

A revolutionary coating repair system



Offshore wind turbines suffer from severe corrosion and with limited access to them, the choice of the right corrosion protection is crucial. The most widely used protection methods are anti-corrosion coatings, often in combination with cathodic protection (in the submerged zone). However, these coatings often suffer from premature failure due to mechanical damage, application errors or the wrong choice of coating system.

These failures need to be addressed during service life to ensure the integrity of the structure. The lack of accessibility results in high repair costs up to €2000 per m². Therefore it is important to choose a high performance repair system that will last for

the remainder of the service life and can easily be applied in the extreme conditions encountered offshore.

The high repair costs should be reduced by selecting a system which saves on surface preparation and application costs. This translates directly in a coating that is surface tolerant and reduces the amount of layers.

Another concern is the environmental impact of offshore wind farms. Wind turbines are known to create disturbances (e.g. increased noise levels) that affect marine life. The environmental impact of the corrosion protection should be considered as well. For example, the use of zinc anodes has been under recent scrutiny as it

releases tons of heavy metals into the sea.

Solvent-based coatings, on the other hand, emit VOC's which have toxic effects on organisms. Moreover, VOC's contribute to photochemical reactions introducing ground-level ozone. The introduction of VOC's into the environment can be avoided by applying 100% solvent-free coatings.

The Humidur coatings address all the challenges mentioned above and is therefore the coating of choice for the maintenance of the wind mills on the Thanet Wind Farm and Kentish Flats Offshore Wind farm. The repairs are done by rope-access.





“The lifespan of the Humidur coatings exceeds 30 years.”



Humidur anti-corrosion coatings

This is a solvent-free 2K polyamine cured modified epoxy coating and offers following benefits as coating repair system in the offshore wind industry:

- **Applied in one layer by brush:** reduces the number of layers to a single layer reducing man hours up to 3 times compared to alternative systems. There is no longer the need of returning to the same spot multiple times for multiple layers by rope-access.
- **Surface tolerant:** high performance on minimally prepared surfaces by hand tool or power tool cleaning (ISO 8501-1 St 2 and St3)
- **Capable of curing under water:** immediately after application it can be immersed in water without any impact on the environment. This guarantees the quality in splash zones and tidal zones or when covered by rain or other climate conditions during curing.
- **Wide application window:** it can be applied at cold temperatures and high relative humidity (up to 95%). The curing continues even at freezing temperatures

and under water.

- **No impact on the environment:** it is completely solvent free, contains no VOC's, no heavy metals, no isocyanates, no coal tar or any other hazardous component
- **High abrasion resistance:** this is crucial for boat landings as on these locations coatings fail often due to the abrasive action of boats

The expected lifetime in these conditions applied on minimal surface prep is more than 15 years. For optimal surface preparation (Sa2½ grit blasting). The lifespan of the Humidur coatings exceeds 30 years.

The application is carried out by Total Jobs Contracts Ltd by means of rope-access. Acotec, the sole manufacturer of these coatings, trained all the painters and provides on-site assistance and inspection to ensure the quality of the coating system.

Application process

As blasting is not feasible on offshore wind turbines, hand and power tool cleaning is the best solution for surface preparation.

The cleaning step is carried out in accordance with the international standard ISO 8501-1 St2 or St3 depending on the accessibility of the surface.

Power tool cleaning is carried out by means of an angle grinder which allows feathering the edges of the existing coat to ensure a good overlap with the repair system.

An angle grinder is very efficient in terms of productivity but it does not create a rough profile in contrast to a bristle blaster. Extra care should be taken not to polish the surface and the coating, which is applied should be surface tolerant, to compensate for the lack of roughness. Humidur achieves adhesion values of more than 10 MPa (1450 psi) on this kind of surface.

After surface preparation the salts are removed by cleaning with fresh water. The level of salts is checked using a Bresle test.

Immediately after surface preparation the coating is applied. The coating is supplied in 1 kg sets. This allows the applicator to proceed easily by rope-access. The sets are simply mixed by pouring pail B into pail A and mixing it. No thinners, which have an adverse effect on the environment, are necessary.



The coating is applied in one yellow layer, by brush at a thickness of 400 µm. The thickness during application is checked with WFT gauges. As the coating is a solvent-free system, the wet film thickness equals the dry film thickness.

Once applied, the coating is allowed to cure. Solvent-based systems do not cure once the temperature drops below 5°C. As this curing process doesn't depend on the evaporation of solvents, it cures even at freezing temperatures. Hence, it can be applied throughout the whole year, even in winter.

Furthermore, contact with water during the process does not degrade the coatings, which is a great benefit when applying it in tidal and splash zones. There would be a quality issue with other systems.

The whole preparation and application process can be finished in one day. There is no need to return to the same spot to apply for example a second or a third coat as would remain the case for solvent-based systems. This results in substantial cost and time savings. With the same budget more surface area can be repaired than with an alternative system.

Inspection

The repairs were inspected by a certified Acotec inspector.

The first application of Humidur dates from early 2015 on the meteorological mast of the Kentish Flats. After two years the repairs are still in excellent condition. There are no signs of degradation.

The boat landings are critical areas for the coating system on offshore wind turbines. The coating system is exposed to harsh conditions due to the abrasive action of the boats.

Before a conventional coating was used. Apparently, this coating was applied less than two years before.

As can be seen in the image, the grey coating does not withstand the abrading action exposing the steel to seawater. This shows the importance of selecting the right coating system. The reason of failure could be any of following factors or a combination.

The most straightforward explanation is that the coating does not offer sufficient abrasion resistance to withstand the forces

applied on the boat landings. As the boat landings are in the splash zone/tidal zone and come into contact with water, another plausible cause is that the chosen system is not able to cure correctly due to water or at high humidity. Another factor to take into account is the performance of the coating system on minimally prepared surfaces.

Nevertheless, this coating offers a high quality finish on these boat landings because of its high abrasion resistance and because it can be applied at high humidity. Furthermore, it cures under water disregarding its salinity without sacrificing any of its quality.

The inspection of the boat landings after 2 years proves the superiority of Humidur in these conditions. Visually the coating does not show any degradation.

DFT measurements were carried out and showed no decrease in thickness. In other words, the abrading action does not result in coating loss.

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