

THE SCIENCE AND TECHNOLOGY PARK OF SICILY (PARCO SCIENTIFICO E TECNOLOGICO DELLA SICILIA)

Cultural heritage profile and projects

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1. Introduction

The Science and Technology Park of Sicily (STPS) is a no profit joint-stock consortium established in 1991 between the Regional Authority, research centres and companies operating in different sectors of the Sicilian economy, with the aim of increasing Sicily's competitiveness through research, innovation, technology transfer, training and attraction of investments. STPS acts as a catalyser between processes and SME product innovation and regional research system capability, both in traditional strategic sectors such as Agro-Food, Environment and Cultural Heritage and in emerging sectors such as ICT, Biotechnology, Bioenergy and Innovative Materials.

Thanks to teamwork with Sicily's Universities and the National Research Council, the STPS is one of the originators of territorial innovation. Efforts are oriented towards identifying the technological needs of SMEs and to supply them with assistance also in an international context, developing innovative products and processes and promoting technology transfer as well as providing a high level of professional training and innovative services.

Besides the ability to develop research and innovation, the PSTS has developed expertise over time in managing complex projects, governing the whole process from the planning to the implementation and reporting phases.

In the field of Cultural Heritage, the STPS has developed consolidated experience creating the "STPS Laboratory for Cultural and Environmental Heritage and analysis of materials". The laboratory is able to provide ARCHAOMETRIC investigations, particularly aimed at determining the chemical and mineralogical composition of solid materials (ceramics, mortars, metal alloys, stone, glass, *etc* ...) through innovative and advanced methods.

The services available are related to diagnostic analysis for the restoration, preservation and assessment of the status quo, the characterization and analysis of degradation, the assessment of the physical and chemical compatibility of materials, development of new materials, design of interventions, evaluation of the performance of treatments, *etc*

Major laboratory equipment includes (Figure 1):

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Figure 1. Main laboratory equipment

a) D/MAX-2500HL Rigaku Diffractometer equipped for investigations - Ritveld identifies natural crystalline substances (minerals) or synthetic, present in a solid material, through the detection of X-rays diffracted by them;

b) Fluorescence spectrometer Rigaku ZSX Primu – carries out elemental analysis of solid and liquid materials by X-ray fluorescence;

c) Porosimeter by mercury intrusion – investigates the distribution of porosity in the range of diameter between 360000 nm and 5 nm in solid or dust samples, by mercury intrusion, through gradually increasing pressure.

In addition, the STPS has a Chemical Laboratory (Figure 2) and an X-ray Spectroscopy Laboratory equipped with an AXIS Ultra DLD photoelectron spectrometer; it allows detailed information to be obtained on the chemical state of a surface with high analysis speed, resolution and sensitivity.



Figure 2. Chemistry Laboratory

2. Cultural Heritage projects

Research projects

- A. THE MORTARS AND PLASTERS OF HISTORICAL AND MONUMENTAL BUILDINGS IN SICILY - compositional characterization and research into new restoration products compatible with regional stone substrates funded by the National Operational Programme for Scientific Research, Technological Development and Higher Education 2000-2006.
- B. DEVELOPMENT OF INNOVATIVE INTEGRATED ASSETS for operators in the recovery, preservation, enhancement and fruition of cultural heritage funded by the National Operational Programme for Scientific Research, Technological Development and Higher Education 2000-2006.
- C. TECHNOLOGICAL DEVELOPMENT IN THE FIELD OF TERRACOTTA AND RESTORATION - *Terrecotte* project - funded by MIUR 1999-2001.

Training projects

- D. MASDIBEC - Master in Diagnostic Systems for Cultural Heritage funded by the National Operational Programme for Scientific Research, Technological Development and Higher Education 2000-2006 axis III.
- E. MORTARS TECHNOLOGIST - Advanced training course for “Expert focused on the introduction of innovative processes in mortar production and on its use in the restoration of historic town centres and monumental heritage” funded by the National Operational Programme for Scientific Research, Technological Development and Higher Education 2000-2006.

