

1. Research activity

The aim of my research is the development of environmental friendly methodologies, based on phytochemical compounds, for the removal of biodeteriogens from stones' surfaces, in particular, from cultural heritage artifacts.

The Biodeterioration⁽⁹⁾ is an undesirable phenomena caused by the growth of various microorganisms forming a Sub-Aerial Biofilm (SAB)⁽⁶⁾ on the stones' surface causing chemical, esthetic and mechanical damages⁽⁸⁾. Recent studies have shown the biocidal efficacy of phytochemical compounds to eliminate and control the growth of biodeteriogens. Among these are the essential oils: liquid, volatile and aromatic compounds extracted from plant materials, whose antibiotic properties are known since antiquity⁽¹⁻²⁾. The biocidal properties of essential oils and other restoration products were compared⁽⁷⁻⁸⁾ and it has been demonstrated that the former have: lower toxicity, broad spectrum fungicidal and bactericidal action, long term action and most of all they are biodegradable. Furthermore, encouraging experimental results have been obtained so far, underlining the potential of phytochemical products to control and eliminate the SAB from stone materials, with particular care for the cultural heritage artifacts exposed to the open environment⁽³⁻⁴⁻⁷⁻⁸⁾.

In view of the above, essential oils are particularly suitable for this research that aims to bring the world of Restoration closer to the concept of 'Green Chemistry'⁽⁵⁾.

To reach the goal, several research activities are planned. The first part of the project will be dedicated to search bibliographic information about: the most used local stone materials in cultural heritage, the phytochemical products having biocides proprieties and the negative effects of biodeterioration on these materials. After the identification of the most significant

lithotypes, stone samples will be acquired. The samples will be chemically, mineralogically and physically characterized and will be submitted to aging process. After this preliminary procedures, the biological attack will be reproduced in laboratory on samples' surfaces, using selected microbial cultures. The essential oils and their active components having the best biocidal effectiveness, according to the bibliographic results, will be made to interact with the colonized samples, in order to quantify their biocidal contribution.

The focus of the research will be the realization of formulations based on innovative dispersive systems (emulsions, microemulsions, nanosomes etc.), containing the active principles or the combinations of active principles having the best biocidal effectiveness. This formulas will be applied on the samples previously prepared for the experimentation. A methodological approach will be conceived to evaluate the biocidal action of the systems, using consolidated methods (colorimetry, stratigraphy, chlorophyll fluorescence, extracellular polymeric substances quantification etc).

After evaluating the effectiveness of formulas applied on the lithotypes in view of their intrinsic properties, these ones will be applied on stone materials exposed to an open environment. At least three sites of cultural-artistic interest will be chosen, and the experimentation will last for one year.

References

- 1) Bakkali F. et al, Food Chem Toxicol (2008), p 446-445
- 2) Cavanagh H.M.A. et al., Phytoter.Res. (2002), p 301-308
- 3) Mironescu M. et al, AUCFT (2010), p 41-46
- 4) Mironescu M. et al, JAP&T (2009), p 361-365
- 5) Rakotonirainy M. S. et al ,Int. Biodeterior. Biodegradation (2005), p 141-147
- 6) Sanmartin P. et al, Microbiol Ecol (2016), p 1-17
- 7) Stupar M. et al., S. Afr. J. of Bot. (2014), p 118-124
- 8) Stupar M. et al, Indoor Built Environ. (2014), p 584-593
- 9) Vázquez-Nion D et al, Sci. Total Environ. (2017), p 44-54

2. Research products

a) Publications (ISI journals)

- M.P. Sammartino, C. Genova, S. Ronca, G. Cau, G. Visco, *A cheap protocol for colour measure and for diagnostic in planning a cultural heritage restoration. Case study: main façade of Palazzo Governi (Cagliari, Sardinia, Italy)*, Environmental Science and Pollution Research (2017), 24: 13979-13989, DOI 10.1007/s11356-016-8160-5

b) Abstracts

- C. Genova, G. Visco, M.P. Sammartino, G. Cau, *Physico-chemical, Colorimetric and Mineralogical Characterization of a Plaster Sample Coming from "Palazzo Governi", Cagliari (Italy)*, Proceedings Book: CMA4CH Employ of Multivariate Analysis and Chemometrics in Cultural Heritage and Environment Fields, V ed., Roma, 14-17 Dec 2014, G. Visco (eds.), Marcovalerio Edizioni (2014), ISBN 88-7547-405-2
- C. Genova, G. Guida, G. Cau, R. Reale, G. Visco, M.P. Sammartino, *Physical-chemical Characterization of Black Crusts Coming from Cagliari Town Hall, "Palazzo Bacaredda", Cagliari (Italy)*, Proceedings Book: CMA4CH Straightforward approach in Cultural Heritage and Environment studies – Multivariate Analysis and Chemometry, VI ed., Roma, 18-20 Dec 2016, G. Visco (eds.), Marcovalerio Edizioni (2016), ISBN 9-788875-474416