

CONVENTION ON LONG-RANGE TRANSBOUNDARY AIR POLLUTION

International Co-operative Programme on Effects on Materials, including Historic and Cultural Monuments

Minutes of the 26th Meeting of the Programme Task Force

14-16 April 2010, Building Research Establishment Ltd (BRE) Garston

Prepared by the Main Research Centre
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The twenty-sixth meeting of the Programme Task Force of the International Co-operative Programme on the Effects on Materials including Historic and Cultural Monuments was held in Garston, United Kingdom on April 14-16, 2010. The meeting was hosted by the Building Research Establishment Ltd, Watford, United Kingdom. The meeting included a special session devoted to corrosion exposures in Asia, Africa and other parts of the world.

The meeting was attended by representatives from the following Parties to the Convention on Long-Range Transboundary Air Pollution: Czech Republic, France, Germany, Greece, Italy, Norway, Poland, Russian Federation, Spain, Sweden, Switzerland and United Kingdom.

The meeting was further attended by representatives from the following countries of the Malé declaration on Control and Prevention of Air Pollution and its Likely Transboundary Effects for South Asia: Bangladesh, Bhutan, Maldives, Pakistan and Sri Lanka.

The meeting was further attended by representatives from the following countries of the Air Pollution Information Network for Africa (APINA): South Africa, Tanzania and Zambia.

The meeting was further attended by representatives of the Corrosion Network (CORNET): China, Vietnam and Thailand.

Finally, Argentina, the United Nations Environment Programme (UNEP), the Global Atmospheric Pollution Forum (GAP) and the Convention on Long-Range Transboundary Air Pollution (CLRTAP) was also represented at the meeting.

1. Opening of the meeting

Johan Tidblad welcomed all participants, thanked BRE for organizing the meeting and declared the meeting opened.

2. Approval of Draft Agenda

Johan Tidblad presented the draft agenda, which was approved.

3. Information from the local organisers

Tim Yates welcomed every one to BRE and provided practical information, inviting everyone to a show of BRE Innovation Park, organized by *Graham Hardcastle*, Innovation Park Liaison Officer on Thursday, and to the meeting dinner on Thursday.

4. Practical information regarding cost reimbursement

Johan Tidblad provided information on reimbursement of costs for participants invited to the International workshop on corrosion exposures.

5. Introduction

The participants of the meeting gave a brief presentation of themselves.

6. Discussion of finished trend exposure 2008-2009

Johan Tidblad introduced the subject by pointing out the role of the meeting being a working meeting with discussions and planning of future work.

a) Corrosion and soiling data

i) Corrosion of carbon steel and zinc

Katerina Kreislova presented new corrosion data for carbon steel and for zinc, including results from the beginning of the first exposure programme in 1987. For carbon steel, a quick response to the SO₂ decrease in Europe during the last 20 years was experienced. Similar results were shown for zinc corrosion.

ii) Corrosion of zinc

Markus Faller presented zinc corrosion data 2008-09 for blasted zinc specimens, comparing with results for Czech zinc specimens prepared by grinding according to the ISO-standard. As expected, higher corrosion rates were measured for blasted surfaces. It was observed that zinc corrosion products from different stations show different appearance, the amount of corrosion products was however not sufficient for analyses. Increased corrosion rates were measured from 1995 to 2006, followed by a decrease. High corrosion rate with high scatter was found for 2006. High zinc corrosion during this year was found all over Europe, including the rural site Aspveten where high acetate levels were found in the corrosion products. *Tiziana Lombardo* suggested providing daily data for precipitation, to try and explain variations in corrosion product chloride levels found.

iii) Corrosion of limestone

Tim Yates presented results from Portland Limestone trend samples 1987-2010. Since the origin of the stone specimens had to be changed a few times during the period, sensitivity for different batches was compared. The stone used 2005-2006 was found to be weathered slightly more than the original stone. When selecting the batch for 2008, care was taken to keep properties as close as possible to the old stone. Also for stone materials, a decrease in corrosion during the programme period was observed, largest changes seen in the Czech Republic, followed by an increase 2005-06 (new more sensitive stone). The 2008-09 results were as expected.

Johan Tidblad suggested including passive samplers for organic acids in the next trend exposure. Organic acids might have an influence, not only for zinc but possibly also for stone, when pollution levels are low, even if microbiological influence dominates (*Tim Yates*).

iv) Soiling of modern glass and Teflon filter

Tiziana Lombardo presented results from exposure of modern glass (Si-Ca-Na glass exposed for one year in vertical position) and Teflon (vertical Teflon cylindrical filter) for soiling. Mass of deposited particles and haze (haze = transmitted diffused light / transmitted direct light - standard method for measuring transparency of glass) is measured for the modern glass and reflectance for the Teflon filters. Since a third of the glass samples came back broken an alternative evaluation method had to be developed, although with higher error. The reason for the problems with broken glass will be investigated further.

