

Chemical study of the influence of the marine environment on historical buildings

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The University of the Basque Country's (UPV/EHU) IBeA research group has studied by means of various analytical tools the influence that may be exerted by various marine and urban-industrial atmospheres on the state of conservation of three buildings located in different places . To do this, they studied the chemical reactions that take place in different construction materials. All this could help to design possible strategies for new restoration processes of buildings close to the sea.

The marine aerosol is produced by the interaction of the wind and the waves. It is a suspension of inorganic salts and organic matter in minute particles that is transported by the air and with the rain. These particles present in the marine aerosol may undergo different [chemical reactions](#) in the atmosphere and they can be deposited on construction materials along with other particles present in urban-industrial atmospheres coming from anthropogenic sources (road traffic, industry, etc.). The interactions taking place between all these compounds and the construction materials may encourage different types of pathologies in these buildings: material loss, formation of salts, cracks, fissures, crust formation, etc.

The researcher Héctor Morillas in the Department of Analytical Chemistry in the UPV/EHU's Faculty of Science and Technology has studied the deterioration processes that various construction materials (sandstone, limestone, plaster, bricks, cement-based material, etc.) may undergo over the course of time in three buildings close to the sea: the Igueldo Lighthouse (Donostia-San Sebastian), which is directly exposed

to the sea and is not far from an urban-industrial environment; newly-built houses located in Berango, a place some distance from the sea and in an urban-industrial environment; and at the Galea Fort (Getxo), which is exposed to the direct action of the sea and the urban-industrial environment. All these buildings were built using different construction materials. What is more, the type of environment influences the type of aerosol composition and the type of chemical reactions that take place as a result.

Combination of analytical tools and simulations of chemical reactions

In the research the pathologies found in these buildings were assessed by developing a new analytical methodology based on the combination of various [analytical tools](#) (mainly spectroscopic techniques). The methodologies applied in each case in the study help to obtain the necessary information (in terms of the elements and molecules) about the original composition and the products resulting from the deterioration of the different building materials analysed. "The results obtained offer a very specific, concise idea of the state of conservation of the materials studied, thanks to the characterisation of their respective pathologies," explained Morillas.

Having obtained data on the original and current composition at different points on each building, simulations of chemical reactions were used by means of thermodynamic models (pieces of thermodynamic software) to explain the deterioration mechanisms proposed in accordance with the results obtained experimentally.

The knowledge acquired in this PhD thesis has helped "to understand the deterioration processes from the perspective of [analytical chemistry](#) that the different [construction materials](#) may sustain in locations close to the

coast or otherwise owing to the influence of the different marine environments," explained the researcher. This PhD thesis may also help to design possible strategies in the new restoration processes of buildings close to the sea. "That way, in a future building restoration process the right information will be available to do the restoration correctly, and to opt for using certain products or others depending on the pathologies that have formed on them," he concluded. This research work has also resulted in a large number of scientific publications in various prestigious journals.

More information: Héctor Morillas et al. The role of marine aerosol in the formation of (double) sulfate/nitrate salts in plasters, *Microchemical Journal* (2015). [DOI: 10.1016/j.microc.2015.06.004](https://doi.org/10.1016/j.microc.2015.06.004)

Héctor Morillas et al. The influence of rainwater composition on the conservation state of cementitious building materials, *Science of The Total Environment* (2016). [DOI: 10.1016/j.scitotenv.2015.10.041](https://doi.org/10.1016/j.scitotenv.2015.10.041)

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