Salt Spray tests & Corrosion resistance

I – Introduction:

Salt spray tests are among the oldest tests used for a summary evaluation of the corrosion resistance of various materals, particularly coated materials . Though subject to specific and well defined procedures, the most widely used standard ASTM B117 emphasises the significant limitations of these types of tests which involve over-aggressive chlorine environments. Most noteworthy remarks :

- the lack of good correlation between the results of spray tests and the corrosion resistance in other media
- their reproductibility, highly dependent on the type of samples
- the lack of consideration for the corrosion phenomena linked to the surface condition of the samples
- the sheer “atmospheric”nature of these tests , making them thus non representative of corrosion in submerged conditions

II – Stainless Steels & Salt Spray tests:

The salt spray tests are not well suited for application to stainless steels, only to provide a rough ranking of various grades vis-à-vis their resistance to pitting corrosion. This directly stems from the hyper- chlorinated atmospheres of the salt spray tests which exacerbate the pitting corrosion which can occur on stainless steels in the presence of halide ions, such as chlorides. As discussed in more detail in our technical note on “Corrosion resistance of stainless steels “, chloride ions can be adsorbed on small surface defects and damage the integrity of the

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protective surface “passive layer“ insuring the “stainless“ behavior of the stainless steels.

From the standpoint of pitting corrosion resistance, it is more relevant to use as indicator the “Pitting Resistance Equivalent Number or PREN in short”. This indicator takes into consideration the Chromium, Molybdenum, Tungsten and Nitrogen contents in the stainless steel grades.

Nonetheless, the choice of an adequate stainless steel grade for a well defined application must involve an array of considerations substantially beyond the limited information of a rough test centered on the pitting corrosion resistance in highly chlorinated environments.

Indeed, due consideration must be given to the other types of corrosion (such as uniform corrosion, stress corrosion, crevice corrosion) and their relationship with the integrity of the protective passive layer. As an example, the PREN index does account for the protective effect of Molybdenum vis-à-vis the detrimental adsorption of chloride ions but it does not take into consideration the Nickel content which is the key alloying element for the resistance to corrosion in many corrosive media encountered in numerous industrial and domestic applications!

Numerous modern electrochemical studies have led to the definition of much more precise criteria such as depassivation pH, redox potential, etc…The electrochemical considerations allow to truly understand the complex interactions occuring at the surface of stainless steels in specific corrosive media. This body of knowledge mkes it now possible to :

- give rational and scientifically sound basis to Tables of corrosion resistance in various media, with also the support of proven behavior in service.
- Explain the role of various alloying elements of the stainless grades vis-à-vis the corrosion resistance in specific media.

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In our detailed summary note on “Corrosion of resistance and selection of stainless steels” already mentioned we provide a comprehensive overview of these technical matters and ensuing recommendations for proper stainless steel grade selection vis-à-vis their usage in various corrosive environments.

III – Coated steels and stainless steels in salt spray tests:

Salt spray tests are sometimes used to compare coated steels (such as galvanized, organic coated) and stainless steels. Such an approach is fraught with dangerous interpretations and is based on a wrong understanding of the mechanisms and phenomena in play.

In fact, as illustrated in the graphs hereafter in Exhibit I:

- Coated steels may exhibit a fairly long initial resistance to corrosion, up to 500 hours of guarantee. However, this good apparent resistance is deceiving since it ends sooner or later in catastrophic fashion once the coating is penetrated or disappears altogether.
- In sharp contrast, stainless steels can eventually show minor signs of localized corrosion, such as pitting, but they are « stainless in depth » : thus their resistance over time is assured, all the more so if their alloying content is optimized and minor surface cleaning is performed at the onset of use and periodically.

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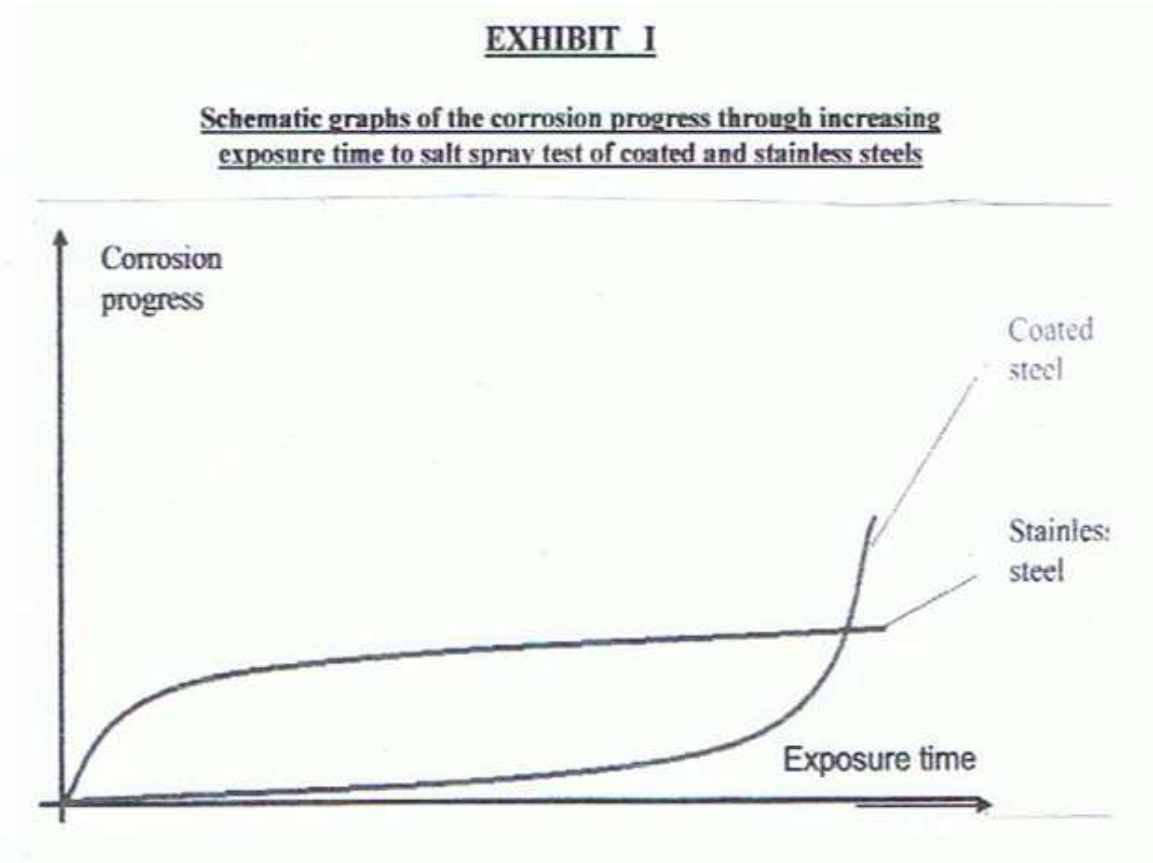
EXHIBIT I

Schematic graphs of the corrosion progress through increasing exposure time to salt spray test of coated and stainless steels



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