A correlation between haze and mass of deposited particles was found. A method was developed to measure reflectance also for glass specimens. Quite good correlation was found between haze and reflectance. Results for the two campaigns 2005-06 and 2008-09 are similar, Athens show the highest levels of soiling, as measured by all methods. Chaumont show the lowest levels of soiling 2008-09, Oslo (deposition), Svanvik (haze) and Birkenes (reflectance) the lowest 2005-06.

Reflectance for the Teflon filter was mostly under the detection limit for filters exposed inside a box. When exposed under a windshield, large differences between the sites were found, Berlin showing the highest values. There is a correlation between reflectance for glass and for Teflon filter. It is believed that the measurement method for glass, using backing paper, can be further improved.

b) Passive sampling and collection of environmental data

Terje Grøntoft presented environmental data collected and results from passive sampling. All sites but Sofia and Katowice use the IVL passive samplers.

Stefan Doytchinov informed that the Milan station has been moved, now located at Milan University. The Venice station was moved two years ago, to a location at the fourth floor close to heavy traffic.

For most of the sites low values have been obtained for HNO_3 , measured sheltered from rain, 2005-06 values slightly higher than 2008-09. Highest HNO_3 levels were found in Milan and Venice, also Katowice did show relatively high values. SO_2 concentrations were highest in Katowice, Athens and Kopisty, still lower than three years ago. Highest NO_2 levels were found in Vienna, Athens, Oslo and Paris while the rural and background stations show highest O_3 concentrations.

As for precipitation data, Birkenes and Chaumont show the highest amount of rain, 2005-06 levels were even higher. Results from pH, temperature and humidity measurements were shown.

Available data will be sent to all participants by the end of May, the data should be considered preliminary and some data will still be missing. A message will be sent when the final data is available, this data should be used for analyses

7. Discussion of 2009 work plan: Report No 61 “Assessment of stock of materials at risk including cultural heritage”

Johan Tidblad reported on the one remaining items from the 2009 work plan Report No 61 “Assessment of stock of materials at risk including cultural heritage” that is now completed and can be downloaded from the ICP website: <http://www.corr-institute.se/ICP-Materials> (left-hand menu “Results”, headline “Mapping, tolerable levels and calculation of corrosion costs”, click the text “methodologies to obtain data on stock of materials at risk”).

8. Discussion of 2010 work plan

The work plan has been decided by the Working Group of Effects, stating points a)-d) for ICP Materials, point e) is stated for all ICP's. As much as possible, including preliminary conclusions, shall be reported in September 2010 and remaining parts in December 2010.

a) Report on corrosion and soiling from the 2008–2009 exposure programme for trend analysis

The report will be compiled by *Johan Tidblad* including data for carbon steel, zinc, limestone, modern glass, Teflon and environmental conditions in one report. Only data will be presented, no statistical analyses. Data as presented at this meeting should be sent to Johan who will prepare the preliminary report in May. Comments to the report must be given by the end of July, in order for the report to be presented at the WGE meeting in September.

b) Report on validity of dose-response functions for different climatic conditions

Motivation for this report is climate change. Efforts have been made by individual participants to validate DRFs but so far there has been no effort to co-ordinate. Data from field exposures, not used in the development of DRFs, should be compiled. Relevant data from everyone should be sent to KIMAB by the end of July. *Johan Tidblad* will perform a preliminary assessment for the WGE September session and a final report by the end of November this year. *Terje Grøntoft* reported that Peter Brimblecombe has done some assessment on dose-response functions for stone, this information could be included in the report.

c) Report on economic evaluation of corrosion of materials including cultural heritage

This is an extensive and important report, it will be compiled by *Johan Tidblad* based on information from everyone. It will be a natural continuation report to be built on the stock at risk report no. 61. The new report is proposed to follow the same structure, i.e. sections for individual countries. Each national representative should write 1-3 pages on achievements. The report shall show what has been done in each country; it is basically a literature report, if possible including also unpublished open results. Original references must be given. *Johan* will distribute a structure for the report, to be completed by the end of July. The first draft will be presented to WGE at the September session; the final report should be finished at the end of November.

