EUREKA PROJECT E!316 - EUROCARE COPAL

1. General description

Project	E! 316 - EUROCARE COPAL	**Status**	Finished - 18-JAN-2001
Title	**Technologies For Conservation Of Copper Alloy Monuments**		
Class	Sub-Umbrella	**Technological area**	Environment
Start date	01-JUN-1989	**End date**	01-JAN-2001
Duration	139 months	**Total cost**	1 Meuro
Partner sought	No		
Summary	Investigation Of Corrosion Processes Of Different Copper Alloys According To Certain Environments, And Develop Special Conservation Therapies. (Outdoor Bronze Monuments Selected).		

Budget and duration

Phase	Budget(Meuro)	Duration (Months)
Total	**1**	**139**

Member contribution

Member	Contribution	Position	Since
Germany	**15.00%**	**Notified Finished**	**18-JAN-2001**
Austria	45.00%	Notified Finished	18-JAN-2001
Czech Republic	5.00%	Notified Finished	18-JAN-2001
Hungary	5.00%	Notified Finished	18-JAN-2001
Italy	5.00%	Notified Finished	18-JAN-2001
Portugal	5.00%	Notified Finished	18-JAN-2001
Russian Federation	15.00%	Notified Finished	18-JAN-2001
Sweden	5.00%	Notified Finished	18-JAN-2001

Participants

Company	Country	Type	Role
Bayerisches Landesamt Fuer Denkmalpflege (Muenchen)	**Germany**	**Governm./Nat. Admin.**	**Main**
Svuom Praha A.S.	Czech Republic	Research Institute	Partner
Goeteborg University/Department Of Inorganic Chemistry	Sweden	University	Partner
Hochschule Fuer Angewandte Kunst In Wien Institut Fuer Silikatchemie Und Archaeometrie (Isca)	Austria	University	Partner
Laboratorio Nacional De Engenharia Civil	Portugal	Research Institute	Partner
Forschungszentrum Karlsruhe - Projekttraeger Produktion Und Fertigungstechnolgien	Germany	Research Institute	Partner

Participants

Company	Country	Type	Role
Istituto Centrale Per Il Restauro	Italy	Governm./Nat. Admin.	Partner
Enea - C. R. E. Casaccia Ente Per Le Nuove Tecnologie, L'Energia, L'Ambiente	Italy	Research Institute	Partner
Russian Scientific Research Institute Of Restoration	Russian Federation	Research Institute	Partner
Bay Zoltan Foundation/Materials Science & Technology Inst.	Hungary	Research Institute	Partner
Budapest Galeria	Hungary	Large company	Partner

2. Project outline

Project description

Metal works of art are impaired in their outward appearance by the influence of corrosive substances. The damage is greatest - just as in the case of the problems connected with stone corrosion - to objects in the open air. The damage caused to the objects which, in a very simplified manner, is often attributed to the high level of SO2, can in extreme cases lead to the destruction and subsequent loss of the work of art. The aim of COPAL is to investigate corrosion processes of different copper alloys according to certain environments, and to develop special conservation therapies. Practically every country partner selects one representative outdoor bronze monument for investigation.
The criteria for selection are:
- cultural reference
- no practical conservation work in combination with the selected monument within the next 5 years
- existence of as many data as possible concerning aspects such as casting technique, materials used, techniques of construction, patination, conservation therapies already carried out in the past, etc.
- selection should be within the range of a certain chemical composition:
Pb .. 0-14%
Zn .. 0-16%
Sn .. 0-12%
Mi .. 0-2%
Fe, As, Sb up to 0.6%
It is to be noted that a certain non-homogeneity of chemical composition appears within one monument and has to be taken into account as well. After sampling in-situ - using a special sampling device - the chemical composition is analysed and the different metallographic structures of the monument samples are investigated. According to these results, sample plates are recast, concerning only chemical compositions of the alloys, but also a network of possible metallographic structures that occur within the selected monuments. The sample plates are defined in sizes of 20 x 40 mm, 2 mm thickness.
Two different kinds of surface treatment will be performed:
- polished
- sandblasted
both under exactly defined conditions.
These sample plates are distributed among the partner institutions, each only taking over those sample plates that fit the chemical compositions and metallographic structures of the one selected monument. The plates are to be exposed in-situ in the nearest possible neighbourhood of the monument.
The aim of this exposition is:
- to build up natural patinas according to the special environment
- to investigate the corrosion processes according to the special environment. Environmental data should be provided through measurements.
Some part of the exposed plates will be used after some years as naturally corroded plates for testing and

