Editorial

Atmospheric Corrosion

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The scope of this special issue is to gather the most varied research work performed on atmospheric corrosion.

According to the purpose of each project, different methodologies have been followed on diverse environments along the history. However, the nowadays generalised increase in the world pollutants contamination emphasises the need on working on transboundary research objectives. Uneven human interests determine the diversity of subjects where the money and effort inversions suggest producing the best results. In spite of that, cooperative projects have shown at present to have been the most promising systematic inversion in terms of new findings, sharing experience, time saving, and light shedding on unexpected phenomena and materials involved. They also resulted in different type of economical benefit to the respective societies in terms of personnel development, avoiding material losses, and producing direct profit incomes.

The paper “*Effects of air pollution on materials and cultural heritage: ICP materials celebrates 25 years of research*” gives an overview of all results from the International Cooperative Programme on effects on Materials including historic and cultural monuments (ICP Materials), which was launched in 1985. Since then, about twenty different materials have been exposed repeatedly in a network of test sites consisting of more than twenty sites with an extensive environmental characterisation and more than sixty official

reports have been issued. Recent results on trends in corrosion, soiling, and pollution show that corrosion of carbon steel, zinc and limestone are today substantially lower than 25 years ago but while corrosion of carbon steel has decreased until today, corrosion of zinc, and limestone have remained more or less constant since the turn of the century. Unique data are given on measured HNO₃ concentrations from 2002-2003, 2005-2006, and 2008-2009 and the relative average decrease was about the same from 2002-2003 to 2005-2006 as it was from 2005-2006 to 2008-2009.

It reveals the many ways in which the research work of the European community countries produced not only the benefit of long term pollutants assessment and trends but also triggered efficient policies driving to reduce the most aggressive pollutant, the SO₂, in the atmosphere content. In 1979, the member states of the United Nations Economic Commission for Europe (UNECE) adopted the convention on long-range transboundary air pollution as a response to acid rain, brought on by contamination of the air, killing forests and lakes even in remote places far from industrial facilities. Already in 1980, Vladimir Kucera was approached by UNECE with a request to provide a short summary of the state of knowledge concerning the effects of sulphur compounds on materials. At present, the most preferable way to use the ICP data include, the economic evaluation of the “stock at risk” studies and discussion on the “use of results for policy purposes”.

The paper “*Looking back on contributions in the field of atmospheric corrosion offered by the MICAT Ibero-American testing network*” summarises the joint experience of two European and twelve American countries analysing together the atmospheric corrosion of the four main base metals of structural alloys. The most extreme climates, from equator to 3 test sites in Antarctica, in natural and anthropogenic polluted atmospheres were the outdoor experience field for 6-year studies on metallic corrosion. The most advanced international techniques available (SEM, EDS, electrochemical polarisation, X-ray Diffraction, etc.) were applied to deepen the characterisation of thousands of test samples exposed in the 75 test stations network.

No less important was the objective of promoting international cooperation. The building of bridges of understanding and the establishing of Ibero-American research groups have been considered achievements of deep and lasting significance. It was taken advantage of existing synergies and above all sharing knowledge and providing training for other countries less developed in the study of atmospheric corrosion. This research project was the first time in Ibero-America that 14 countries had worked together towards a common goal in the field of corrosion.

Also, the just emergent clean technologies for anticorrosive protection were tested in the MICAT laboratories and outdoor test network in contrast with previous heavily contaminant protective materials. This also gave rise to another enormous multiplier effect in personnel qualification and strengthened the contact amongst the university and the production. Such entail was remarkably enlarged and appreciated. Not only professionals from universities and scientific institutions but also from industries gave their enthusiastic support to join experience and funds to those provided by the scientific sector in the Ibero-American region.

In that context, the paper “*Atmospheric corrosion of painted galvanized and 55% Al-Zn steel sheets. results of 12 years of exposure*”, reflects the local technical need for basic science support to the manufacturing. The good correlation between visual inspection and the impedance electrochemical tests performed allowed explaining troubles observed in service and contributed to improve production quality. The laboratory and field normalized tests involved in this study were useful to understand the behavior of duplex systems exposed to natural weathering at La Plata test site, in Buenos Aires, Argentina. An almost constant corrosion rate of bare zinc and zinc-aluminum layers acting as galvanic coating of steel sheets was found during the 12-years exposure to the natural atmosphere. Both materials cathodically protected the steel substratum for 12 years. Respecting the comparative electrochemical study among the three painting systems applied on both S/Z or S/ZA sheets, different R_cC_c and R_tC_dl evolutions were obtained depending mainly on the paint. The best protective performance offered by the Polyurethane-based painting system was explained in principle taking into account its better barrier properties. The experimental results coming from the alkyd- and epoxy-based painting systems were not satisfactory due to their low

resistance to the atmospheric conditions existing at La Plata station.

Also the paper “*Six-year evaluation of thermal sprayed coating Zn/Al in tropical marine environments*” reveals the impulse given at the Zulia University to the technical formation of specialists on the bases of applied research. Many of the cited bibliographic references are thesis work of different degree of students of that University Corrosion Centre. The main objective of this research was to evaluate the performance of thermosprayed coatings of zinc and aluminum (double layer) after 6 years of exposure, with and without the use of sealant (wash primer) in tropical marine environments of very high aggressiveness: La Voz (Cabo San Román/Falcón State) and Cruce del Lago de Maracaibo (Zulia State), in Venezuela. Carbon steel coupons were Zn/Al sprayed by flame process. The coupons were characterized by means of initial weight, thickness, metallographic, coating adherence, and roughness, being evaluated monthly by visual inspection during six years. After removal, the coupons were evaluated by microscopic analysis to determine the morphology of attack, microstructure, penetration of contaminants, composition, and morphology of corrosion products. The results showed that after six years, the double-layer system represents an excellent choice for corrosion protection of steel by combining the galvanic protection of zinc with the erosion resistance of aluminum. However, due to the erosion-corrosion effect, a sealant such as wash primer can be used in order to extend its service life.

In the paper “*Some clarifications regarding literature on atmospheric corrosion of weathering steels*”, extensive research work has thrown light on the requisites for a protective rust layer to form on weathering steels (WS) in the atmosphere, one of the most important being the existence of wet/dry cycling. However, the abundant literature on WS behaviour in different atmospheres can sometimes be confusing and lacks clear criteria regarding certain aspects that are addressed in the present paper: What corrosion models best fit the obtained data? How long does it take for the rust layer to stabilize? What is the morphology and structure of the protective rust layer? What is an acceptable corrosion rate for unpainted WS? What are the guideline environmental conditions, time of wetness (TOW), SO₂, and Cl⁻ concentration for unpainted WS? The paper makes a review of the bibliography on this issue.

The same sophisticate instrumental techniques, usually applied to push beyond the present limits the scientific knowledge, may also be used by the industry to develop new and better products to improve our every-day-live quality. The long lasting research work on the most important construction materials impels the knowledge and development to a possible better built world.

Important equipment financed with official funds for scientific organisations are generally great national inventions which might be faster amortized providing very rentable solutions to unaffordable technical problems of other institutions or industries.

The research working plan for Ph.D. thesis, projects financed by the Official Scientific System, and so forth, should not be limited to basic or theoretical solutions but

training of young researchers must also involve the capability to solve real every-day problems faced by manufacturers.

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