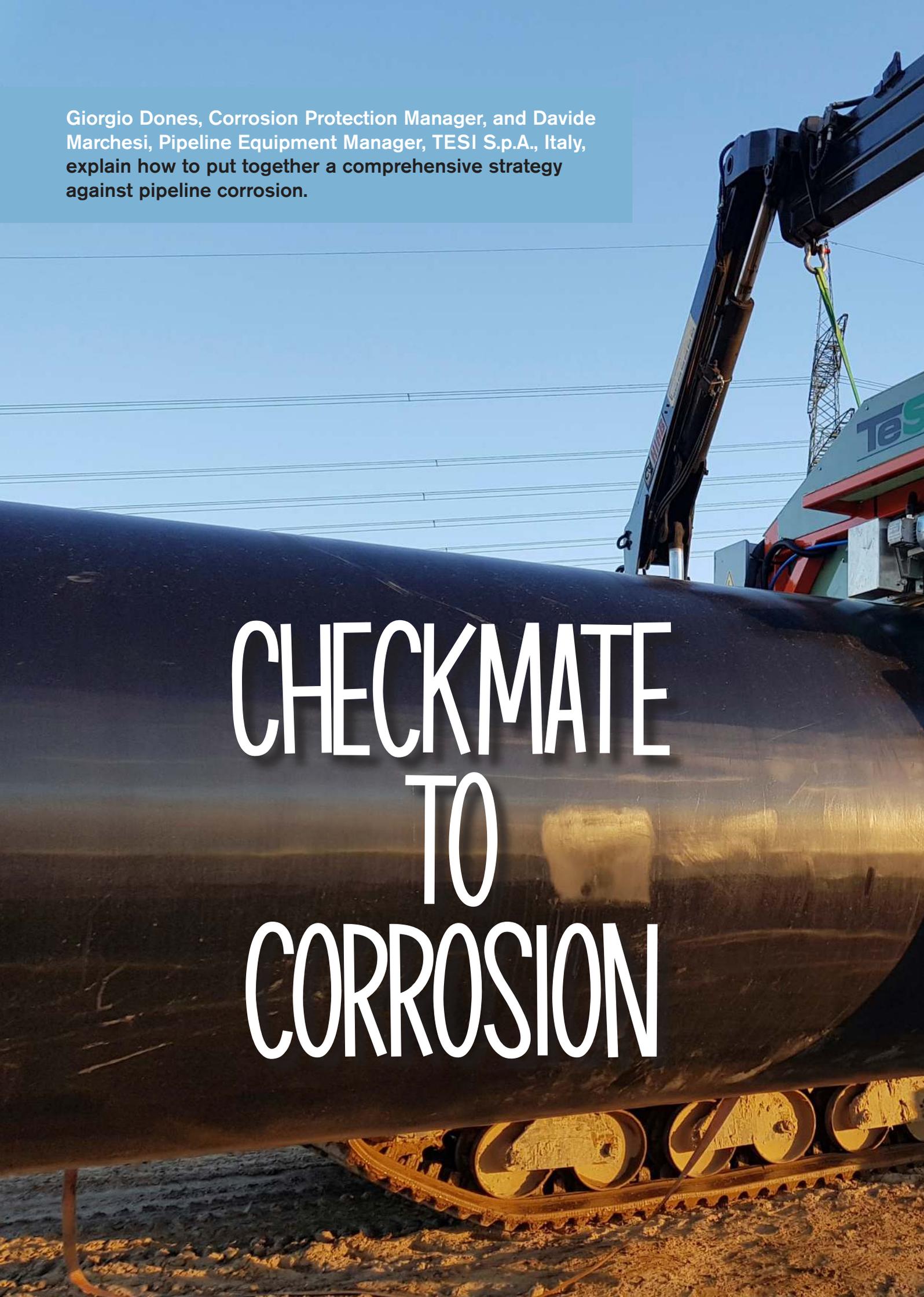


Giorgio Dones, Corrosion Protection Manager, and Davide Marchesi, Pipeline Equipment Manager, TESI S.p.A., Italy, explain how to put together a comprehensive strategy against pipeline corrosion.

CHECKMATE TO CORROSION

A large black pipeline section is being lifted by a crane at a construction site. The pipeline is the central focus, with a crane arm and hook visible above it. The background shows a clear blue sky and some industrial structures, including a building with the 'TeS' logo. The pipeline is supported by a series of rollers or tracks at the bottom.



