UNITED
NATIONS

E

Economic and Social Council

Distr.
GENERAL

ECE/EB.AIR/WG.1/2007/8
29 May 2007

Original: ENGLISH

ECONOMIC COMMISSION FOR EUROPE

EXECUTIVE BODY FOR THE CONVENTION ON LONG-RANGE TRANSBOUNDARY AIR POLLUTION

Working Group on Effects

Twenty-sixth session
Geneva, 29–31 August 2007
Item 4 of the provisional agenda

RECENT RESULTS AND UPDATING OF SCIENTIFIC AND TECHNICAL KNOWLEDGE

RECENT RESULTS ON CORROSION TRENDS AND THE PROTECTION OF CULTURAL HERITAGE FROM AIR POLLUTION

Report by Programme Centre of the International Cooperative Programme on Effects of Air Pollution on Materials, including Historic and Cultural Monuments (ICP Materials) and by the workshop rapporteurs

INTRODUCTION

1. This report describes preliminary results on recent trends in corrosion and a comparison with earlier trends. The annex contains a report of a workshop on the protection of cultural heritage from air pollution, the need for effective local policy, and maintenance and conservation strategies, held on 15 and 16 March 2007 in Paris. The results are presented here in accordance with the 2007 workplan (item 3.2).

GE.07-22748

I. RECENT RESULTS ON CORROSION TRENDS

2. One of the main aims of ICP Materials is to describe and evaluate long-term corrosion trends attributable to atmospheric pollution, both to elucidate the environmental effects of pollutant reductions achieved under the Convention on Long-range Transboundary Air Pollution and to identify extraordinary environmental changes that result in unpredicted materials damage. This is achieved by performing repeated exposures of carbon steel, zinc and Portland limestone in the network of test sites. At present they are performed every third year. Each exposure has a duration of one year.

3. The previous evaluation of trends was based on data from the period 1987–2003. It concluded that during the period 1987–1997 the decreasing trend in the concentrations of acidifying air pollutants resulted in a decreasing trend in the corrosion of carbon steel, zinc and limestone. During the period 1997–2003, however, the corrosion rate of carbon steel decreased, while the corrosion rate of zinc and limestone increased slightly.

4. The most recent one-year exposure of carbon steel, zinc and limestone was performed during 2005/2006. At present, only corrosion results are available while the environmental data during the same exposure period are still being collected from individual partners and validated. Figure 1 shows the trend in corrosion with an updated value for carbon steel. Even for carbon steel, the average trend is no longer decreasing. For the other materials, data are still being evaluated.

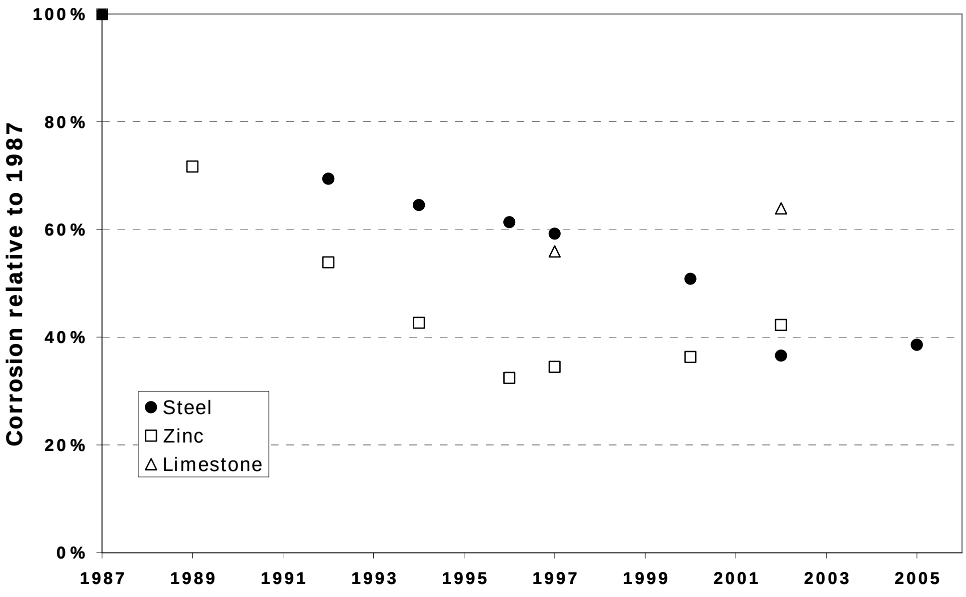

Figure 1. Average trends in corrosion relative to the first exposure in 1987.

