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Cortec® VCI Article One of Five Most-Viewed Stories for Oil & Gas Engineering in 2017!

Cortec® is making a significant impact on the way major oil and gas companies preserve their assets. These solutions are becoming increasingly popular subjects for industry magazines such as Oil & Gas Engineering, where a Cortec® article made it on the list of the top-five most viewed articles for 2017!

Cortec's article on "Practical approaches to rigorous corrosion protection" was published in the October online and print editions of Oil & Gas Engineering. Despite being posted near the end of the year, the article placed only third for the year's most viewed online articles behind a 2017 oil and gas industry overview and an article on wireless benefits for oil and gas.

Cortec's article addresses the serious issue of corrosion in the oil and gas industry, where corrosion increases costs and safety hazards. It describes how VCI technology and related methods can provide effective protection in a variety of upstream, downstream, and midstream applications, often in ways that are very practical and replace the use of materials that are more hazardous to humans or the environment.

To read the full October edition of Oil & Gas Engineering, please visit the following link:

http://bt.e-ditionsbyfry.com/publication/?i=445230#{"issue_id":445230,"page":0}

For Cortec's full article, please continue to next page.

Practical approaches to rigorous corrosion protection

Across industry sectors, wide application possible

By Julie Holmquist

Corrosion is a persistent challenge in all oil & gas industry sectors: upstream, midstream, and downstream. This is due not only to the corrosiveness of the materials exploited, but also to the harsh environments many structural and equipment assets are exposed to in oil & gas production, transport, and processing.

High costs, safety hazards, downtime, and additional labor result. According to NACE International, total annual corrosion cost in oil & gas production is about $1.4 billion, with roughly $590 million assigned to surface pipeline and facility costs, $460 million to downhole tubing expenses, and $320 million to capital expenditures.

Some aspects of corrosion that could be better controlled are completely overlooked or inadequately addressed. For example, millions of dollars' worth of spare equipment sits idle in gas or oil facilities around the world. Too often, a lack of sufficient preservation technology and expertise leaves these assets at the mercy of harsh outdoor environments.

Volatile corrosion inhibitor (VCI) technology and related methods enable more effective protection. VCIs are typically easier to use and more environmentally friendly than many traditional treatments.

Figure 1: Hot layup of risers on a drillship using waterborne VCI fogging and capping with film. All images courtesy: Cortec Corp.

A brief survey

The upstream sector explores for and procures crude oil and natural gas using oil rigs, drill ships, and offshore platforms. Corrosive attacks come both from the nature of the resources used in drilling and from the corrosive environments in which drilling is performed, including, for example, offshore salt-spray conditions. Practically any metal structure or piece of equipment is at risk for corrosion in these circumstances, from polished bore receptacles and offshore platform caisson legs to valves, pistons, pumps, electricals, and fire extinguishing systems. In addition, market volatility often brings long periods of layup, which put the equipment at risk for corrosion, if not adequately protected.

The midstream sector focuses on oil & gas transportation involving millions of miles of pipeline around the world. Corrosion can start at the pipe-manufacturing plant long before pipeline construction begins. Typically, pipes are left unprotected, or a wax-like coating is used that is challenging to thoroughly apply on internal pipe geometry and equally difficult to remove. Corrosive conditions may worsen as the pipes are transported through different types of weather and, in many cases, undergo salt-spray conditions while being transported overseas topside on ships. On land, some pipeline projects take years to complete, during which time pipes sit in unsheltered pipe yards. Welders coming to couple the pipes together have additional work cleaning any corrosion off the to-be-welded surfaces.

Downstream facilities face similar corrosion problems but often on a larger scale due to the oil & gas volumes involved. Downstream facilities keep spares on hand ready for quick replacement of a failed part. Often, though, spares are stored outside on open racks and subject to corrosion.

Thousands of aboveground storage tanks risk corrosion on tank bottoms and need to be protected against possible leakage. Basic

facility assets such as boilers, coolers, pumps, valves, engines, insulated pipes, and structural steel are also at risk during mothballing or facility construction.

Ways to the means

Steps to prevent corrosion are not necessarily difficult, if the proper precautions and proper technology are used. By active vigilance and the use of VCIs, corrosion can be reduced in a cost-effective, often more environmentally friendly manner than is otherwise the case.

