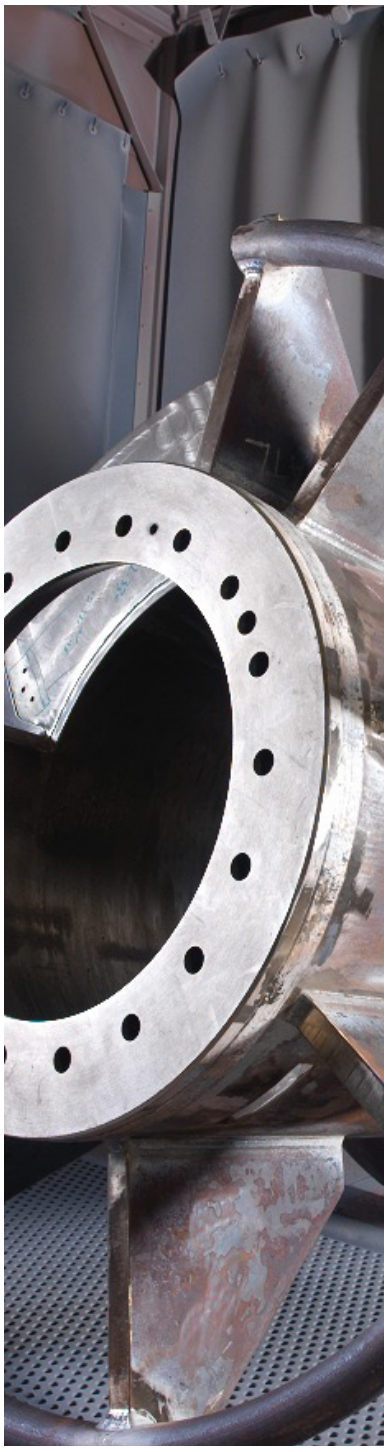
THE COST OF CORROSION IN THE OFFSHORE INDUSTRY

Using engineered surface coatings to minimise corrosion and wear



Metal corrosion is a costly fact of life in the oil and gas industry. Surface deterioration of the metal components used in offshore production processes can lead to premature and often sudden failure with the risk of costly, unscheduled downtime and the threat of hydrocarbon leaks.

Author, Andrew Courtney, of Surface Technology, part of Norman Hay plc and a global industry leader in specialist engineered surface coatings, looks at the issue of corrosion and the preventative steps that can be taken in component design, specification and manufacture. He will also explain how minimising corrosion can optimise component performance and reliability, significantly reducing operational downtime in critical offshore applications.

Corrosion can be defined as the gradual destruction of materials by chemical reaction with their environment. According to the United States Cost of Corrosion Study, produced by NACE International, one of the world's leading authorities on corrosion engineering and control, corrosion costs the US oil and gas exploration and production industry $1.4 billion a year. To put the cost of corrosion to the offshore industry in closer perspective, as far back as 2000, retrospective bolt preservation on each of its North Sea assets accounted for costs of between £150,000 and £250,000.

For oil and gas producing operations, there is no escaping the challenge of corrosion; steel is susceptible to corrosion and the harsher the environment, the more accelerated the corrosion process becomes. As offshore exploration moves into deeper and more hostile waters, so the potential impact of corrosion increases. The greater difficulty maintaining components in increasingly remote and challenging environments requires the need for extended component life. Components which have enhanced resistance to the effects of corrosion are now essential as they increase service life and reduce the need for costly maintenance. Developments within the industry, aimed at

reducing offshore development costs, involve reduction in platform weight and increasing use of satellite wells and subsea manifolds, all of which require specific attention to corrosion prevention.

Any surface deterioration on the metal products used in key applications can lead to premature and often sudden failure. In addition to corrosion, wear is another factor, typically from abrasion and impact, and while each is damaging enough on their own, they can combine to cause aggressive damage – pitting, roughening, grooves, dents, cavitation and cracking to name but a few.

We have more than 200 different coatings available for corrosion, wear, release and porosity challenges

Individually, corrosion and wear are problematic,combined the sum can be greater than the parts. In offshore oilfields, metal structures and components are under constant attack from a variety of sources from drilling muds to water and carbon dioxide to acid. Much metal loss in oilfield casings is caused by crevice corrosion. Although corrosion will initially be uniform across the surface area of the metal, in time it will accelerate in any small crevice in the metal. Crevice corrosion often starts at drill-point joints, tubing or casing collars. Pitting equally causes vulnerability when a small scratch, impurity or deformity in the metal can start the corrosion process.

Corrosion that starts with pitting can ultimately progress into cracks in the metal, which can be accelerated by tensile stress, resulting in stress corrosion. Corrosion fatigue, when metals are subjected to alternating stresses in a corrosive environment, can affect all types of welded connections on drill ships, drilling and production rigs and platforms.

With an issue as significant in terms of both cost and productivity, we cannot afford to think in terms of rectification. We are, instead, looking at surface engineering – the treatment of material surfaces to change their properties or characteristics to achieve improvements in performance - eliminating corrosion by design.

When considering offshore and sub-sea components, engineered surface coating solutions can be employed to achieve, amongst other things, improved corrosion and wear resistance. As such, it is a discipline that should be applied throughout the design, specification and manufacturing process as an integral part of component development to ensure that the specific needs of the operational environment are addressed.