- d) Report on combined stock at risk and mapping for Italy at the national level
 This report will be produced by ENEA, *Stefan Doytchinov*. What is needed is data on Cultural Heritage and air pollution data in the area selected. Materials to study will have to be selected, materials for which dose-response functions have been developed. What already exists is general data on CH in the country (from the Istituto Centrale per il Restauro of Rome), EMEP data for air pollution and dose-response functions for limestone, sandstone and bronze. What should be done is control of geo-references for monuments in the country, Kriging interpolation of air pollutant and environmental data, elaboration of cultural monument positions, air pollution, corrosion (using DR functions) and exceedance maps. The time plan is to have a final report available for the WGE September session.
- e) Common items for all ICPs
 The following items are to be included in the work of all ICPs (*Johan Tidblad & Stefan Doytchinov*).
- i) The development of targets for 2020 and 2050 and application in ex-post integrated assessment using harmonized data on concentrations and depositions, in collaboration with the Task Force on Integrated Assessment Modelling
 ICP Materials is prepared to take part in the ex-post assessment. This assessment provides the opportunity for effects (like materials) that are not included in the integrated assessment for the Gothenburg protocol to still provide data that can be used in the negotiation process.
 - ii) The updating of robustness of air pollution effects in integrated assessment modelling
 Information on how certain our results are is required. Data on random error in dose-response functions and measurements have been provided previous years. The work item “validity of dose-response functions” this year can provide data on possible biases of the dose-response functions depending on climatic conditions.
 - iii) The links between air pollution effects and biological diversity
 This item is not directly applicable to ICP Materials but still have to be treated. Atmospheric pollutants directly affect human health, biodiversity and cultural heritage. A qualitative description of effects on cultural heritage (by introducing the broader concept human well-being instead of biological diversity) could be given, accompanied with illustrative examples.

9. Collaboration with corrosion networks outside Europe

An International workshop on corrosion exposures – State of the art and possibilities for future development was organised as part of the meeting on 15-16 April 2010. The program for the workshop is annexed to the minutes.

10. Discussion of 2011 work plan

a) Report on trends in pollution, corrosion and soiling 1987–2009

It was decided to compile one final environmental data report, co-ordinated by *Terje Grøntoft*, and one common report on trends, co-ordinated by *Johan Tidblad*.

b) Pilot study on inventory and condition of stock of materials at risk at UNESCO cultural heritage sites

After a discussion led by *Stefan Doytchinov* it was decided to select a few sites that can be used for case studies. Several sites were discussed for inclusion: Paris (*Tiziana Lombardo*), Prague (*Katerina Kreislova*), Berlin (*Stefan Simon*) and the City of Bath (*Tim Yates*).

The time plan is to have preliminary results in September 2011, and a final report in November 2011. We should try and involve UNESCO in the study and *Stefan* will ask his contact at UNESCO concerning their interests.

c) 27th meeting of the Programme Task Force

The meeting is suggested to be held in Prague, April 6-8, 2011 (subject to confirmation).

d) Other:

i) Start of trend exposures 2011-2012

Possible additions of environmental data or materials were discussed. One suggestion is to add passive sampling of organic acids. *Tiziana Lombardo* suggested PM10 measurements as mandatory. *Terje* pointed out that it will probably only be a few sites that can provide continuous PM 10 data. Other sites will use diffusive samplers, not necessarily those provided by IVL.

Johan Tidblad suggested including longer exposure periods for zinc, to reduce effects of the initiation period. *Markus Faller* suggested one and two years exposure, zinc goes to steady state after the first year, this is however a question of cost.

The discussions on the next trend exposures will be finished at the next meeting.

11. Financing of the programme

Sweden: yearly funding, no problems foreseen

UK: very limited funding from UK heritage

Italy: no problem for the moment

Czech Republic: a yearly contract is signed with the ministry of environment, promises have been given for partly financing of the ICP work, no serious problems foreseen

Switzerland: EMPA has a contract with the ministry, no problems foreseen

France: funding is available until 2010, sufficient for meetings etc.

Germany: funding from the environmental agency is stabilize on a very low level, this year covering two new racks

Greece: some financing from university funds, no immediate problems

Spain: working under a contract valid until the end of this year, according to oral information there should be no problems to prolong the present contract

Norway: no immediate problems

Poland: no national support is provided, financing is from the institution

12. Any other business

Blanca Rosales would like to see more analyses of corrosion products, including analyses of soiling. *Johan Tidblad* informed that sub-centres sometimes analyse corrosion products, but that is voluntary and a question of resources. *SVUOM (Katerina Kreislova)* have selected some sites for analyzing soluble products in the rust layer, the insoluble part, i.e. soiling, was not analysed. *Markus Faller* has one sample left from each site and can do the analyses.

