An Innovative Coating System to Extend the Service Life of Aging Pipelines

Addressing the Global Concern Over Aging Infrastructure

By Mario Silvestro

Replacing, maintaining and rehabilitating aging pipelines require continuous investment in innovative technologies for the oil and gas, water, power generation, utility and industrial sectors. Statistics show that 62 percent and 46 percent of respective North American and International existing onshore pipelines are older than 21 years. In the United States, approximately half of the 2.5 million miles of U.S. steel pipeline infrastructure is at least 50 years old (Groeger, 2012).

Cast iron and wrought iron pipelines have been used since as early as the late 1800s to transport mainly wet gas and were later converted to transport dry gas. The re-purpose of these lines resulted in costly repair and rehabilitation costs to bell and spigot joints due to protective sealant drying out (Pipeline & Hazardous Materials Safety Administration, 2018). In addition, wide usage of bare steel pipes continued until the 1960s for natural gas and hazardous liquid pipelines (Pipeline & Hazardous Materials Safety Administration, 2018). Without a sufficient barrier to mitigate corrosion, these pipelines often had short service lives and presented a high risk of failure creating a risk to public and environmental safety.

To prevent corrosion, tape wraps and coal tar were used as early technology pipeline coatings, however these materials had their limitations in performance and were not designed to have a long service life. Shortcomings with these early technology coatings, which led to coating failures, are a result of poor resistance to key corrosion phenomena and poor application, in uncontrolled environmental conditions. Some of these important phenomena or factors which are vital to the prevention of corrosion include; surface preparation, adhesion of the coating to the substrate, and salts and osmosis. As technology advanced through the 1960s, 3-Layer HDPE and FBE factory applied coatings were developed and started to become the industry norm. The advancement in this coating technology, along with more controlled application procedures and environments, mitigated many risks associated with the development of corrosions. FBE alone has been applied on more than 100,000 km of pipe around the world and is the most widely used coating today in the United States, with a typical service life of up to 30 years (Kehr & Enos, 2000).

Considering that 62 percent of pipelines in North America are over 21 years old and the design life of factory coatings is approximately 30 years, it can be concluded that the majority of coated pipelines are due for inspection and evaluation to determine if any rehabilitation or replacement is required in order to prevent pipeline failures and to extend the service life of the assets. Most existing field-applied anti-corrosion coating solutions require complicated and expensive near white SPPC.SP10 (Sa 2 ½) surface treatment and application conditions which are not suitable for in-service assets. This makes many rehabilitation and repair impractical, increasing demand for surface tolerant and easy to apply rehabilitation coatings that will meet the most stringent industry standard requirements.

Visco-Elastic Coating Systems for the Repair & Rehab Market

External Visco-Elastic corrosion protection systems have been used in the underground pipeline industry for over a decade. The term Visco-Elastic is defined in the external coating industry by ISO 21089-3 "Petroleum and natural gas industries — External coatings for buried or submerged pipelines used in pipeline transportation systems: Field Joint Coatings" as a non-crystalline (fully amorphous) low-viscosity (non-crosslinked) non-reactive polyolefin based compound (International Organization of Standardization, 2016).

The aforementioned Visco-Elastic material defined for external coating consists of viscous material properties that resist shear flow and strain linearly with time when a stress is applied, as well as elastic material properties that strain when stretched and return to their original state once the

Replacing, maintaining and rehabilitating aging pipelines require continuous investment in innovative technologies for the oil and gas industry. Above: WrapidBond and WrapidCoat PVC on Onshore Pipeline: Fahud-PDO Rehab Project.

stress is removed. Visco-Elastic materials have elements of both properties and, as such, exhibit time-dependent strain. Being non-crystalline and inert, Visco-Elastic coatings will not dry out or drastically change in performance over time. Furthermore, the coating will flow into damage areas, exhibiting self-healing characteristics. To mitigate the negative factors which influence corrosion, Visco-Elastic coatings are chemically engineered to have very good wetting properties and instant bonding to the substrate with minimal surface preparation, while acting as a barrier to water and oxygen. Typically supplied as a roll with the Visco-Elastic adhesive compound on a reinforced carrier backing, it can be easily applied through spiral wrap onto a pipeline. These coatings generally need additional mechanical protection which can be provided in many forms depending on the project and environmental requirements.

