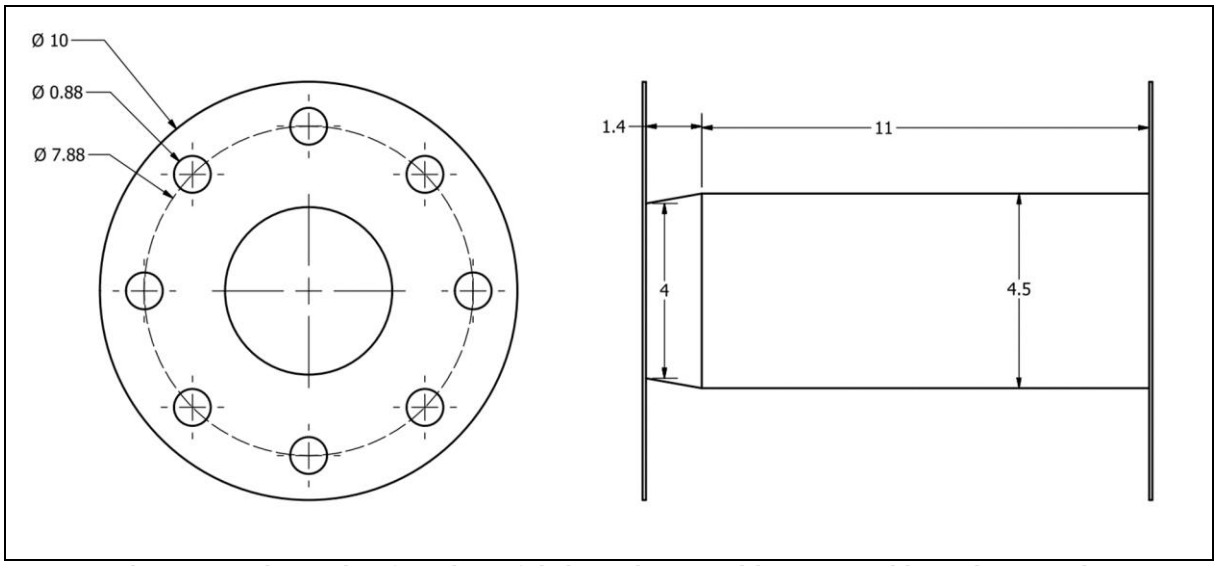

Figure 6. Schematic of canister fabricated to mould, store and launch EVO-Pig

The canister serves multiple purposes – mould for casting the liquid EVO-Pig, storage and launching mechanism when coupled with a threaded bar plunger. The inside of the canister was lubricated with motor grease to prevent adhesion of EVO-Pig and facilitate removal. A removable end plate was bolted with a gasket to the canister flange and the canister was oriented vertically so that it was standing on the end plate with the taper at the bottom.

EVO-Pig was cast from its two liquid components (approximately a 95:5 ratio of Base to Activator) and poured into the canister the afternoon before the operation. A chemical crosslinking reaction occurred overnight turning the mixture into an elastic solid. The mixture was kept in a heated workshop overnight since the ambient external temperature was -10 °C. Like most chemical reactions, the crosslinking rate is affected by temperature and the overall curing time would have increased significantly.

Operation
EVO-Pig was assessed first thing in the morning and found to have crosslinked successfully. Once the operational plan had been reviewed and signed off by the operations team, EVO-Pig was transported in its canister to the worksite by truck.

Per the operational plan, the pipe section of interest was isolated by closing upstream and downstream mainline valves then safely depressurised by venting through blowdown valves. Once the pressure in the spool had dropped to ambient, a crane truck was used to take the weight of the spool. The flanges were then broken and the crane truck removed the spool.

The canister containing EVO-Pig was bolted on to the flange. A threaded bar plunger was used to push EVO-Pig out of the canister and into the line. Once EVO-Pig was inserted into the line, the canister was removed and the spool was reattached with the aid of the crane truck. Air was purged from pipe behind EVO-Pig by pushing with natural gas to avoid the creation of an explosive atmosphere behind the pig. Blowdown valve was then closed and EVO-Pig was pushed along the line by the flow of natural gas, being choked on the delivery side to control the pig speed.

The pig run was timed at 3 minutes, matching the calculated pig speed of around 15 ft/s. 2 barrels of water was collected in the temporary surface tank, closely matching the predicted quantity from the differential pressure calculations. EVO-Pig navigated the 4”x2” tee and approximately 10 metres of 2” pipework including four tight 90° bends to extrude into the test tank, leaving the pipe clear and ready to return to normal operation.

Performance review
Pressure monitoring the subsequent day showed that the 10psi differential pressure between the upstream and downstream points had reduced to 1.5psid, indicating fully restored flow and a complete removal of water from the pipe. The operation was therefore regarded as a success.

Conclusion
An elastomeric pig was used to successfully dewater a 2,400ft section of the 4” gas gathering line between 2 wellpads. An accumulation of water in the low point in a gorge was causing a 10psi differential but EVO-Pig, driven by the natural gas production displaced all the water and restored full flow. EVO-Pig was inserted via a dropped spool and removed through a reduced diameter blowdown line into a temporary tank along with the 2 barrels of water that had been causing the flow restriction.

The operation provided a dewatering solution with significantly lower cost than the infrastructure modifications that would otherwise have been required to install a traditional pig launcher and receiver.