To win the game against corrosion, you need to stay focused, and know the 'rules' of the phenomenon. You need to play the right moves, prevent as much as you can and keep the situation monitored.

With over 30 years of experience, TESI gained deep knowledge of corrosion phenomena applied to pipelines and carefully followed developments of material technology for corrosion protection, until becoming an official distributor of Covalence® products by Seal for Life. But that's not all.

Studying corrosion phenomena in detail, discovering insights day by day, project by project, TESI developed its own highly automated and user-friendly machinery that ensures high quality preparation and application of corrosion protection coatings. Finally, its successful history led TESI to invest in Industry 4.0, growing its productivity of corrosion protection coatings, in order to support large pipeline projects.

The enemy's behaviour

Corrosion is the biggest enemy of metals. It comes about when metal reacts with oxygen and moisture under the influence of the temperature. If it is under an insulation layer, it is difficult to detect and counteract. This 'corrosion under insulation' (CUI) poses a serious threat to the stability of the metal. It is not until a critical stage has been reached that it becomes visible on the surface. The insulation layer is not the cause of the corrosion. At most, it creates a space where oxygen and moisture can accumulate. In some cases, the insulation layer intensifies the corrosion, for example when it is made of a material that absorbs a lot of moisture or when chlorides and acids leach out of the insulation layer.



Figure 1. Protection coating damaged by corrosion under its layer.



Figure 2. Onshore pipeline construction project where TESI supplied heat shrinkable sleeves, induction coils powered by induction heating generators (over 800 generators built and spread all over the world).



Figure 3. Heat shrinkable sleeve application in an onshore pipeline construction project.

Studying a strategy against corrosion

That gives rise to the question of how moisture gets under the insulation layer. Two causes can be identified.

- The first is when moisture seeps through small leakages in the watertight covering of the insulation layer. This gives rain, production water, steam or groundwater the chance to reach the metal surface. These leaks could in most cases have been prevented. They are often the result of poor design, poor fitting of the insulation, poor use of the material or poor maintenance. Moisture under the insulation layer can also be caused by the forming of condensation. If the temperature of the metal surface is lower than the atmospheric dew point, condensation forms on the surface. This possibility must be considered as early as possible during the design of an item so that the appropriate type of insulation can be chosen.
- The corrosion process can be intensified by dirt. Here too, cracks in the insulation layer can result in the penetration of moisture. Chloride, acid and salt pose a special threat to the metal. These substances are sometimes even present in the insulation layer itself. If the insulation layer comes into contact with the moisture, these subjects can leach out and corrode the underlying metal. The dirt concentration increases sharply if the moisture evaporates when the temperature rises. Temperature is a factor that contributes to corrosion. Although evaporation reduces the duration of contact between the moisture and the metal, the higher temperature intensifies the corrosion. That in turn reduces the metal's life span. There is a good chance of corrosion occurring at temperatures between -4°C (25°F) and 175°C (350°F). At a lower temperature the metal is protected against corrosion by the cold, at higher temperatures the heat keeps the metal dry. There are few objects with a temperature that remains constantly below or above the critical point. This is because of variable operation, temperature variations in parts of the object or different temperatures of parts connected to the object.

Pain points

CUI can occur under all types of insulation, but especially insulation where:

- The insulation contains salt that leaches out.
- The insulation easily absorbs moisture or moisture penetrates through the top layer.
- The insulation contains foam with chloride and acid residues, which react with moisture.

Insulation which absorbs the least moisture and dries the quickest offers the lowest chance of corrosion occurring. Bear in mind that cheaper insulation is not necessarily the most economical choice viewed over the entire lifecycle.

Experienced solution

For instance, a perfect combination to achieve consistent corrosion protection when restoring the insulation on the



Figure 4. Covalence® heat shrinkable sleeve half applied on a pipeline joint.

welded joints of a gas pipeline, utilising factory coated 3LPE pipes, would include:

- Suitable choice 3-layer heat shrinkable sleeve, to replicate the characteristics of the line coating.
- Metal preparation grit blasted to SA 2 ½.
- Roughening of the lateral overlaps to the factory PE coating.
- Right preheating of the area, to be obtained by induction heating.
- Application of primer onto the metal surface.
- Wrapping of heat shrinkable sleeve with preinstalled patch closure.
- Manual or automatic shrinking at 120°C, until visual change of the dimples onto the backing.

