Projekttitel:
New ecological and sustainable solution for protecting architectural metals using an ecologically friendly biological treatment

Projektleitung:
Prof. Edith JOSEPH
Laboratory of technologies for Heritage materials (LATHEMA)
University of Neuchâtel
Avenue de bellevaux, 51
CH- 2000 Neuchâtel
Tel. +41 32 718 22 35
E-Mail: edith.joseph@unine.ch

Projektpartner:
Ra&D department, Haute Ecole Arc Conservation-restauration (HE-Arc CR), HES-SO.
Laboratory of technologies for Heritage materials, University of Neuchâtel (LATHEMA)

Projekt-Summary / Abstract:
The project aimed to provide a new ecological and sustainable solution for protecting architectural metals using an ecologically friendly biological treatment. The method is based on the development of an aesthetical and protective biopatina that can be applied for preserving built heritage, in particular outdoor metal monuments and historical landmarks.
Outdoor metal surfaces encounter irreversible changes in their original appearance and structure due to electrochemical processes, chemical reactions with pollutants, and the physical phenomenon of deposit accumulation. The corrosion patina formed is considered aesthetically valuable and part of the life history of the monuments. Most often, the corrosion products present are, however, unstable and can be leached out. Constant efforts are therefore devoted to stabilize them and overcome their continuous damage through conservation-restoration interventions.
So far, the methods used for protecting metal surfaces create an artificial barrier against aggressive environments without considering the difference in terms of patina composition and stability. Most frequently, organic coatings are employed, such as microcrystalline waxes, acrylic resins and corrosion inhibitors (i.e. benzotriazole for copper alloys). However, these treatments are unsatisfactory in terms of efficiency and durability. In addition, inhibitors are toxic and pose potential threats to human health and to the environment.
Taking advantage of unique properties of metal-resistant microbes, existing unstable corrosion products could be converted into an insoluble and stable *biopatina* that provides the treated surfaces with long-term protection and no aesthetical alteration. The project aimed to extend this process developed on copper (since 2006) to iron, zinc and aluminum alloys that are commonly found as architectural parts.
Regarding copper alloys, after 3 years treatment, copper oxalates are still present. The biopassivation represents therefore an excellent additive to organic coatings (shell-life of 2 years) to extend the duration of the preservation of outdoor bronze sculptures. The wax used as a top layer could be eventually reapplied.
Aside from the application on copper alloys, the test results are promising for zinc and iron alloys. Indeed, In the case of self-weathering steel, the biopatina treatment might be an interesting alternative to currently conservation-restoration and maintenance practices for architectural parts in outdoor conditions. Tests showed that the biopatina treatment leads to less color modification of the surface then the application of a traditional wax coating after cleaning. The desired “rust effect” of the self-weathering steel is preserved by the

biopassivation treatment. In terms of protectiveness, the results are also very promising. Indeed after 6-month exposure of treated samples previously cleaned by soft micro-airblasting, more stable and less soluble compounds were only detected on the biopatina-treated samples and not on the wax-coated samples (where mainly lepidocrocite was detected). While for biopatina-treated samples that were not cleaned prior to treatment, no particular difference in comparison to the untreated samples was noticed. For this reason an application of biopatina is recommended after a preliminary cleaning in the case of interventions on selfweathering steel.

In the case of both bare and naturally-corroded zinc surfaces, biopatina induces the formation of a more homogenous and less darker patina after 6-month exposure in comparison to untreated samples. Stable species like zinc oxalates are still detected after exposure together with hydrozincite, a stable corrosion product.

As biopatina shows good compatibility with both iron and zinc alloys, an application to degraded galvanized iron could be an appropriate way to extend the life-time of these type of surfaces. Tests that were also carried out on ancient damaged galvanized outdoor elements confirmrf the promising results obtained on the laboratory samples.