5. In comparing the two most recent exposures, the average trend (i.e. trend calculated form average annual data from sites) for carbon steel is slightly increasing. For some sites, with an overrepresentation of sites with expected low annual mean temperature, corrosion has increased substantially (figure 2). Preliminary data indicate that this increase for the cold sites is even more noteworthy for zinc and possibly limestone. When environmental data are available, the relative contribution of pollution and climate to the most recent trends will be assessed.

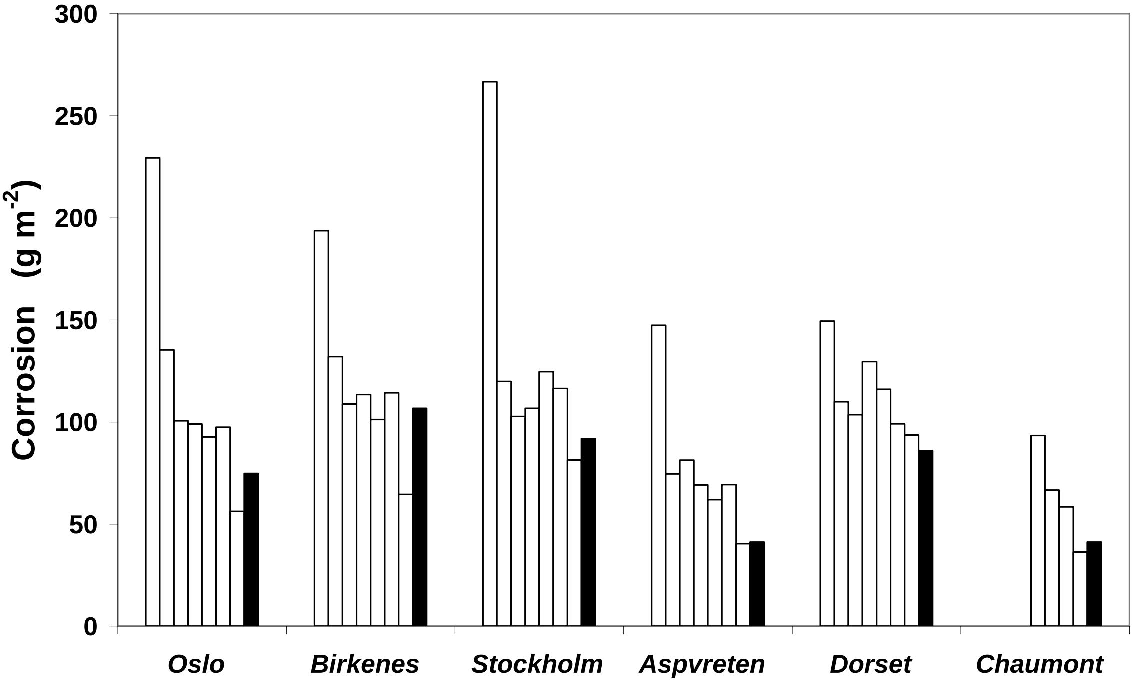

Figure 2. Trends in carbon steel corrosion showing values for the periods 1987/1988, 1992/1993, 1994/1995, 1997/1997, 1997/1998, 2000/2001, 2002/2003 and 2005/2006 (the last is marked in black). The Chaumont site was not part of the original network and monitoring started in 1996.