The best option

Ausonio Zubiani, the owner of TESI, has inherited a considerable experience in the field of corrosion protection, starting from the initial collaboration with Raychem in the late 1970s and continued with Canusa for over 30 years. Nowadays TESI is the official distributor of Covalence® products.

Covalence® (formerly 'Raychem') – the original heat-shrinkable technology – was invented in 1957. The product line consists of a series of multi-layer sleeves that have high electrical resistance and low permeability, making them the optimal solution for corrosion prevention and mechanical protection of field joints for steel pipelines and pre-insulated piping systems. The products consist of a radiation cross-linked and stretched polyolefin backing with an adhesive laminated on in order to form the basic product. The adhesive may be either visco-elastic based mastic or co-polymer hot melt adhesives to match up with in-service performance requirements:

- Systems conform to all pipe diameters.
- Mastic or hot melt-coated sleeves balance performance, economy and ease of installation.
- Excellent resistance to cathodic disbonding, hot water immersion, thermal ageing and soil stress at maximum-rated operating temperature.
- Dimpled pattern provides a 'permanent change' indicator for proper heat applications.

Covalence® is a trademark of Seal for Life Industries, a group of a closely associated companies manufacturing multiple technologies of products focused on corrosion prevention, fire and temperature protection, and cathodic protection for pipeline, oil, gas and water infrastructure and industrial applications.



Figure 5. Automatic finishing machine for Industry 4.0 located in TESI Corrosion Protection Division's workshop.



Figure 6. Offshore pipeline construction project where TESI supplied heat shrinkable sleeves, induction coils powered by induction heating generators (the latter is not shown in the picture).

Industry 4.0 and big projects

In order to achieve the highest standards of quality and continuous improvement of lead time to its customers, TESI Corrosion Protection Division has designed and implemented an automatic finishing machine, interconnected and remotely manageable (Industry 4.0).

This exclusive system, in addition to ensuring maximum compliance with the tolerances imposed, works in a fully traceable process of cutting to size, pre-attachment of the closure patch, packaging and labelling, all in compliance with the most stringent regulations of ISO 9001 quality and safety.

This innovative machine went into operation at the beginning of 2019. It is able to produce heat shrinkable sleeves for every pipe diameter request and at high production rate, several tens of thousands of sleeves in a short time.

The capabilities of this machine meant a huge step ahead for TESI, with the certainty of results in terms of quantity and quality.

The first big project where TESI used this brand new machine was in the second half of 2019, for the SNAM project "Interconnessione TAP" (TAP Interconnection Gas Pipeline). It was the provision of over 4000 heat shrinkable sleeves for this natural gas pipeline DN1400, running along southern Italy for around 55 km with a design pressure of 75 bar.

All in one solution

Through the synergy between its Corrosion Protection Division and Pipeline Equipment Division, TESI can nowadays supply a complete package against pipeline corrosion, made of corrosion protection coatings, rental or sale of machinery for field joint sand blasting and field joint coating, factory training or on-site training, and remote or on-site support with a supervisor.

TESI's history in manufacturing equipment for the pipeline construction industry began 20 years ago, firstly with only

induction heating generators and induction coils for filed joint coating application with heat shrinkable sleeves, then, after huge investments made in the engineering department, with a wider portfolio which includes multiple machines, and not only with anticorrosive coating application purpose.

The latest equipment consists of: AutoBLAST high efficiency automatic blasting machine, AutoCOAT high efficiency automatic coating machine (FBE), automatic induction coil for coating/welding pre-heating (S-Lay and J-Lay), induction generators in multiple configurations such as rotative generators (diesel/electric), static generators (inverters), containerised induction heating and coating solutions for the offshore industry, and much more.

All the field equipment has been designed with a high level of automation but without exasperation, leaving the possibility for operators to operate even in semi-automatic mode and to carry out on-site maintenance in a simple way. Another fundamental of TESI equipment is the renowned capability to handle the most severe conditions in term of environment and cycle time, typical of the pipeline projects, in particular offshore.

Another strength is the after-sale service. TESI has several service centres located in strategic points of the world, (USA, Europe, Middle East) and multiple field teams that support customers with training sessions rather than during commissioning or pre-qualification tests. All of TESI's equipment is supervised remotely, so that the team can guide operators in real time during emergency situations to minimise breakdown times.

A further article about pipeline construction equipment and services will be released soon. 

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