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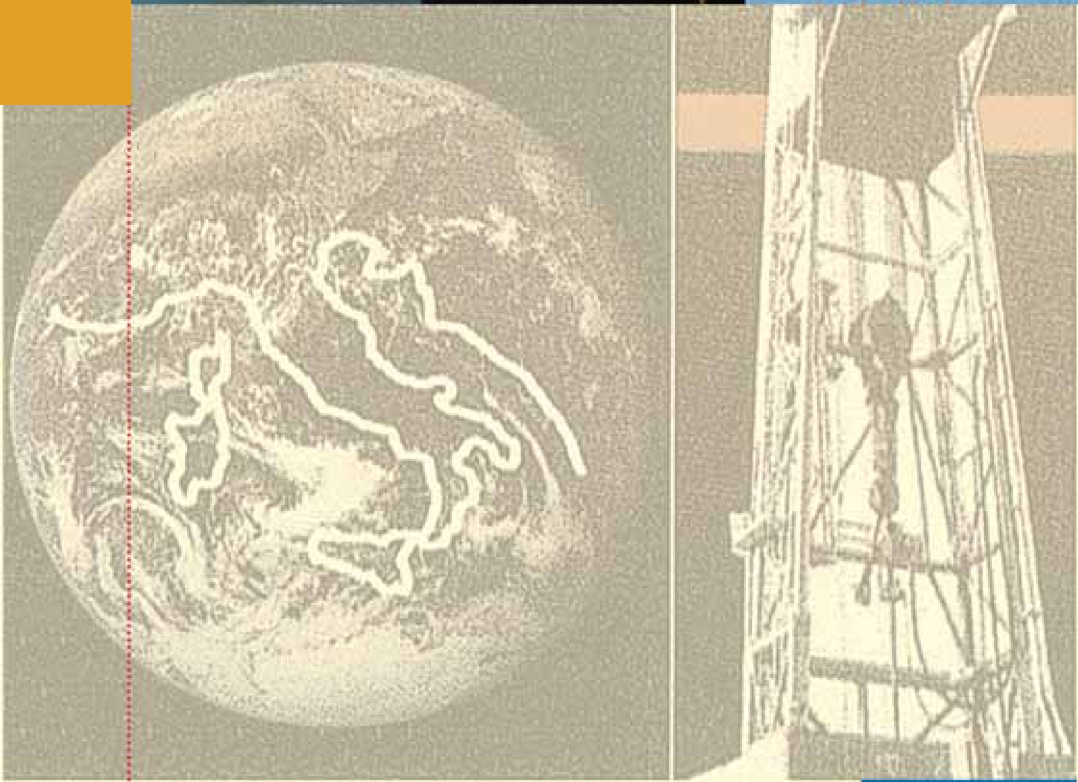

Technical Bulletin

SPE International

# Pressure-Activated Sealant Technology. A Cost-Effective Alternative to Conventional Leak Repair Methods.

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**Maintaining wellbore integrity is an ongoing process within the oil and gas industry. Leaks occur. The conventional method of repair is to mobilize a workover rig, at considerable cost and potential harm to personnel and environment. What is needed is a method of repairing leaking wellbore equipment and control systems in-situ without the need of mobilizing expensive and risky intervention operations. Pressure-activated sealant technology is such a method.**

## Introduction

With age, the integrity of all wellbores will deteriorate. Over the life of an oil or gas well, it is possible for a leak to occur in most of the components of the well system. Connection leaks are found in pipelines, umbilical lines, hydraulic lines, control systems, flow hubs, tubing, casing and similar components. Dynamic seal leaks are experienced in SCSSVs, actuators, valves, control systems and similar components. Static seal leaks are seen in pipelines, wellheads, packers, hangers and similar components. Damage to components during installation can result in a variety of leak sources.

The conventional method is to mobilize a workover rig and pull and replace the leaking piece of equipment, or perforate and squeeze cement; all at considerable cost and potential harm to both personnel and environment. As an alternative to a rig workover, a safe, cost-effective sealant process has been developed that seals the leaks without clogging the hydraulic systems or wells.

## Development

Seal-Tite International has developed a line of unique pressure-activated sealants that are designed to seal leaks in wells and hydraulic systems. The sealants are unique in that a pressure drop through a leak site causes the sealant fluid to polymerize into a flexible solid seal only at the leak site. The sealant remains fluid until the sealant is released through a leak site. Only at the point of differential pressure through the leak site will the sealant reaction occur. The monomers and polymers in the formula are crosslinked by the polymerizing chemicals. As the reaction proceeds, the polymerized sealant plates out on the edges of the leak site and simultaneously links across the leak site to seal the leak. The resulting seal is a flexible bond across the leak. The remainder of the sealant remains fluid and will not clog the hydraulic systems of the well.

Figure 1 shows a graphical representation of the polymerization process. Figure 2 shows photographs of an actual sealant after the polymerization process, as a flexible solid.