13. Final remarks and closure of the meeting and workshop

Johan Tidblad summarized the meeting and workshop by concluding that corrosion is a real problem in many countries and there is an interest in many countries to continue the work. The main problem in many parts of the world is funding. It is very important to have a framework, such as CLRTAP, Malé and APINA in order to secure long-term national funding. The identification and support for sub-centres responsible for evaluation of corrosion attack is especially important. Trend exposures are a considered a core activity and what is unique for corrosion is that there exists a common methodology, described in ISO standards, for exposure and evaluation of corrosion samples.

Both climate and pollution effect corrosion and therefore our work are important both for assessing effects of climate change as well as effects of pollution. Estimations of economic values and economic loss from corrosion are key issues for all countries. There should be an opportunity is to collaborate our corrosion impact studies on stock at risk and cost with health studies (“rapid urban assessment”) as a large part of the required original data are the same.

We have an opportunity to benefit from co-operation between different parts of the world. Many countries have a long tradition in corrosion research while others have just started. Some countries have a strong link to policy which others countries lack such a link. Exchange of data and information are very valuable and activities in all countries should establish, or strengthen, the link between policy and science.

Johan Tidblad thanked all participants, with special thanks to *Tim Yates* and BRE for organization the meeting, the meeting dinner and sorting out financial issues. With this he closed the meeting, looking forward to the excursion to St Albans Abbey Cathedral, hoping everyone would be able to get home eventually under the present circumstances (Icelandic volcano eruption and cancelled flights).

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International workshop on corrosion exposures, “State of the art and possibilities for future development”, 15-16 April 2010, Watford, United Kingdom

Final program

Thursday, April 15, 2010

09:00 – 09:30	Opening	
	<i>Tim Yates</i>	Building Research Establishment (BRE)
	<i>Richard Mills</i>	Global Air Pollution (GAP) Forum
	<i>Mylvakanam Iyngarasan</i>	United Nations Environment Programme (UNEP)
	<i>Johan Tidblad</i>	Swerea KIMAB
	<i>Graham Hardcastle</i>	BRE Innovation Park
09:30 – 10:30	Transboundary air pollution – from science to policy	
	<i>Jesper Bak</i>	The Convention on Long-range Transboundary Air Pollution
	<i>Mylvakanam Iyngarasan</i>	The Male declaration on control and prevention of air pollution and its likely transboundary effects for South Asia
	<i>Chози Lungu</i>	The Air Pollution Information Network for Africa (APINA)
10:30 – 11:00	Tea / Coffe	
11:00 – 12:30	Effects of air pollution and climate on materials and cultural heritage	
	<i>Johan Tidblad</i>	Overview of exposure programs and new developments in standardisation
	<i>Zhao Dawei</i>	Atmospheric corrosion in Chongqing, China
	<i>Wirach Chantra</i>	Atmospheric corrosion in Thailand
	<i>Le Thi Hong Lien</i>	Atmospheric corrosion in Vietnam
12:30 – 13:30	Lunch	
13:30 – 15:00	Effects of air pollution and climate on materials and cultural heritage	
	<i>L Jay Foax</i>	Atmospheric corrosion in Southern Africa
	<i>Albert Mmari</i>	Atmospheric corrosion in Tanzania
	<i>Johan Tidblad</i>	Kits for rapid assessment of atmospheric corrosion exposed in Kathmandu, Nepal
	<i>Joanna Kobus</i>	Atmospheric corrosion in Poland
15:00 – 15:30	Tea / Coffe	
15:30 – 17:00	Effects of air pollution and climate on materials and cultural heritage	
	<i>Daniel De la Fuente</i>	The MICAT exposure programme
	<i>Blanca M Rosales</i>	Atmospheric corrosion in Latin America
	<i>Katerina Kreislova</i>	Atmospheric corrosion in the industrial microclimate in Ostrava, Czech Republic
	<i>Stefan Doytchinov</i>	Mapping of UNESCO cultural heritage sites

Friday, April 16, 2010

09:00 – 10:00	Future developments of corrosion networks	
	<i>Johan Tidblad</i>	ICP Materials
	<i>Richard Mills</i>	Global Air Pollution (GAP) Forum
	<i>Nadya Karmanova</i>	JSC "SRI Atmosphere", Russia
	<i>Chози Lungu</i>	The Air Pollution Information Network for Africa (APINA)
10:00 – 10:30	Tea / Coffe	
10:30 – 12:00	Future developments of corrosion networks	
	<i>Stefan Doytchinov (Moderator)</i>	Discussion and plans for the future including financing
	<i>Johan Tidblad</i>	Final remarks and closure of the meeting/workshop
12:00 –	Excursion to St. Albans Cathedral and the Roman remains	