Multiphysics Model Of Atmospheric Corrosion And Fertilizer Effect On Green Wall Supporting Structure

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Abstract

The new trend opened worldwide with the Green Deal politics is enhancing topics such as sustainability and Natural Based Solutions to be adopted in cities for climate control and inhabitants' wellbeing. Following this topic, Green Walls offer various benefits, including improved air quality, temperature regulation, and biodiversity. Thus, this innovative technology has been applied in different countries during recent years. With the aim of creating new technologies and applications related to the Steel Industry sector, Rina-CSM S.p.A. developed for the European project GREENVESTS RFCS a simulation model using Comsol Multiphysics, in order to study the corrosion effects on the Geen Walls, considering the contemporary presence of chemicals (fertilizers), water (from the irrigation system) and atmospheric pollutants and conditions, and their potential aggressive effect on different materials that might be used for the Green Wall metal supporting structures (e.g. zinc-coated steel, stainless-steel, weathering steel).

As the considered environment can be potentially very aggressive, the model represents a design support tool to identify the most corrosion resistant metal structure.

The model establishes a relationship between the physical laws and chemical reactions that govern the electrode process. The theory of secondary current distribution was used combined with Tafel's law. Moreover, for the modelled electrochemical process it has been considered a perfect mixing condition, thus the concentration of excess species in solution has been considered negligible. In addition, considering atmospheric corrosion, the losses caused by electrodes' kinetics appear non-negligible compared to ohmic losses. Also, Electrochemical Tests have been carried out for each investigated structure material, in order to define the polarization curves and to extrapolate at least three polarization parameters, essentials to set up the corrosion simulation model.

With this work, it was possible to combine laboratory estimated properties and corrosion simulations both related to a new innovative and sustainable technology.

After characterizing the material and electrolyte by varying the aqueous film thickness, the model can then be used to evaluate:

The Electrolyte and electrode potential

The Corrosion Current Density

Keywords:

Green Wall Technology, Living Walls, Atmospheric Corrosion, Electrochemical Corrosion, Fertilizers, Numerical simulation, Zinc-Coated Steel, Stainless Steel, Weathering Steel, Electrochemical, Urban Greening, Sustainable Architecture

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Figures used in the abstract

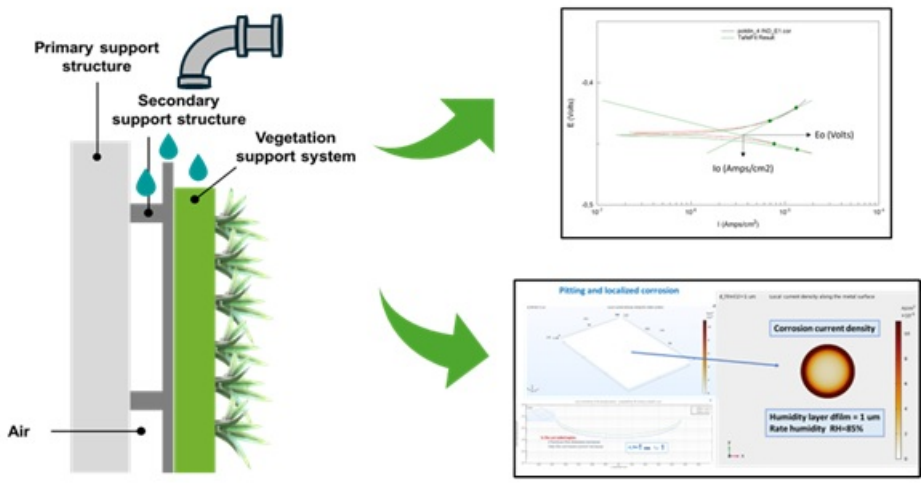

Figure 1 : Green Wall Technology: Urban Greening & Sustainable Architecture