While corrosion is inevitable, it can be inhibited by the application of specialist engineered coating solutions to extend the service life of components and control maintenance costs. Steps taken at the product finishing stage will minimise the risk and effects of corrosion and so optimise performance and longevity.

Surface Technology have been protecting and enhancing the performance of metal surfaces since 1946

Although there are a number of options, including changing the environment by the use of inhibitors, cathodic and anodic protection – even using more highly alloyed specialist stainless steels – the application of corrosion- resistant coatings is perhaps the most widely used way of protecting steel. The choice of coatings includes organic, metallic or inorganic and there is a wide variety to choose from.

Specialist engineered coating solutions can address issues of corrosion, gall resistance or fouling problems. Applications typically include Christmas trees, subsea connectors and seals, riser systems, clamps, seat, seals and valves, hangers, threaded components such as nuts and bolts, as well as manifolds and valve bodies.

Coating options offshore

Thermal spray coatings exhibit high resistance to corrosion and wear in extreme applications and are increasingly being used in the oil and gas industry. The use of thermal spray to apply coatings, such as High Velocity Oxy Fuel (HVOF), is one of the most commercially viable and allows the control of various parameters including powder particle velocity and temperature,

which influence coating properties such as residual stress, bond coat strength and microstructure.

Another coating system used to provide corrosion resistance, often to offshore structures on-site, is Wire Arc spraying. Wire-Arc thermal sprays provide a dense and strong metal coating and they are an excellent choice for protection against corrosion. Galvanically active coatings such as Zinc and Aluminium can be applied using the Wire-Arc process.

The Wire-Arc process involves two wires that are driven into an electric arc to form molten particles of spray and are forced out of the gun by compressed air onto the substrate. The Wire-Arc spray process is known as a 'cold' procedure, as the substrate temperature can be kept low throughout.

Wire-Arc metal spraying is also used to apply non-slip coatings to protect both infrastructure and employees and is typically applied to walkways and tread plates. Thermal Spray Aluminium (TSA) is also applied using a wire-arc spray gun.

Fluoropolymer coatings are a blend of high performance resins and fluoropolymer lubricants, such as polytetrafluoroethylene (PTFE). This type of coating offers a superior dry film lubricant that produces a smooth, hard, slick surface and provides excellent corrosion and chemical resistance, often used to meet the environmental demands within the offshore oil and gas industry. Fasteners are particularly suited to PTFE coating, with its ability to provide a combination of high corrosion resistance combined with accurate torque loadings.

Well head equipment operating under extreme conditions can also take advantage of PTFE high performance coatings, both for corrosion resistance and its load bearing and release properties.

Enhanced Material Performance and Protection:

Corrosion

- HVOF
- Wire Arc Spray
- TriCem 3800®
- SIFCO Process®
- Zinc Nickel

Wear

- Fluoropolymer
- Armourcote®
- Dry Film Lubrication
- Electroless Nickel PTFE
- Silver Plating
- SIFCO Process®

Release

- Fluoropolymer
- Armourcote®
- Electroless Nickel PTFE

Porosity

- Ultraseal MX2
- Ultraseal PC504/66

Armourcote is an engineered coating solution developed by global leader in specialist surface coatings for the oil and gas industry, Surface Technology, to inhibit corrosion and provide surface release for marine equipment. The brand was originally established with the introduction of proprietary composite coating systems developed to overcome the inherent softness of the materials used for surface release and friction control applications. These composites were first developed using fluorocarbon and fluoropolymer coatings and have subsequently been extended to include high load bearing, high temperature precision deposited dry film lubricants.

Benefits include improve wear resistance and lower friction, leading to improved abrasion resistance. Loads are taken up by the reinforcement peaks and any wear and abrasion that occurs exposes more of the fluoropolymer coating. The peaks of reinforcement are continuously smeared with the coating, which results in a smooth wear and abrasion-resistant, low-friction finish.

Where greater levels of corrosion protection are necessary for operations in hostile and demanding environments advanced multi coat, anti-corrosion paint systems are often specified, which complement other protective surface coatings to overcome these serious situations. The anti-corrosive qualities of epoxy paint systems make them suitable for providing marine barrier protection on sub-sea equipment that will be permanently immersed or in the splash-zone. Epoxy systems are also resistant to chemical attack, making them useful on equipment such as pipelines and chemical tanks.

Responding to the challenge

The oil and gas industry has well-established processes which have been used for many years to provide high levels of corrosion resistance.

Surface Technology facilities in key oil and gas manufacturing and production areas in the UK and Australia and are able to support the industry with dedicated application knowledge and expertise across the full range of coatings used in the industry. This ability to offer finishes including thermal spray coatings, engineered coatings and anti-corrosion paint systems in conjunction with surface preparation and finishing, gives our customers a “one stop shop” for their entire surface finishing needs.

Our experienced, skilled and qualified workforce applies these finishes in strict adherence to the specifications and quality assurance requirements demanded by our customers. We inspect and ensure that our work complies with the requirements of Norsok, NACE and ICORR as expected by customers in this industry.

With an ageing asset infrastructure, a constant need to improve productivity and a move towards increasingly hostile production environments, preventing corrosion is vital in every step of the offshore oil and gas production industry. Having more than 50 years’ experience serving this market globally, providing a complete range of engineered surface coatings combined with extensive technical knowledge and application advice, Surface Technology is well placed to help the industry mitigate the threat of corrosion and meet its key challenges of extending equipment life, reducing downtime and reducing operating costs.

Contact us now to discuss your coating requirement

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