CCNS: Corrosion Control for Navy Ships

The CCNS project, Corrosion Control for Navy Ships, ended in November 2016. The results show how to improve corrosion and fouling control for Navy ships.

The increase of military requirements combined with the impact of environmental regulations, such as REACH, lead to critical situations characterised by significant risk upon operational availability and running costs for Navy ships in terms of corrosion and surface protection. In addition, there is a requirement to extend repair intervals to 6-10 years in order to reduce maintenance levels and running costs, to maintain ship security and to comply with environmental regulations. The consequences are various and have a serious impact on potential risks, unsuitability and/or suppression of existing technical solutions.

In this context, the project was targeted at considering new approaches and solutions for defining in particular the adapted conditions based maintenance. In order to achieve this, a large study namely Corrosion Control of Navy Ships (CCNS) was undertaken between 2013 and 2016 to establish the critical areas within Corrosion Control Technology.

In detail

CORROSION AND FOULING IN SEAWATER PIPING SYSTEMS

The proper function of seawater piping systems is of great importance for correct operation of any ship. The protection of the constitutive materials was considered taking into account two main characteristics of seawater: presence of solved salts, in particular chlorides which favour corrosion, and aquatic species resulting in biofouling.

The limits and drawbacks of existing technologies for biofilm control (the first stage of biofouling development) were assessed. The most efficient treatment, electrochlorination, was tested with biosensors for online and real time monitoring in seawater pipelines. One sensor, which is now commercialised, has proven to be very sensitive to biofilm development and can be a promising solution for on-board applications. The possibility of using this sensor for cleaning treatment triggering and optimisation was successfully demonstrated.

The efficiency of two emerging biofouling control systems e.g. Ultra Sound (US) and Ultra Violet (UV) was tested in a seawater experimental loops containing mock-up of heat exchangers and compared to natural and electrochlorinated seawater.

From the obtained results, the way of combined systems, for instance electrochlorination with low dosage and UV could offer interesting potentialities, being more tolerant for stainless steels and nickel bases alloys, as well as being more environmental friendly.

CATHODIC PROTECTION OPTIMISATION

Carbon or mild steel is the most common metal for ship's hulls. This steel is very susceptible to corrosion and therefore it needs to be properly protected in the very corrosive marine environment. The combination of protective coatings and CP (Cathodic Protection by sacrificial anodes (SACP) or

by impressed current (ICCP)) is a well-known and effective protection solution. However, in practice on-board ships, various problems may occur: coating failures, bad system design or implementation, failure of reference electrodes, fouling on sacrificial anodes. Furthermore, for navy ships in particular, well performing cathodic protection (CP) systems are even more important: a well-designed and correct working of CP system at the minimal required protection is essential.

The overall objective was to get available a dedicated numerical model for designing CP systems for navy ships. A database including relevant and usable data for modelling of cathodic protection was created.

Related to measurements and data collection on navy ships in operation, this study has highlighted the difficulty to measure on-board currents, especially in the shaft. From the study, it was recommended to have reliable entry data. Such work needs a good knowledge of the ships structure and the material used. Collection and integration of such data into an improved numerical model will help navies of all participating countries to come to optimised and dedicated CP systems for navy ships.

In addition, work has been performed to identify and test new coatings to be applied on propellers. Physical Vapour Deposition (PVD) coatings were found to be an interesting alternative for both improving the reduction in current demand and the corrosion resistance.

IMPROVING PERFORMANCE OF PROTECTIVE COATINGS

The purpose of this work was to develop new, faster testing for atmospheric and immersion exposure conditions that still have relevance to real-life in-service degradation of coatings and corrosion of the underlying structure.

Various accelerated corrosion tests presented rather acceptable correlation to field exposure in marine atmosphere when considering rather aggressive conditions.

Testing of new/emerging paint systems applicable to different zones of the ship (such as hull, water ballast tanks, superstructures, topsides or interiors) highlighted the satisfying performance of a silicone alkyd finish coating for atmospheric conditions (superstructures) while all emerging paints presented a relatively high resistance to corrosion penetration in immersion conditions. Therefore, the work provided also very interesting results in the testing domain.

Who was there

CCNS project was carried out by a consortium composed of Institut de la Corrosion (Project leader, France) DCNS research (France), Centro Sviluppo Materiali (Italy), CNR-ISMAR (Italy), BAE Systems (UK), University of Southampton (UK) and AISH technologies (UK) with contribution from DGA (France), BWA WIWeB and BWB WTD 71 (Germany).

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