VCIs are commonly made of organic salts of carboxylic acids. They work as mixed inhibitors to protect against both anodic and cathodic reactions of a corrosion cell. In use, VCI inhibitor molecules vaporize from a source material until they reach equilibrium in an enclosed space. The VCI molecules are attracted to and adsorb on metal surfaces to form a hydrophobic layer that protects the metal from interaction with corrosive contaminants. When the enclosure is opened, the VCIs will dissipate from the surface, leaving the metal corrosion-free and ready to use. On the other hand, if the space is only temporarily opened and enough source material remains, the protective layer will replenish on the metal surface and protection will continue after the openings are closed again.

Because of their vapor activity, VCIs work in multiple phases. Like traditional contact corrosion inhibitors that are added to liquids, they can dissolve and protect metal surfaces in contact with the liquid, including, for example, the insides of a pipe or tank below the surface of the fluid. VCIs also can protect metal surfaces in the void space above the fluid and at the vulnerable interface where the air and fluid meet.

VCIs protect against micro-corrosion and corrosion creep. Many coatings rely on zinc, chromates, and other heavy metals to work. However, the large particle sizes of these substances leave gaps in the coating that can allow corrosion to start in micro-cavities and more easily spread. VCIs protect against this and discourage corrosion spread if the coating is marred by a scratch or dent.

VCIs can be incorporated into other mediums such as liquid forms for pipes and tanks, powder forms for void spaces, packaging materials for wrapping equipment, removable or long-term coatings, foams, and papers. Versatility allows for a tailored approach that considers length of protection and ease of removal.

Applications in oil & gas

A sound corrosion plan preserves assets in all three sectors of the oil & gas industry. A variety of application methods may be used to develop a spares layup strategy that requires very little labor and time to re-commission. Across all oil & gas sectors, a common application method is equipment shrink-wrapping using polyethylene film containing VCIs. The film is made to different durability levels depending on the indoor or outdoor storage situation. Foaming or fogging are added as needed based on the volume of the space being protected. Equipment stored in this manner can be unwrapped and re-commissioned relatively quickly, typically without the need to clean off traditional petroleum-based coatings that may be classified as hazardous waste. VCI film can be recycled and in some cases turned into new film. This is useful for standby layup of spare equipment as well as for long-term mothballing of entire plants.

These methods are preferable to traditional layup strategies, such as potentially dangerous nitrogen blanketing or dehumidification systems that require monitoring and a constant source of electricity.

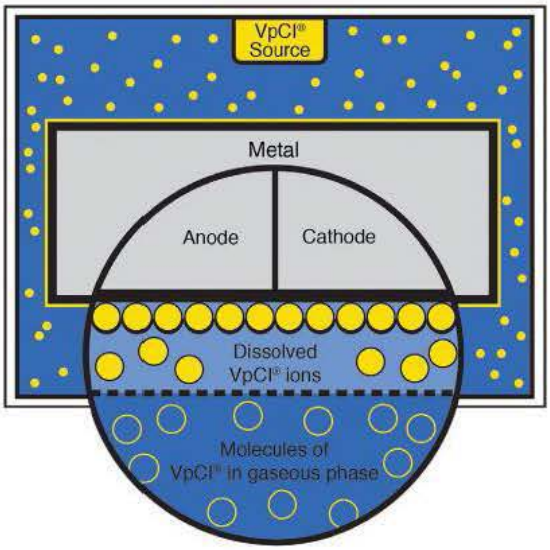

Figure 2: VCI molecules evaporate from a source, fill an enclosed space, and adsorb on metal surfaces to protect them from corrosion.

Upstream structural corrosion

To protect against exterior structural corrosion in the upstream sector, VCI coatings can be used in offshore platform layup projects. These types of coatings protect with a relatively thin film, making them more versatile and reducing labor and materials. For internal structural protection, the addition of waterborne and powder VCIs proves highly effective. In a two-year trial inside an offshore platform

Figure 3: Corrosion inhibitor being applied to caisson legs.

caisson leg, a reduction in corrosion rate compared to the control caisson leg was demonstrated.

It is important to ensure electricals and electronics are in good working condition, preserved from corrosion. This can be done by sticking a self-adhesive cup filled with VCIs inside an electrical or electronics enclosure. The VCIs escape through a breathable lid and fill the enclosure, forming a self-replenishing protective layer on the metal surfaces. Another option is to spray electrical panels with a VCI-enhanced coating formulated for indoor or outdoor conditions.