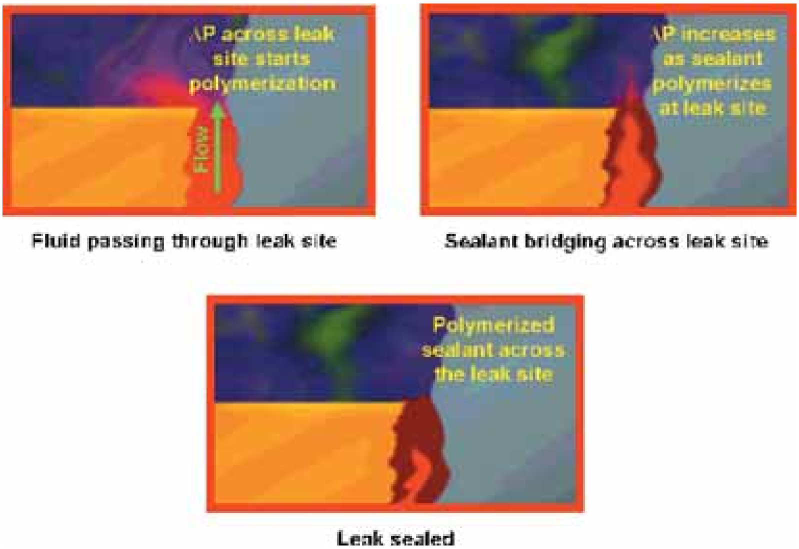


Figure 1 - *Sealant Polymerization Process*

Figure 2 - *Polymerized Sealant*

Because the sealant does not harden except in the presence of sufficient differential pressure to start the polymerization process, concerns about the time to deliver the sealant, the temperature of the well (below 500°F / 260°C), and the ambient pressure in the well have been eliminated.

The ability to provide a long-term seal is dependent on the severity of the leak and the stress placed on the seal after the treatment. While it is impossible to correlate meaningful data on seal longevity when faced with ever changing well conditions and operating parameters, it can be said that for moderate leaks, the sealant, after curing for two weeks, has the same longevity as a 60 to 80 durometer elastomer in the same geometry and environment.

The pressure-activated sealant technology

was originally developed in 1995 to seal leaks in the hydraulic systems of control lines and SCSSVs. Since then, the technology has been expanded to cure leaks in over 1200 operations, including leak types listed in Table 1.
Success rates for different applications follow in Table 2.

| | |
|---|---|
| ● Dynamic Seal Leaks<br>❍ Seal Units<br>❍ Safety Valves<br>❍ Sliding Sleeves | ● Static Seal Leaks<br>❍ Packers<br>❍ Hangers<br>❍ Wellheads |
| ● Connection Leaks<br>❍ Riser<br>❍ Tubing and Casing<br>❍ Control Lines<br>❍ Umbilical Lines | ● Pipeline Leaks<br>❍ Pinholes<br>❍ Weld Defects<br>❍ Internal Corrosion<br>❍ Gate and Ball Valves |
| ● Microannulus Leaks<br>❍ Compaction<br>❍ Cement Composition<br>❍ Stress-Thermal/Hydraulic | |

Table 1 - *Leaks Cured*

| | | | |
|---|---|---|---|
| Actuators | 89% | Pipeline | 100% |
| Casing | 76% | Risers | 100% |
| Control Lines | 75% | SCSSVs | 83% |
| Downhole Equip. | 75% | Subsea | 76% |
| Surface Equipment | 93% | Tubing | 64% |
| Microannulus | 100% | Wellheads/Hangers | 81% |
| | | **Total Operations** | **84%** |

Table 2 - *Success Rates*

## Case History: Control Line Leak – Italy

Seal-Tite was contacted to evaluate a possible repair to a control line leak on an offshore platform. Previously the leak was almost continuous, but after injecting Teflon based particulate sealant the leak would mainly occur during rough seas, indicating a leak at the control line to tubing hanger connection due to movement of the well head. Control line operating pressure was 300 bars, but actual leak rate was unknown. Diagnostics, a standard procedure for every pressure-activated sealant treatment, would be performed to confirm leak location and to establish a leak rate for the selection of the appropriate sealant.
Upon arriving on location the control

line pressure was 0 bar. The existing Teflon based sealant needed to be removed before beginning the pressure-activated sealant treatment. A particulate sealant provides a temporary seal by plugging the leak site with layers of Teflon. This temporary plug would prohibit achieving a long term seal by inhibiting the pressure-activated sealant from bridging across the leak site.

A very aggressive proprietary solvent was injected to remove the existing particulate sealant and to establish a leak rate. Initial leak rate when injection started was 10 ml per minute at 340 bar. Final injection rate after solvent injection was 60 ml per minute at 340 bar. Based on this injection rate the appropriate sealant was injected into the control line. After injecting 2 liters the rate decreased to 47 ml per minute. A more aggressive sealant was then injected. The injection rate decreased further to 4.7 ml per minute. Operations were then shut-in overnight.

The next morning the pressure on the control line was 68 bar. Sealant injection continued. A seal was formed and broken several times during the course of injection, where each time a seal broke a stronger seal was formed. Injection rate decreased to 5 ml per minute at 224 bar before locking in at 340 bar due to approaching storm.

Due to the amount of sealant pumped before the leak rate decreased, it is suspected that there was another leak at the DHV.

To date, the well is still flowing with no reappearance of a leak.

## Risk / Economic Benefits

In the final analysis, what actions should be taken to address the problem of leaks in wellbores is a function of the benefits of maintaining a well with a leak versus the costs and risks of attempting to eliminate the leak.

## Risk Benefits.

A major impediment to curing leaks is that the risks associated with curing the problem may be greater than the risks of ignoring the problem.
A conventional rig workover is a risky operation. In contrast, the described sealant process can be performed using only one technician and very little equipment. No rig is needed. Thus, wellbore leaks can be eliminated and the risks of injury to personnel or damage to equipment and the environment are reduced.

## Economic Benefits

Typical expenditures for downhole leak workovers on offshore wells are conservatively in the range of US$1,000,000. Using the pressure-activated sealant technology, the cost for the case history described was US$42,127 – over a 95% reduction.

## Conclusions

The use of a pressure-activated sealant technology to seal wellbore leaks and restore wellbore integrity is a safe and cost-effective alternative to a conventional rig workover.