II. CONCLUSIONS

6. The previous evaluation of trends concluded that the corrosion rate of carbon steel decreased while the corrosion rate of zinc and limestone increased slightly during the period 1997–2003. The data obtained from the most recent exposure in 2005/2006 shows that even for carbon steel, the average trend is no longer decreasing. For some sites, with an overrepresentation of sites with expected low annual mean temperature, corrosion has increased substantially when comparing data from the exposures in 2002/2003 and 2005/2006.

Annex

Workshop on the Protection of Cultural Heritage from Air Pollution – the Need for Effective Local Policy, Maintenance and Conservation Strategies

INTRODUCTION

1. The Workshop on the protection of cultural heritage from air pollution, the need for effective local policy, maintenance and conservation strategies took place on 15–16 March 2007 in Paris. It was organized jointly by ICP Materials, the European Union (EU) project CULT-STRAT (Assessment of Air pollution Effects on Cultural Heritage – Management Strategies), and the French Environment and Energy Management (ADEME). It was also supported by the European Association for Historic Towns and Regions (EAHTR).

2. The workshop was attended by 84 experts from the following Parties to the Convention: Austria, Belgium, Czech Republic, Denmark, Estonia, France, Germany, Italy, the Netherlands, Norway, Poland, Portugal, Sweden, Switzerland, Turkey and the United Kingdom of Great Britain and Northern Ireland. A member of the UNECE secretariat also attended.

3. Mr. R. Lefevre of the University of Paris XII opened the meeting.

4. The purpose of the workshop was to bring together heritage building managers, policymakers and CULT-STRAT project partners. It provided an opportunity for practitioners in the field to influence the policy review of the project and to ensure that future policy properly reflects their needs.

5. The workshop was organized in the following four plenary sessions:

(a) Scientific evidence relating air pollution to damage;
(b) Effects of air pollution and other factors;
(c) Prevention, maintenance and conservation strategies;
(d) Social, economic and legal issues.

I. THE SCIENTIFIC EVIDENCE RELATING AIR POLLUTION TO DAMAGE

6. The workshop noted there were three ongoing main research projects: the Convention’s ICP Materials, and the EU projects CULT-STRAT and MULTI-ASSESS (Model for multi-pollutant impact and assessment of threshold levels for cultural heritage).

7. Two sets of dose-response functions have been developed for mapping areas of increased risk of corrosion, assessing corrosion costs and tolerable pollution levels: one for the sulphur dioxide (SO_2)–dominant pollution and the other for multi-pollutant cases, additionally including nitric acid (HNO_3) and particulate matter (PM).

8. Dose-response functions for soiling, defined as loss of reflectance, include the effect of coarse particulate matter (PM10). PM represents several pollutants that can have different effects.

9. Two methods were available to estimate tolerable corrosion levels. The first related to background corrosion rates and the second was based on maintenance criteria and reasonable maintenance times. For soiling, only the second method has been used.

II. EFFECTS OF AIR POLLUTION AND OTHER FACTORS

10. The workshop noted that both outdoor and indoor sources could be important for preventive conservation. Prevention strategies often involved compromises between different types of effects.

11. The workshop stated that cultivation was not a recommended method for identification of bacteria, since the non-cultivable portion is significant. Molecular analysis was to be preferred and could also detect the metabolic activity. The EnviArt programme explored chemical interactions between cultural artefacts and typical indoor environments.

12. The stock of materials at risk was evaluated in two city centres (Paris and Venice). The methodology comprised a field inventory based on direct examination of facades, providing an estimate for the surface area of a wide range of building materials, including limestone, render/mortar/plaster, paint, brick, metal and modern glass. The relative abundance of render, brick and stone was substantially different when comparing Paris, a city of stone, to Venice, a city of render.

13. Corrosion risk maps could aid decision-making, as an increased risk requires more investment in maintenance actions or in reducing pollutants. Recommendations for strategic actions to reduce pollutants in the proximity of areas with cultural heritage could be based on target values for corrosion and cost evaluation, taking into account the background level. Measurements combined with modelling on the appropriate scale would be needed for rational decisions.