The corrosiveness of downhole drilling operations is well-known. VCIs have been formulated into chemistry that can create a persistent anti-corrosive film barrier in these structures to protect against water intrusion, pitting, and corrosive gases. The VCI components of the chemistry provide additional protection for any portions of the downhole structure not in direct contact with the fluids. It can be used in both sweet and sour conditions, that is, low or high hydrogen sulfide concentrations.

Firefighting systems aboard offshore rigs are another critical point of protection. These systems often rely on water pumped directly from the sea, which is highly corrosive. If corrosion occurs between testing periods, the system could malfunction when it is needed. Systems using VCIs have been devised to protect against corrosion of these critical firefighting devices.

Midstream pipeline protection

Early corrosion protection of newly manufactured pipes is an important step for maintaining pipelines in good condition from the start. This can be done by fogging pipe internal diameters with a waterborne VCI, capping the ends with VCI film, and coating the outer diameters with a waterborne VCI coating that can be removed or left in place as desired. Weld-site coatings reduce the time and effort welders normally require to obtain a clean welding surface. Coating can be washed off with an alkaline cleaner (preferably containing flash corrosion inhibitors), leaving the welder with a clean surface. The same protection strategies apply to pipes already onsite once cleaned of the typical buildup of dust and debris.

On an in-service pipeline, the technology has the potential to protect the pipe against internal corrosion on 360 degrees of the inside diameter as the fluid flows through the pipe. This comprehensive protection potential is due to VCI multi-phase characteristics. A traditional corrosion-inhibiting additive in liquid gas or oil streams would only protect the pipe walls in contact with the oil or gas. Here, protection of the entire pipe-wall circumference is achieved.

Environmentally friendly pipeline casing fillers have been developed that protect the annular void spaces between pipelines and their casings. The gel filler is a unique alternative or backup to traditionally used cathodic protection because it protects with or without the presence of an electrical current. The vapor action allows VCIs to migrate under disbonded coatings and provide corrosion protection to inaccessible and recessed surfaces. Development of the method was inspired by the request of a North American pipeline corrosion engineering group. The technology has been patented in the U.S. It also can be used in other tubular structures.

Downstream strategies

Downstream layup strategies are like those already described for spares layup. Preservation of the many spare parts that may be lying on outdoor racks is an important step to downstream asset preservation. This is a growing trend, and many major oil & gas facilities today are preserving everything from the smallest screws to the largest equipment using films, coatings, emitters, and fogs. When the parts are needed, it is easy to unwrap them, recycle the film, and install or re-commission the parts.

Oil & gas facilities also include aboveground storage tanks that require protection from corrosion on tank bottoms. Risks from corrosion include leakage and environmental contamination but can be countered using VCIs

found to be compatible and even synergistic with cathodic protection (CP). VCIs injected beneath the tank bottom work to protect areas not in contact with the CP's conductive electrolyte, while in certain cases the CP may enhance the effectiveness of the inhibitor. VCIs can be added to tank pads before construction or injected below existing in-service or out-of-service storage tanks.

Downstream systems such as piping or electronics benefit from proactive corrosion protection. VCIs can be injected into insulated piping to protect against so-called corrosion-under-insulation. Emitters added to electrical and electronic instrument boxes can be a simple protection against the extra costs of electrical repairs, malfunctions, or downtime. Coatings can be used on a variety of structures and equipment.

Industry changes

Corrosion is everywhere in the oil & gas industry. Fortunately, practical methods for protection of assets are available today that were once overlooked. VCIs enable more thorough protection in void spaces using vapor-phase action. They enhance coatings performance by protecting against micro-corrosion, and reduce need for materials that must be disposed of as hazardous waste. Instead, they are typically recyclable or easy to remove and discard. They preserve important assets during common waiting periods prior to construction or when a volatile market warrants layup. They have forged important ground in the layup of equipment for major oil & gas companies globally and will continue to be an important source of providing cost-effective preservation to the industry.

Special thanks to Bob Boyle, Jim Holden, Eric Uutala, and John Wiermaa of Cortec Corp. for their firsthand insights on corrosion in the oil & gas industry. CG

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