Poly Lined Tubing Update - Protecting Downhole Tubing

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ABSTRACT

With the current rise in the cost of tubular goods many operators are using polylined tubing to reduce well failures from rod on tubing wear and tubing corrosion in artificially lifted, disposal and injection wells. Since the original paper presented in 2005, the price of steel has fluxuated and is now on the increase. The liners have been particularly effective in solving tubular performance problems in highly deviated and doglegged wellbores. Poly liners have been installed in over 12,000 domestic wells amounting to over 25 million feet of lined tubulars. Fasken Oil and Ranch Ltd. has used polylined tubing in beam pumped, SWD and water injection wells in the Permian Basin. A summary of that experience compared to past practices is presented in this paper. An emphasis on the substantial cost savings in operating and completion costs will be covered in detail given today's rising prices for tubular goods. The use of poly lined tubing has helped in the reduction in failures from a 26.9% to an overall 11.4%. One of the largest cost saving measures experienced by Fasken is installing the poly liner over used IPC tubing. This process dose not require the plastic coating to be burnt out of the tubing prior to the liner being installed. Some tubing that could not normally be plastic coated can be poly lined.

INTRODUCTION

Fasken Oil & Ranch has increased the utilization of polylined tubing to 25 fields for production, injection, and disposal in areas where failures were costly in lost production and repair. Cost savings has a significant value in lining over used and/or damaged internal plastic coatings.

LINER DESCRIPTION

The thermoplastic materials classified as "polyliners" have some limitations, most importantly operating temperature limits and high concentrations of CO_2. Polyliners have been successfully installed in flowlines; disposal wells; water injection wells; plunger lifted, beam pumped, progressive cavity pumped, gas lifted, free flowing, and submersible pumped production wells.

The three types of liners that Fasken Oil & Ranch Ltd. have in operation are the Falcon Polycore and Falcon Enertube:

- Falcon Polycore™ is a high-density polyethylene (HDPE) liner that has been used to protect tubulars in the Permian Basin since 1992. The patented product and can be used in oil producing wells with a maximum temperature of 160°F and water handling wells or flowlines with a maximum temperature of 180°F.

- Falcon Enertube™ is a specially formulated blend of polyolefin resins designed specifically for oilfield service. It has a maximum temperature limitation of 210°F in most oil and gas production, disposal and enhanced recovery systems. The product is made to the same precise dimensional requirements as Polycore™ and is enhanced by approximately a 50 percent increase in tensile strength.

- Falcon Ultratube™ is a seamless engineering thermoplastic manufactured from a proprietary blended polyphenylene sulfide resin specially designed for downhole oil and gas production environments. It has a maximum temperature limitation of 350° F in most environments.

All of Western Falcon liner products are flexible and highly abrasion resistant which accounts for their success in the elimination of tubing rod wear, wire line, mechanical, and handling damage. Surface roughness is .0006 allowing for help in pressure drop and reduction in lifting cost. The smoothness of the liner overcomes the ID restriction of the liner. They are recyclable chemically inert materials that provide a seamless corrosion barrier. The thermoplastics are tolerant to minor surface damage and eliminate concerns with holidays or voids as in adhesive or thermally bonded liners and coatings.

LINER INSTALLATION

Prior to the installation of polyliners, all tubulars are subjected to a visual inspection and ring/plug gauge evaluation of the tubing/coupling threads. Defective couplings are replaced and pin ends are repaired at the lining facility. Economically, this is important because the threads alone can potentially limit the service life of the tubing. Starting with threads that meet these minimum requirements can help ultimately maximize the service life of each joint.

All polyliners are mechanically bonded materials that often provide cost savings by allowing the use of lower-quality tubing (i.e. blue and green band or drift and tested). The end finish process during installation eliminates the need for corrosion barrier rings, inserts, special torque procedures, and/or service technicians. The end finish does not create any potential leak paths like many other liners because it is done using the installed liner and does not contain a fused or glued end.

The liners are initially larger in OD than the ID of the tubulars that they are inserted into. The first step is to mechanically reduce the liner OD to insert it into the tubing. The plastic is allowed at least 24 hours to expand and conform to the ID of the pipe. The ends are then formed using excess liner material that extends from both ends of the tubing.

The unique bonding process allows liners to be installed over used internal plastic coatings without incurring the cost of removing the coating. Frequently plastic coated tubing suffers from localized corrosion on the threaded ends where the coating has been chipped from handling or wirelines. When this occurs, localized accelerated pitting attack takes place on the exposed steel. If this problem is isolated on the ends of the tubulars and the threads are repairable, the string that is often scrapped for structural steel can typically be salvaged and reused without the required purchase of a new steel tubing string. This common practice can provide a substantial saving in completion costs as detailed later in this presentation.

With most tubular corrosion control products including internal plastic coatings, thermoset fiberglass liners, and other thermoplastic liners the most difficult area of the string to protect from in-service attack is the connection area. By combining large, seamless poly liner ends with internally plastic coated coupling J-areas, this system has eliminated failures on the threaded ends and couplings.

FIELD HISTORIES AND WELL COMPLETION COSTS

Fasken Oil & Ranch Ltd. has utilized poly lined tubing in injection and disposal wells ranging in depth from 3,800 feet to 12,900 feet. The poly lined tubing has also been used in rod pumped wells in the San Andres, Grayburg, Gin Sand, Dean, Clearfork, Wolfcamp, and Spraberry Formations. Listed below are some of the wells where Polyliners have been installed.

Phil Wright Spraberry Unit 204, Dawson Co, TX

> Polylined tubing installed October 2001 in this injection well. Prior to poly, plastic coated tubing developed leaks in April 2000 and October 2001. Polyliner installed over used plastic coating in this 7,700’ well of 2-3/8”. Liner cost of $10,395 versus new coated replacement cost of $44,506. Savings of $34,111 compared to June 2009 market price.