A. THE MORTARS AND PLASTERS OF HISTORICAL AND MONUMENTAL BUILDINGS IN SICILY

The research project developed in Sicily focused on the study of plaster and artificial stones in regional architectural tradition and was aimed at increasing knowledge about used recipes in order to re-propose them, as well as improving production processes and experimenting innovative mixtures to develop products compatible with traditional wall supports.

The collected data, the proven methodologies and absorbed experience are knowledge and “best practices” that are available to be exchanged, disseminated and transferred. In particular:

- Codification of methodological approach for diagnostic analysis of plaster and artificial stones aimed at :
 - improving knowledge about the material and traditional techniques of production and construction: sampling design methods, design methods of diagnostic plans, methods for the compositional characterization and definition of “recipes” - definition of compositional and functional parameters;
 - understanding the mechanisms and causes of degradation and identification of categories of damage in relation to different environmental characteristics;

- Operational code for the application of proper intervention of conservation and restoration;
- Codification of methodological approach for experimenting new mixtures (revival of traditional mixtures or development of innovative mixtures) - characterization of the fresh state and hardened state and definition of operational codes for proper application;
- Codification of methodological approach for the study of the compatibility among stone materials: chemical compatibility, physical compatibility, mechanical compatibility;
- Know-how required for the creation of laboratories able:
 - to implement the fresh state tests (workability time, consistency, air content, bulk specific gravity, *etc.*),
 - to test the hardened state (macroscopic analysis, optical microscopy under a polarizing microscope in thin section, electron microscopy and scanning with quantitative and qualitative EDS analysis, x-ray diffraction, chemical analysis in fluorescence, determination of soluble salts, thermogravimetric analysis, porosimetry analysis, capillary absorption tests and hygroscopic tests, mechanical tests),
 - to implement durability tests (adhesion to the substrate, soluble salt content, salt crystallization, freeze thaw cycles) and CE certification of materials;
- Implementation of specific databases able to manage knowledge and aimed at dissemination of the “intellectual capital” in an integrated manner (both data and structured multimedia documents), and able to ensure the use of the information, through appropriate navigation and search options, consistent with the needs of the interested users community.

Partnership: STPS (lead partner), Consorzio Catania Ricerche, CEPA, IBM, ISIRIM and Guglielmino Group.

B. DEVELOPMENT OF INNOVATIVE INTEGRATED ASSETS

The project focused on the development of new ASSETS (methods, analytical and operational procedures, *etc.*) aimed at improving the current analytical, consultancy and design services offered in the field of Cultural Heritage. The developed ASSETS are able to reduce the experimental work required for diagnostic tests and for the design of restoration with a consequent reduction in time and cost of services and are directed at different operators in the Cultural Heritage sector (architects, engineers, geologists, chemists, conservators, superintendencies, museums, construction companies, local authorities, *etc.*) and can be used at different levels. In particular, the projects were focused on natural stone materials (calcarene stone) and artificial material (terracotta).

The ASSETS developed consist in:

- High value-added information and data on the characteristics of the Plio-Pleistocene calcarenites used in the Sicilian *ars aedificatoria* and the terracotta found in the monumental buildings (churches, castles, historic towns) and in the traditional artistic objects of Eastern Sicily: material characterization, analytical study of their origins, of types and of the most frequent mechanisms of degradation; statistical analysis of the data collected and clustering;

- models, procedural codes and operating practices for diagnosis and interventions for the recovery of archaeological and architectural monuments (for example, practices and methods of treatment and application of products for restoration, surveys/investigations for planning diagnostic campaigns and restoration and conservation interventions);
- methods of cataloging, arranging and enhancing the data in order for it to be available and used in a focused way;
- definition of strategies for the fruition of historical and cultural heritage through:
 - dissemination activities (physical or photographic reproduction of monuments or museum objects using innovative technologies such as three-dimensional digitization and rapid prototyping or refined photographic techniques such as photomosaic);
 - development of training programs with scientific contents (educational and training courses aimed at education institutions, public/private organisms or professionals in the field).

