

## Short Term Scientific Mission, COST IE0601

**Beneficiary:** Mr Constantin Daniel NEGUT, HORIA HULUBEI National Institute of R&D for Physics and Nuclear Engineering- ROMANIA

**Host:** Dr. Laurent CORTELLA, Atelier Regional de Conservation NUCLEART, CEA Grenoble

**Period:** from 19/04/2009 to 25/04/2009

**Place:** Grenoble (FR)

**Reference code:** COST-STSM-IE0601-04601

### Mission Report

#### Mission purpose:

The aim of the mission is training on using nuclear techniques for the conservation of wooden cultural heritage objects. The two main objectives are:

- evaluate colour changes induced by gamma irradiation in wooden paintings
- practical aspects of dosimetry for cultural heritage objects.

#### Mission work plan:

Monday, 20/04/2009: Visit of the facilities, overview of polychromatic in French sculpture from historical period with specialized curator. Irradiation of samples. First colorimetry measurements (unirradiated samples and low doses irradiated samples). Following of the irradiation of samples, new colorimetry measurement.

Tuesday, 21/04/2009: Disinfection and disinfestations aspects. Colorimetry instruments. Following of the irradiation of samples, new colorimetry measurement.

Wednesday, 22/04/2009: Monitoring of the irradiation phase. Dosimetry : Red Perspex measurements. Following of the irradiation of samples, new colorimetry measurement.

Thursday, 23/04/2009: Dosimetry : mapping of doses by calculation. Following of the irradiation of samples, new colorimetry measurement.

Friday, 24/04/2009: End of the irradiation of samples, last colorimetry measurement (high doses). Other processes for the disinfestations of wood. Feedback, conclusions of the visit.

**Mission description:**

On the first day of the mission my host has presented to me the facilities of Atelier Regional de Conservation NUCLEART (CEA Grenoble, France): the Co-60 irradiation facility, dosimetry laboratory, the styrene polyester resin impregnation equipment for dry wood, the polyethylene glycol (PEG) impregnation / drying facilities for wet archaeological wood, anoxia facility for insect disinfestations, and the conservation / restoration workshops. In the restoration workshop, wooden painted statues being in different stages of restoration were shown and Ursula Mariak, a specialized curator, has made a historical overview of different techniques used in polychromatic French sculpture.

Together with the host we agreed to evaluate possible colour changes induced by gamma irradiation treatment in acrylic painted layers on wood. The reason of this choice is that after the restoration process (in which acrylic paints are frequently used) recontaminations are possible, materials used being fresh and containing water in a high degree. From the colorimetric point of view, this kind of test permits to establish if another irradiation treatment for previously irradiated painted wooden objects is possible. Also, the resistance at irradiation of acrylic paints is little known.

For colour tests two series of samples (acrylic of different colours on wood) were prepared: one as reference (non-irradiated) and the other to be irradiated. Absorbed doses were chosen corresponding to a logarithmic scale. References (non-irradiated) and their corresponding irradiated samples were measured after every irradiation using a Minolta Spectrocolorimeter CM-508i; 8 readings in 5 points for every sample were taken for a good statistic. Colour measurements between non-irradiated and their irradiated corresponding samples were compared on the base of CIE 2000 colour difference formula. The results allow us to conclude that up to 10 kGy (the usual dose for disinfestations) there is no significant colour change. For the future we agreed on using much higher doses to reach the limits at which colour changes become significant.

Specific problems of disinfestations from both the technique and material point of view were presented to me; explanations were made on very different cultural heritage objects available at ARC-Nucleart.

Different aspects of colorimetry (i.e. equipments and colour spaces) were discussed. For monitoring the irradiation process of acrylic on wood samples I used Red 4034 Perspex dosimeters measured by a Spectronic Genesys 5 spectrometer at 640 nm. Dr. Cortella presented to me theoretical and practical aspects of dose mapping for cultural heritage objects that usually are of irregular shapes. For the exemplification of dose mapping by calculation a previous irradiation treatment of a Buddha statue was used.

Aurélie Terral, trainee curator specialized in restoration of paintings, has presented me different traditional techniques used in wooden paintings: from the preparation of ground layers (aqueous solution of rabbit-skin glue in mixture with  $\text{CaCO}_3$  or  $\text{CaSO}_4$ ) to the preparation of paints (mineral pigments mixed with linseed oil or tempera).

I have visited an ERP Spectroscopy Laboratory and discussed with the head of the facility, Dr Laurent Le Pape, the possibility for collaboration on damages induced by gamma irradiation on wooden painting trying to correlate the colour shift induced by irradiation with the colour centres that can be detected by EPR spectroscopy.

I have presented to my host a Romanian project on conservation by irradiation of wooden painting (focused on devotional painting). The project is financed by Romanian Ministry of Education, Research and Innovation and led by IRASM Irradiation Centre of HORIA HULUBEI National Institute of R&D for Physics and Nuclear Engineering. One of the aims of the project is to establish classes of degradation for wood and relate them to changes in mechanical properties induced by irradiation. We discussed about the participation of the French team in this project.