Rose Creek North Unit 302, Sterling Co, TX

> Polylined tubing installed March 2000 in this injection well due to plastic coated tubing failure. Polyliner installed over used plastic coating in this 4,700’ well of 2-3/8”. Liner cost of $6,345 versus new coated replacement cost of $27,166. Savings of $20,821 compared to June 2009 market price.

Germania Grayburg Unit 808, Midland Co, TX

> Rod well converted to a new injection well. Polyliner installed October 2000. This 3,000’ well of 2-3/8” liner cost of $4,050 versus new coated tubing at $17,340. Savings of $13,290 compared to June 2009 market price.

GG Wright 17, Dawson Co, TX

Rod well converted to a new injection well. Polyliner installed December 2000. The initial tubing used in this rod well was pulled and lined for this injection well. This 7,500' well of 2-3/8" liner cost of $10,125 versus new coated tubing at $43,350. Savings of $33,225 compared to June 2009 market price.

Rose Creek North Unit 604, Sterling Co, TX

Polylined tubing installed March 2000 in this injection well due to plastic coated tubing failure. Polyliner installed over used plastic coating in this 4,700' well of 2-3/8". Liner cost of $6,345 versus new coated replacement cost of $27,166. Savings of $20,821 compared to June 2009 market price.

Huddleston 2, Dawson Co TX

Polylined tubing was installed over used plastic coated from another injection well. Injection well at a depth of 7,600' well of 2-3/8". Liner cost of $10,260 versus new coated replacement cost of $43,928. Savings of $33,668 compared to June 2009 market price.

MTS SA Unit 413, Dawson Co, TX

Rod well converted to a new injection well. Polyliner installed May 2002. The initial tubing used in this rod well was pulled and lined for this injection well. This 4,300' well of 2-3/8" liner cost of $5.805 versus new coated tubing at $24,854. Savings of $19,049 compared to June 2009 market price.

Myers #5-Wolfcamp and Lower Spraberry Formation

Bottom 746' of Polylined tubing installed February 2000. NO TUBING FAILURES TO DATE.

Germania Grayburg Unit 607-Grayburg Formation, Midland Co, TX

2 joints of Polylined tubing installed installed at bottom of string in this rod pumped well in July 2005. Bare tubing experienced tubing failures every 10-12 months. NO TUBING FAILURES TO DATE.

MTS SA Unit 201- San Andres Formation, Dawson Co, TX

Polylined tubing installed in this rod pumped well in May 2001. Bare tubing experienced tubing failures every 9 months. NO TUBING FAILURES TO DATE.

MTS SA Unit 606- San Andres Formation, Dawson Co, TX

4 joints of Polylined tubing installed at bottom of string July 2002. NO TUBING FAILURES TO DATE

OPTIONS FOR POLY-LINED PUMP JOINTS

There are many options when considering the use of poly lined tubing in rod pumped wells.

- 5.5" Casing w/ 2.875" tubing & 1.75" or larger pump – Run 3.5" 10rd NU joint of poly-line pump joints w/ 2.5" changeover on bottom.
- 5.5" Casing w/ 2.875" tubing & 1.5" or smaller pump – Run 2.875" EUE 8rd joint of poly-line pump joint w/ 2.0" changeover on bottom.
- 5.5" casing w/ 2.375" tubing – Run 2.875" 8rd EUE joint of poly-line w/ 2.0" changeover on bottom.
- 4.5" casing w/ 2.375" tubing – Run 2.875" 10rd NU joint of poly-line w/ 2.0" changeover on bottom.

FIELD INSTALLATION PROCEDURES

One reason that polyliners have proven to be so successful is because they are thick and provide enough material to accommodate minor surface scratches and damage. The liner causes a slight reduction in the pipe's inside diameter. The respective nominal DRIFT diameters for polylined 2 3/8-inch, 2 7/8-inch and 3 1/2 –inch standard weight tubing are 1.600-inch, 2.000-inch, and 2.500-inch resistively. Poly liners can be installed in tubulars as large as 7-inch. For other sizes or weights of tubing or casing, please consult the liner manufacturer for specific lined tubing dimensions.

Polyliners have proven to reduce rod on tubing wear most effectively when used without any guides on the rods. Sacrificial rod guides are not recommended for use in conjunction with polyliners.

Polyliners are compatible with all types of rod boxes. API T rod couplings or spray metal couplings are both acceptable. Special clearance or full-hole rod boxes that allow enough clearance with the lined tubing ID are both compatible with polyliners. Polyliners obviously provide adequate protection of the tubing (and significantly reduce wear on the rod string) but do not mitigate corrosion of the rod string. In very corrosive environments, a proper chemical inhibition program is recommended to protect the rod string.

Pumps, rods, and rod boxes should be visually inspected for sharp edges and heavily pitted areas that can damage the liner. A cursory well site inspection of all downhole components should be maid to avoid mechanical damage to the liner. Often sharp edges or wrench grip marks can be ground or filed smooth.

An additional important step in maximizing the service life of any API tubing is utilization of proper torque during installation. It is highly recommended that API **minimum** torque is applied to every connection when running it in the well.

SUMMARY

As the price of goods and services continues to increase the need to look for cost effective options in today's competitive market place. As waterfloods continue to age and mature operators must look for effective ways to operate in a cost effective manor.

REFERENCES

Plastic Pipe Institute
SPE Technical Paper 39815
World Oil – Petroleum Technology Digest, January 2003 Publication
The American Oil & Gas Reporter – Tech Connections, November 2001 Publication.