Partnership: STPS (lead partner), Consorzio Catania Ricerche, CEPA, ISRIM and Department of Chemical Sciences-University of Catania.

C. TECHNOLOGICAL DEVELOPMENT IN THE FIELD OF TERRACOTTA AND RESTORATION “Terrecotte project”

The project, closed in 2001, and was aimed at implementing processes of technological innovation in the activities of small enterprises of the ceramic sector, increasing knowledge of raw materials, optimizing production processes and marketing. It involved the small businesses of the three main Sicilian ceramic districts (Caltagirone, Santo Stefano di Camastra and Sciacca), trade associations, Art schools and the Local Authorities.

Within this overall objective, the project achieved :

- know-how transfer to the user (knowledge of local raw materials, study and cataloging of the pottery of ancient traditions - from the twelfth to the twentieth century - modern techniques of business management, advanced marketing, computer science);
- designing and creation of technological laboratories for chemical, physical and mineralogical- petrographic analysis of raw materials, resistance testing of materials, experimenting of new cooking methods and equipment, such as the designing of the innovative oven based on the application of the control system with fuzzy methodology;
- designing and creation of computer laboratories aimed at developing specific applications dedicated to the ceramic industry, based on high technology computer-aided design, multimedia catalogs, technical drawing and retouching images, E-commerce.

Partnership: STPS (lead partner), Consorzio Catania Ricerche, CEPA, IBM.

D. MASDIBEC - Master in Diagnostics Systems for Cultural Heritage

The Master was aimed at training professionals able to manage and monitor complex diagnostic interventions on Cultural Heritage. The professionals learned know-how and tools in order to be able to operate in the conservation and restoration field, paying particular attention to material analysis, detection and prevention of possible degradation mechanisms, checking for damage and defining methods of intervention as well as checking the correctness of the applied restoration techniques and monitoring the state of the cultural asset under investigation.

Partnership: STPS, CEPA and ISIRIM

E. MORTARS TECHNOLOGIST

The course, related to the research project “the mortars and plasters of historical and monumental buildings of Sicily”, aimed at training professionals “Expert focused on the introduction of innovative processes in mortars production and on its use in the restoration interventions of old historic town centres and monumental heritage”. At the end of the course “Experts” had acquired: a) Knowledge on the characterization of historic mortars in the monumental and historical buildings, b) Skills relating to mortars in order to experiment new products appropriate to the climatic conditions and stone substrates, c) Methods of dissemination of knowledge on mortar composition, d) How to create platforms for the dissemination of results.

Partnership: STPS (lead partner), Cepa, CEPA, Consorzio Catania Ricerche in collaboration with the Department of Chemical Engineering of Processes and Materials, University of Palermo, and Department of Chemical Sciences, University of Catania.

Biographical notes

Roberto D'Agostino has a degree in Chemical Engineering and since November 2013 is CEO of the Consortium, Science and Technology Park of Sicily - STPS (*Parco Scientifico e Tecnologico della Sicilia* - PSTS), whose members include the *Regione Sicilia* and 20 other private shareholders; since September 2014, CEO of the lead Company of the High-Tech Biomedical District of Sicily (*Distretto Biomedico ad Alta Tecnologia Siciliana* - ATS); since 1988, Special Prosecutor and responsible for Sicily and Calabria relations for IBM Italy; from 2009-2012, Professor at the Faculty of Computer Engineering at the University of Palermo; from 2012-2015, CEO of the Consortium, Pact of Palermo (*Patto di Palermo*), whose members include: the municipality of Palermo, Confindustria Palermo, Palermo Chamber of Commerce, *Istituto Regionale per il Finanziamento alle Industrie in Sicilia* (IRFIS); from 2011-2015 councilor of the Chamber of Commerce of Palermo and member of the Commission for Innovation, Internationalization and Marketing of the same.