THE APPLICATION OF INSERT LINERS FOR CORROSION PROTECTION IN SURFACE AND DOWNHOLE TUBULARS

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INTRODUCTION

This paper will demonstrate a different and proven approach to internal corrosion control in steel tubing, line pipe and casing. Polyvinyl chloride (PVC) plastic and fiberglass-epoxy (FRP) insert linings can be installed in either new or used tubulars to prevent corrosion. These rigid linings afford a smooth uniform nominal inside diameter and are not affected by the rough pitted inner surfaces usually encountered in used pipe.

Protecting the connections is a large part of the battle in corrosion control. For this purpose, the lining system uses the more practical reinforced oil-resistant rubber corrosion barrier ring. This rubber corrosion barrier ring is compressed when the connection is made up in the field. The design of this system will be explained in detail as we discuss the installation, handling and running procedures that make this system corrosion resistant.

INSTALLATION OF LININGS

When tubular goods are received for lining at the lining plant, a quick visual inspection is conducted to detect any obvious flaws in the pipe and bad order joints are set aside.

Before lining threaded goods, the pins and collars are cleaned using a hot water and detergent blasting procedure. After the threads are cleaned, each pin and collar is hand-checked to detect excessive thread wear. All threads should have at least one (1) thread stand-off at hand-tight make-up to assure proper make-up in the field. Joints with worn pins are sent to the threading rack for rethreading, and joints with worn collars are sent to the bucking rack for new collars or to have collars reversed (endoed).

After the threads are cleaned and checked, the pipe is then cleaned internally by sandblasting. If used pipe has excessive scale or paraffin build-up on the interior, the pipe may have to be cleaned by boring or by steaming.

A polyvinyl chloride (PVC) or fiberglass-epoxy liner is inserted full length into the joint of pipe. The liner has a flare already formed or in place on one end and this flare is placed at a predetermined depth (midpoint) in the collar. Special pumping caps are placed on both pin and collar ends. The caps hold the liner in place while a premixed cement is pumped into the annular space between the pipe and the liner. Prior to pumping the cement

into the annulus, one end of the pipe is elevated. This allows the cement to displace air from the annulus as the cement mixture is introduced at a controlled rate. Once the cement reaches the elevated end with the special cap and flare, pressure is allowed to build to just below the collapse pressure of the liner. This pressure produces a squeeze in the annulus and locks the liner in place. If there are any holes in the liner or the pipe, they can be detected visually. Any weak spots in the liner will cause it to collapse. If there is a leak or collapse in the liner, it is pulled immediately and the joint of pipe relined.

After pumping, the pipe is racked horizontally with the caps in place, and the cement is allowed to cure until an initial set is obtained. The pumping caps are then removed. The collar and pin threads are cleaned and the liner is flared over the pin end. This gives a continuous, unbroken, inherently holiday-free corrosion barrier from pin to collar on threaded tubulars, and end-to-end on plain or grooved end tubulars. A highly visible reference mark is then painted on the pin end of threaded tubulars. This reference mark indicates when proper compression is achieved on the rubber corrosion barrier ring. (The use of the rubber corrosion barrier ring will be discussed later.) All threads are cleaned, doped and thread protectors installed. The pipe is then allowed to sit and cure for approximately twenty-four (24) hours before being hauled.

CHOOSING THE RIGHT LINER FOR THE JOB

Polyvinyl chloride is a good reliable product and will give excellent protection. Like any product, PVC has its recommended uses and limitations. The temperature range is -20°F to 160°F. PVC should not be used in cases where there are measurable amounts of gas; i.e., H_2S or CO_2. Under higher pressure, these gases can penetrate the PVC and become trapped between the liner and the cement mortar. If this well is shut-in and the pressure falls off, the PVC liner can collapse. In addition, paraffin/aromatic solvents can soften PVC, depending on the concentration and amount of time exposed. This softening could cause the PVC to disbond from the mortar. The PVC liner is used mainly in salt water disposal wells, water injection wells, and flow lines.

Fiberglass-epoxy liners are more durable and can be used in a broader range of applications. The temperature range for the fiberglass-epoxy liner is -20°F to 300°F. The fiberglass-epoxy liner can accommodate CO_2 and H_2S and is unaffected by paraffin solvents. Mud/hydrofluoric acids or strong solutions of sodium hydroxides are not recommended for use in the fiberglass-epoxy liner. The main point to remember is to let the well conditions dictate which liner should be used.

These liners should not be considered in producing wells which have rod pumps in them. However, producing wells with submersible pumps or gas lift mechanisms are an ideal application for this system.

PROTECTING THE CONNECTIONS

Having established the fact that there are two good linings available to protect the tubing, the most critical part of internal corrosion control must

be focused upon. "THE CONNECTION." "How are collars and pins going to be protected?" This is the most frequently asked question among corrosion and production engineers, production superintendents and field foremen. "THE CHALLENGE." Provide a system that will stand up to a repeated trip program, but will maintain holiday-free integrity. "THE SOLUTION." Use a mechanical device to solve a mechanical problem. By using a steel-reinforced oil-resistant rubber corrosion barrier ring, mechanical compression can be achieved each time a connection is made. These rubber corrosion barrier rings are molded using an oil-resistant compound with double steel rings to give durability and strength. The inside diameter (I.D.) of these rings is concave. This shape allows the ring to compress outwards into the threads of the coupling which displaces the J-dimension threaded area with rubber, eliminating areas to which corrosive fluids or gases could migrate. The flares in the collars and over the pin ends of the pipe (discussed earlier) provide a flat surface for this rubber corrosion barrier ring to seat and be compressed while the connection is being made. Repeated trips with the tubing cause more thread wear, allowing the pin to travel deeper into the collar to achieve the proper make-up. As this happens, the rubber corrosion barrier ring would eventually be compressed into the I.D. This could hamper the running of some tools inside the liner. To prevent this, there are three different sizes (thicknesses) of corrosion barrier rings. As thread wear occurs, a thinner rubber corrosion barrier ring is to be used. This system will allow you to run pipe with excessive thread wear using the proper corrosion barrier ring. Even at this point, new collars can be bucked on, new threads can be cut on the pin, and the whole process can start over again with the thick corrosion barrier ring, giving an unlimited trip life while maintaining "holiday-free" integrity.

One is now able to see how the design of this system is taking shape: (1) The use of a rigid insert liner to provide uniform protection in the pipe; (2) The use of flares on both ends to protect the pin and collar ends and to provide a seat for the rubber ring; (3) The rubber corrosion barrier ring gives mechanical compression each time the connection is made. There are three different thicknesses of corrosion barrier rings to allow for thread wear; and (4) The reference mark painted on the pin end to show when compression occurs on the ring.

The one step left to cover in this system is the proper running or installation of the pipe. Running the pipe is simple. This requires that the rubber corrosion barrier ring be put into the collar, making sure the pipe is made up to (at least) the reference mark on the pin end. Service technicians are available to supervise the running and to make sure that these details are taken care of in the field. The serviceman will also run a drift through each connection to make sure the ring was not over-compressed.

CONCLUSION

This system is designed to give the best possible solution to internal corrosion in steel tubing, line pipe and casing. It utilizes the corrosion protection of a full-length PVC or fiberglass-epoxy liner in conjunction with the strength of the steel pipe, resulting in an inherently holiday-free system with unlimited trip life.