



OFFSHORE CORROSION PROTECTION: LONGEVITY IS A MUST

Some of the fasteners built into a wind turbine are exposed to extreme climatic and corrosive conditions. They therefore need a highly effective and long-lasting form of corrosion protection in order to ensure that the turbine operates reliably and cost-efficiently throughout its prescribed period of use. This applies in particular to offshore locations. Here the standard requirement placed on the coatings used is corrosion resistance of up to 1,440 hours in salt spray testing as per DIN EN ISO 9227.

Manufacturers of wind turbines traditionally use a self-sacrificing zinc coat in the range 100 µm upwards for corrosion protection. That means: these components predominantly get hot-dip galvanised. However, there is a highly effective alternative to hot-dip galvanising: zinc flake systems. For over 15 years, Dörken MKS-Systeme GmbH & Co. KG has been developing and making such highly effective microlayer systems for the wind power industry, which on wind turbines are used in particular in the gondola and for rotor blade connection.

Highly effective alternative – double certified

The tried and tested systematic coating structure composing of DELTA®-TONE and DELTA®-SEAL was issued back in August 2012 with Germanischer Lloyd's certificate for use on standard bolts of sizes M24 to M48 for onshore and offshore wind turbines. It was categorised as 'C5-M long' as per DIN EN ISO 12944-6. At the same time, a long-term experiment began to investigate the influence of the offshore climate on different coating systems. For this test coated M24 bolts were moved from stock to positions at 12.5 and 25 metres above sea level on the FINO2 platform in the Baltic Sea and are being exposed there to all prevailing external influences until 2018.



Moving diverse M24 bolt specimens to the FINO platform in the Baltic Sea.

Impressive proof of the efficacy of moving diverse M24 bolt specimens to the FINO platform in the Baltic Sea these systems has also been provided by a study conducted by the Federal Institute of Materials Research and Testing (BAM) together with the German Institute of Civil Engineering (DIBt). The study included exposing the coating systems to an outside



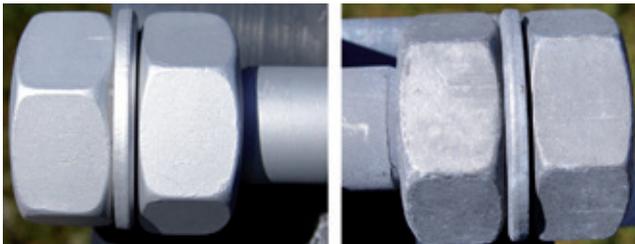
weathering test of 36 months in urban and maritime climates and comparing the corrosion resistance of a Dörken MKS system with that of a hotdip galvanised system. The tests clearly showed that the specimens coated with the Dörken MKS system were in every case, regardless of the manner of its application, at least comparable to the hot-dip galvanised specimens in their resistance to the test climates, if not better: the Dörken MKS coatings showed no signs of failure whatsoever.

As a result of the study, the DIBt and BAM certified corrosivity class 'C5-M medium', which permits use in coastal and offshore areas with a high exposure to salt. For the zinc flakes that includes typical tests in accordance with DIN EN ISO 62701 (condensation test - with a result of 480 h) and DIN EN ISO 9227 (salt spray test - with a result of 1,440 h). By fulfilling corrosivity class C5-M, the zinc flake systems provide an assurance of longevity and functionality, including when used offshore. Costs for downtime and maintenance work are thus greatly

reduced. Creating a custom high-performance corrosion protection system is a complex process that involves the entire value chain. The zinc flake systems from Dörken MKS offer proven solutions in this. For example, Alston Wind has approved the use of components coated with zinc flake systems in its offshore wind turbines. The specification in this case demands corrosion resistance times of over 3,000 hours in salt spray testing as per DIN EN ISO 9227 without any formation of red rust for components used inside the turbine and as long as 1,000 hours of UV resistance, pursuant to DIN EN ISO 11507, for those fitted on the outside. Components that are to be fitted internally require a corrosion resistance time of over 1,000 hours.

We will be happy to discuss the following issues with you

- Defined pre-stressing force without grease
- Simple installation & dismantling
- Application: easy & global
- Low maintenance costs
- The phenomenon of settling behaviour



Set consisting of bolts, washer and two nuts after two years of outside weathering on Sylt: left zinc flake, right hot dip galvanised.