developing special conservation treatments in a further project, thus considering relevantly corroded bronze surfaces and not blank ones. In addition, to exposition experiments in-situ, artificial weathering is carried out to study the corrosion processes in-vitro under defined conditions including synergetic effects of air pollutants. While in the neighbourhood of the selected monuments only those sample plates are exposed that show relevance to the monuments concerning chemical composition and metallographic structures, the artificial weathering will be carried out for all kinds of sample plates under defined conditions. Some selected representative conservation products are going to be tested on the blank alloy surfaces (polished and sandblasted) with the help of artificial weathering:
- Polyacryl
- Polymethane
- Polyester
- Epoxide resin varnish
- combination of hard paraffin with microcrystalline wax
- combination of epoxides with polyethylene waxes.
The results of these investigations should deliver basic information before carrying out these tests that will take place in a further step using the naturally corroded sample plates. It has to include treatment of already corroded surfaces bearing naturally built up patina layers that - partially - have to be taken care of during conservation of the monument.
The techniques being used are:
- specially developed sampling technique for bronze monuments
- recasting of bronze alloys using a specially developed device
- exposition of sample plates according to already existing standards
- artificial weathering using a specially developed device concerning synergetic effects of air pollutants
- chemical analysis using AAS (atomic absorption spectrophotometry)
- SEM-EDS (scanning electron microscopy - energy dispersive system)
- patina layer studies using FT-TR (Fourrier transformed infrared spectrophotometry)
- patina layer studies using XRD (X-ray diffraction)
- patina layer studies using Ion Chronometography.
The selected monuments are:
* AUSTRIA: Monument of Emperor Joseph II (1795-1807) in Vienna
* GERMANY: Monument of King Maximilian II in Munich
* SWEDEN: monument of King Gustav II Adolf (1854) in Goeteborg.

Technological development envisaged

1. Development of a special sampling device with the aim of sampling the minimum amount necessary for investigations without damaging the monument.
2. Building up the base of understanding the relevant corrosion processes taking place at the selected monuments and evaluating the efficacy of tested conservation products to develop new conservation products and therapies for

outdoor bronze monuments.

Markets application and exploitation

The application will be carried out in the field of practical conservation of monuments.
The initial exploitation will be done in every country by the Local Authority being in charge of carrying out the practical conservation of the selected monuments.

Project codes

BSI

UF/UR	alloys
ZO	history
ZV/ZY	culture
ZW	arts

NACE

7310	Research and experimental development on natural sciences and engineering

3. Main participant

Company	**Bayerisches Landesamt Fuer Denkmalpflege (Muenchen)** Hofgraben, 4 80539 Muenchen Germany Tel +49 89 2114-0 Fax +49 89 2114 300
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Organisation type	Governm./Nat. Admin.
Participant role	Main

Contribution to project

Share: 140,000 DM

Expertise

Dr. Rolf Snethlage, Head of the Laboratory, carries out both research and practical conservation work and has been advising on conservation for many years. The following work will be carried out by the Laboratory: - development of special sampling device - FT-IR investigations of patina layers - ion chromographic investigations of patina layers.

4. Partner

Company	**Svuom Praha A.S.** (Praha 7) U Mestanskeho Pivovaru, 934/4 170 04 Prague Czech Republic Tel +420 2 627 1348 Fax +420 2 627 1769 www.svuom.cz
Contact	**Mrs. Dagmar Knotkova** Project Manager Tel Fax
Organisation type	Research Institute
Participant role	Partner

Contribution to project

Expertise

Former research institute (G. V. AKIMOV - STATE RESEARCH INSTITUTE FOR THE PROTECTION OF MATERIALS) which was privatised and is now an independent private organisation carrying out the following activities: * research * consulting * small production.

