Long-term protection of offshore structures

COATINGS Offshore oil and gas installations need the toughest protection possible. Coatings have to withstand extreme weather conditions, saltwater abrasion, dissolved oxygen, ultraviolet exposure, mechanical impact from debris and damage by marine life. Protection may have to last 15, 25 or even 40 years, writes shipping and coatings journalist Mike Garside.

If an underwater coating begins to fail, the costs are enormous. Some rigs, such as semi-submersibles, are movable, but dry-docking any working platform can easily cost more than USD 1 million per day in lost production alone. The challenges are faced by all types of offshore units, whether drilling rigs, production platforms or FPSOs – an estimated total of around 6,500 installations worldwide.

Fouling
Marine fouling is generally not a primary concern for offshore installations, but if underwater inspections in lieu of dry-docking (UWILD) are allowed for the vessel’s class, marine growth needs to be removed to enable the inspection. So in addition to all that nature can throw at them, offshore coatings have to be strong enough to withstand the rigours of underwater cleaning.

Stationary vessels can accumulate heavy fouling very quickly. In warm waters such as the Gulf of Mexico, more than 12 inches of growth can build up between inspections – as much as 5,000 tonnes in a couple of years. Heavy brushing is needed to remove it.

Microbe attack
Microbially induced corrosion (MIC) is a further concern. It has been identified as the probable source of accelerated low-water corrosion in steel piled structures in ports and harbours, and in ship bilge and water tanks. The corrosion prompted by this kind of attack can lead to steel loss rates between 0.2 to 4.0mm per year.

Corrosion zones
The most aggressive corrosion environment is close to the water surface, in the splash or tidal zone. Corrosion of steel in these environments can be greater than 100 mils per year. Dissolved oxygen, chloride in seawater, temperature fluctuations, changing pH values, water abrasion and the action of microorganisms combine to make the splash or tidal zone the hardest to protect. Corrosion rates of steel in this zone are eight to ten times that of the atmospheric
area and three to four times that of fully submerged areas. Damage from floating debris makes the job even harder.

**Types of corrosion-control coatings**

In the 1940s and 1950s vinyl or chlorinated rubber coatings were the common solution, in multiple coats to a total build of 250-300 microns (10-12 mils) in atmospheric areas. Inorganic zinc silicate primers were later incorporated, as well as epoxy intermediate coats and inorganic zinc/epoxy/urethane systems, which are still in use. Underwater and splash zones were protected with a thicker system such as 12-20 mils of coal tar epoxy.

More recent technologies include the use of organic, zinc-rich primers, higher-build epoxies, polysiloxane coatings and glass-flake hard coatings in a base composed of either vinyl ester or polyester.

**Professional foul**

The problem of marine fouling on stationary installations has received less attention than on shipping, where fuel efficiency rapidly falls off even in the presence of light growth. But the experience of the *Odyssey*, a semi-submersible mobile spacecraft launch platform (LP) operating out of Long Beach, California, highlights its importance. The *Odyssey* was converted from a mobile drilling rig in 1997 and is used for equatorial Pacific Ocean satellite launches. It is currently used by the international spacecraft launch service Sea Launch.

Jan Bakke, senior superintendent for the Sea Launch vessels, says there are unique problems in keeping the Sea Launch LP *Odyssey* in service. Dry-docking cuts across the vessel’s launch schedule and interferes with its intended six annual launches, each worth USD 100 million to 200 million.

“We are authorised by class to dry-dock the *Odyssey* every 15 years,” Bakke said. But the biocidal antifouling coating system that was previously used on the hull did not provide the necessary anticorrosive protection. It was not designed to last even ten years, let alone 15.

“This vessel travels slowly,” Bakke added. “We all know first of all that antifouling on this type of slow-moving vessel doesn’t have the ablative properties needed to prevent fouling, so whether you have biocidal antifouling or a hard coating, you will get sea growth. With the soft, antifouling coating system, the biofouling is harder to remove and it will eventually penetrate the coating.”

After these problems, the platform was successfully recoated with Ecospeed, a glass-flake reinforced hard coating developed by the Belgian company Hydrex. The new coating provided long-term corrosion protection and enabled regular underwater cleaning to remove fouling, a combination that has suited the *Odyssey*.

**New hard coating**

Building on experience with the *Odyssey*, Hydrex has now developed a specific variant of the coating, called Ecolock. It uses the same glass-flake technology but has a lifespan of up to 25 years and is aimed directly at the offshore market.

**Glass-reinforced**

Glass-flake-reinforced hard coatings are known to last longer and be tougher and more resilient than antifouling or foul-release coatings, which frequently need to be replaced after five years. Their antifouling or foul-release properties can also be ineffective when there is little or no movement of the structure through the water.

Ecospeed’s glass flakes are held in a vinyl ester resin, which does not suffer from the long-term brittleness associated with other resin coatings. The coating was developed in the early 2000s and has been used on a variety of vessel types, particularly ferries and ice-going ships.

Further developments of the coating system led to the release of Ecoshield, winner of a 2014 Seatrade award for protecting rudders against cavitation damage. The new variant, Ecolock, is intended specifically to meet the hull protection requirements of offshore vessels in highly aggressive environments.

**Durable**

Hydrex says Ecolock can remain in service for 15-25 years or even longer, without dry-docking, repair or replacement. It can be cleaned underwater as often as needed to meet the UWILD and weight requirements of FPSOs, drillships and other offshore vessels.

Barnacles and other fouling organisms have been found to penetrate traditional coatings right through to the steel. The glass-flake/resin combination in Ecolock prevents this penetration, and organisms that grow on the surface of the coating can be removed by divers. Since the coating is non-toxic, it is safe to clean when needed for UWILD, or simply to reduce the weight when too much fouling has accumulated.

**Simple application**

Ecolock is applied by normal spray equipment directly to the hull surface in two or more coats of 500µm DFT, without primers or tie-coat. Overcoating time is about three hours, depending on temperature and humidity. Thickness can be increased to extend longevity if required. Vessels can be launched 24 hours after the final coat has been applied. Hydrex offers Ecolock with a ten-, 15- or 20-year warranty providing standard maintenance is carried out.