III. PREVENTION, MAINTENANCE AND CONSERVATION STRATEGIES

14. The workshop noted three important aspects in heritage management strategies: soiling impact analysis based on public perception and optical measurements; time between interventions; and costs of maintenance, conservation and renovation. In general, the public accepted soiling of stone materials to a higher degree than soiling to painted surfaces.

15. The impact of cleaning could be substantial and result in significant damage on a single occasion, in comparison with degradation due to pollution and weathering over hundreds of years. Once one building has been cleaned, there is substantial pressure to clean neighbouring buildings. Each material needs a different treatment and the training of technical personnel is critical.

16. The public, including children, should be informed on all the aspects of conservation, e.g. why the specific action was taken. Education might bring a demand for higher standards. The need for maintenance was often not considered when undertaking conservation. Investigation and pre-treatment might be needed initially, which could be expensive, problematic and time consuming.

17. It was considered problematic to convey appropriate knowledge to both high-level decision-makers, in particular those taking daily decisions, as conservation principles, e.g. minimum intervention, are no longer a starting point for management decisions. The complete historic environment should be considered, as well as the main historical objects; the aim is not to maintain buildings, but cultures.

18. A case study on the preservation of the Topkapi Palace in Istanbul and the Temple of Augustus and Rome in Ankara was presented. Diagnosis before intervention included detailed characterization of original material and status by surface analytical techniques. In Turkey, large cities are very polluted and the SO_2 levels in Ankara are still high, although significantly lower than 20 years ago.

19. The EU project Noah’s Ark has produced a vulnerability atlas for cultural heritage in Europe and guidelines on adaptation strategies. The maps are based on 30-year mean values: recent past (1961–1990), and near (2010–2039) and far futures (2070–2099) for several materials and effects, also taking into account the effects of global climate change.

IV. SOCIAL, ECONOMIC AND LEGAL ISSUES

20. The workshop noted that EAHTR considered heritage to be a key asset defining the character, identity and diversity of historic cities. World heritage cities might be particularly willing to take into account air quality and its corrosive and soiling effects due to regulatory frameworks imposed on them.

21. The 1999 Gothenburg Protocol to the Convention is under review. Links and synergies of air pollutants with climate change and PM could be issues addressed by the Convention in future.

V. ADDITIONAL CONCLUSIONS

22. The workshop agreed on the following additional conclusions:

(a) The pollution and heritage management was carried out at different scales, ranging from international and national to regional and local levels. Different kind of dissemination was needed for different audiences;

(b) Risk communication was an increasingly important topic for science as well as policy. Mapping of areas and cultural heritage objects at risk was considered a very powerful tool;

(c) Local authorities had an important role in improving air quality and developing sustainable management strategies for the care of heritage;

(d) Corrosion and soiling due to traffic emissions were considered the greatest air pollution risk to cultural heritage objects;

(e) Tolerable levels for SO_2 and PM10 for protection of cultural heritage were below currently adopted guidelines for health. Materials, especially cultural heritage objects, were sensitive to air pollution;

(f) It was considered important to develop estimates of stock at risk to facilitate inclusion of cultural heritage in integrated assessment modelling and economic evaluation. Land use maps, databases held by insurance companies and other sources should be explored;

(g) It was deemed important to continue regular trend analyses. These should be integrated with studies on effects of climate change on cultural heritage objects;

(h) Soiling would deserved more systematic studies. These would include assessment of post-cleaning of soiling, development of guidelines for cleaning and creation of an accreditation system;

(i) Attention should be given to the effects of organic acids. These were found both indoors and outdoors and were emitted from biofuels and alternative fuels for cars.

23. The workshop noted the following additional future research needs:

(a) Treatment of the detrimental effects of pollution and climate in a holistic way, taking into account both biological and chemical effects on corrosion and soiling;

(b) Communication with end-users (heritage managers and policymakers) required to define problems and issues clearly, e.g. type, location and cause. A need was identified to disseminate the complexity of the problems in simple terms.