Current Visco-Elastic coatings within the market, such as the Canusa-CPS WrapidBond coating system, provide an instant bond to a minimum SSPC. SP2 (St.2) prepared steel, PE or PP substrates. This product can be applied at low surface and ambient temperatures without the need for pre-heat treatment, post-heat treatment or primers. WrapidBond retains its wetting properties, due to being non-crystalline and inert, flowing into the crevasse and pores of the substrate, thus increasing the contact surface area over time. It is designed to fracture cohesively, always leaving a residual protective layer on the substrate. This is done without the need for highly expensive capital expenditure (CapEX) investment in plant equipment or heavy field equipment, such as induction coils, to achieve high minimum surface preparation levels and temperatures, as required for application of FBE or 3-Layer HDPE coatings. Due to the low surface preparation and temperature required for application, this coating has the unique advantage of having the potential to be applied on active and live pipelines. Furthermore, WrapidBond's non-polar chemical foundation repels water displaying very low permeability and in turn, eradicating osmosis. The instant bond, self-healing and water resistance limits aggressive rust creep, even at minor damage areas.

This cold-applied coating system has many HSE advantages compared to existing field-applied coatings. WrapidBond's non-hazardous and inert formulation reduces safety risks to field personnel, often associated with exposure to field mixing of multi-component coatings and fumes from high curing temperature products. No special personal protective equipment (PPE) such as face-shields, respiratory masks or full body protective suits are required for the application of this coating. No additional measures are needed to protect the environment, as there is no risk of chemical side reactions or any uncured, unstable residual product remaining post application, thus eliminating the risk of soil leaching and contamination to the surrounding environment.

Visco-Elastic coatings are chemically engineered to have very good wetting properties and instant bonding to the substrate with minimal surface preparation, while acting as a barrier to water and oxygen. Above: WrapidBond and WrapidCoat PVC on Onshore (Water) Pipelines: (SWCC) Central & Western Region Pipeline Rehabilitation Project.

Application of Visco-Elastic Coating Systems to Major Rehabilitation and Repair Projects

Successful rehabilitation and repair projects executed with the Canusa-CPS WrapidBond, Visco-Elastic coating systems, have provided integrity and reliability to assets by extending the service life of pipelines for up to 30 years.

• The Saline Water Conversion Corporation (SWCC) Central & Western Region Pipeline Rehabilitation Project was a project to rehabilitate an asset in service for over 20 years, originally having 3-Layer HDPE parent coating. WrapidBond and WrapidCoat outer layer were applied to 42- to 80-in. water pipelines. Between 2016 and 2018 a total of 200 km of pipeline was recoated overtop straight-line, girth-weld and bend sections, having surface preparation between SSPC.SP3 (St.3) and SSPC.SP10 (Sa. 2 ½).

• The Fahud-PDO Rehabilitation Project took place in 2019 in the Sultanate of Oman. This onshore 8-in. pipeline used WrapidBond and WrapidCoat outer layer to repair sections of 3-Layer HDPE mainline coating which were in service for more than 20 years. This rehabilitation project was performed on SSPC.SP10 (Sa. 2 ½) prepared steel in narrow trenches without any room for bulky or heavy equipment.

The Final Word

Rehabilitation recoat and repair-based pipeline projects require high performance, field-friendly, cold-applied coating systems to provide an effective and economically viable solution. There is a growing demand for tailored corrosion protection solutions to match various line pipe coatings, operating parameters and service conditions. Constrained to zero substrate preheating and minimal surface preparation, coatings must be capable of achieving sustainable end-to-end pipeline protection with consistency. Visco-Elastic coating systems addresses all the above-mentioned needs. Current market products, such as the WrapidBond and WrapidCoat coating system, have proven to provide a cost-effective solution to extend the service life of a pipeline without compromising the integrity of the asset.

References:

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