4. Partner

Company

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Contact

Prof. Oliver Lindqvist
Head Of Laboratory

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Organisation type University
Participant role Partner

Contribution to project

Share: 300,000 Swedish Kroner

Expertise

Professor Dr. Oliver Lundqvist is experienced in the field of corrosion sciences, research work, considering the influence of air pollutants and their synergetic effects on the corrosion of metals over many years. The following work will be carried out by the Department: - artificial weathering of all sample plates under defined conditions - XRD investigation of patina layers. Exposition of the relevant sample plates in situ will be carried out by each partner to defined exposition conditions.

4. Partner

Company

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Eurocare Chairman

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Organisation type University
Participant role Partner

Contribution to project

Share: 1,600,000 Austrian Schillings.

Expertise

Both Dr. Alfred Vendl and Professor Dr. Bernard Pichler, educated in the field of metallurgy, have been working on the metal alloys field for 20 years. The following work will be carried out by the Institute: - metallographic investigations of all samples - SEM-EDS investigations of all samples - AAS chemical analyses of samples recasting of all sample plates, concerning chemical composition and metallographic structure of monument samples - surface treatment of sample plates.

4. Partner

Company **Laboratorio Nacional De Engenharia Civil**
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Organisation type Research Institute
Participant role Partner

Contribution to project

Expertise

4. Partner

Company	**Forschungszentrum Karlsruhe - Projekttraeger Produktion Und Fertigungstechnolgien** Weberstrasse, 5 76021 Karlsruhe Germany Tel +49 7247 82-0 Fax +49 7247 825 456
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Organisation type	Research Institute
Participant role	Partner

Contribution to project

Expertise

4. Partner

Company	**Istituto Centrale Per Il Restauro** Piazza San Francesco Di Paola, 9 00 184 Roma Italy Tel +39 06 48 869 61 Fax +39 06 48 15 704
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Organisation type	Governm./Nat. Admin.
Participant role	Partner

Contribution to project

Expertise

The ICR is supported both by ENEA and CONTRAVES ITALIANA.

4. Partner

Company

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Organisation type Research Institute
Participant role Partner

Contribution to project

Expertise

4. Partner

Company

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Organisation type Research Institute
Participant role Partner

Contribution to project

Expertise

4. Partner

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Organisation type Research Institute
Participant role Partner

Contribution to project

Physical/chemical/compositional investigation of bronze sculptures to be restored. For physical status endoscopy/ ultrasound will be used. Recommendations and conversation work will follow optimized instructions with artwork experts

Expertise

Co-workers of the BZI MS and E have decade-long practice in metallurgy, including copper-based alloys. The Institute is well equipped with equipment for metallurgical investigations. X-ray diffraction methods for phase identification and all kinds of microscopy tools are available, i.e. optical, transmission and scanning electron, and scanning tunnel microscopes are at hand. For chemical microanalysis, electron microprobe and ion accelerator-based techniques (Particle Induced X-ray analysis, PIXE) are available. Electrochemical

equipment for corrosion studies will also be used.

4. Partner

Company	**Budapest Galeria** Szabadsajto Utca, 5 1056 Budapest Hungary Tel +36 1 111 7321 Fax +36 1 117 1001
Contact	**Dr. Andras Szilagyi** Head Of Department Tel +36 1 117 1321 Fax +36 1 117 1001
Organisation type	Large company
Participant role	Partner

Contribution to project

Investigator manager, coordinator/supervisor of project responsible for all documentation. Its experts will analyse the results, organise and supervise the whole development process and investigation/restoration of the architecture.

Expertise

Municipal institution of Budapest concerned with tasks in the fine arts, e.g. monuments and sculptures for public places.