Use and misuse of anodic protection in ballast tanks.

Kris De Baere[1,], Raf Meskens, Remke Willemen[1], Helen Verstraelen[1], Geert Potters[1,2]*
[1] Antwerp Maritime Academy, Antwerp, Belgium.
[2] Dept. Bioscience Engineering, University of Antwerp, Antwerp, Belgium.
[*]Corresponding author E-mail : kris.de.baere@hzs.be

For some 140 years, steel is the common construction material for commercial ships. Together with this, relatively stable, substance a persistent enemy popped up: corrosion. Two long-established methods are being used to fight this never sleeping enemy: either through the use of coatings, creating a barrier between the electrolyte and the steel or by way of using sacrificial anodes or impressed current, lowering the potential of the steel structure until it becomes cathodic. This article will focus on the correct use of sacrificial anodes in ballast tanks, since these tanks are the most vulnerable to corrosion, especially on board double hull ships due to increased temperatures, inherent wet/dry situations, omnipresence of seawater, storage compartment for ship's structural elements.

An in-situ survey of >170 ballast tanks on board merchant ships lead to two principal conclusions: First, epoxy coatings in ballast tanks, remain overall in intact condition for approximately 5 years and afterwards degrade with 1.7% surface per year. Secondly, statistical analysis of the database did not show any distinctive advantage of the presence of sacrificial anodes, hence leading to the alarming conclusions that, probably, for many years anodes have been used without any significant impact on corrosion or corrosion rates. We studied this phenomenon further in depth and found that a cathodic protection system will only generate a distinguishable advantage if installed and maintained meticulously. Calculating the total mass of zinc required to lower the potential of the metallic structure sufficiently is rather easy, distributing the anodes correctly throughout the tank to obtain an even and correct potential is already a lot more complicated. Till today, any legal obligation to install sacrificial anodes in ballast tanks, is lacking. Consequently, there are no rules promoting a correct weighing and spreading out of the sacrificial anodes. Very often, the design and installation of the cathodic protection system is done by the vendors of the zinc or aluminum anodes. Their and the ship's interest are not always the same.

A simulation package, CPMaster, developed by Elsyca, Belgium allows the visualization of the polarization of a metallic structure induced by sacrificial anodes or impressed current. By way of example one of the ballast tanks of the Flanders Harmony, a 28-year-old LNG carrier, was modelled and the results were compared with the outcome of a detailed tank inspection held during dry-dock in Bahrain 2013. The resemblance between the in-situ observation and the simulation model was satisfying. Although the tank was in a splendid condition, taking into account the age of the ship, there was still plenty of room for improvement. The cathodic protection system was oversized and the anodes were not distributed in a uniform way, the sacrificial anodes might even be responsible for the massive quantity of blisters in the tank.

Finally, we conclude that cathodic protection using sacrificial anodes is a useful technique only if the system is well proportioned, installed, maintained and evolves together with and in function of the condition of the tank. If one is not prepared to follow up the system in a proper way it is better to abandon cathodic protection all together and invest the money gained in an improved coating system.