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Indoor corrosivity in museums and archives assessment: standards and recommendations

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Problematics

- Why this compilation of standards and recommendations data?
  - Tool to estimate the indoor air quality in museums and archives
- Classification of corrosivity of indoor atmosphere
  - identification of the corrosion attack on standard specimens
  - or based on the knowledge of humidity, temperature and pollution conditions

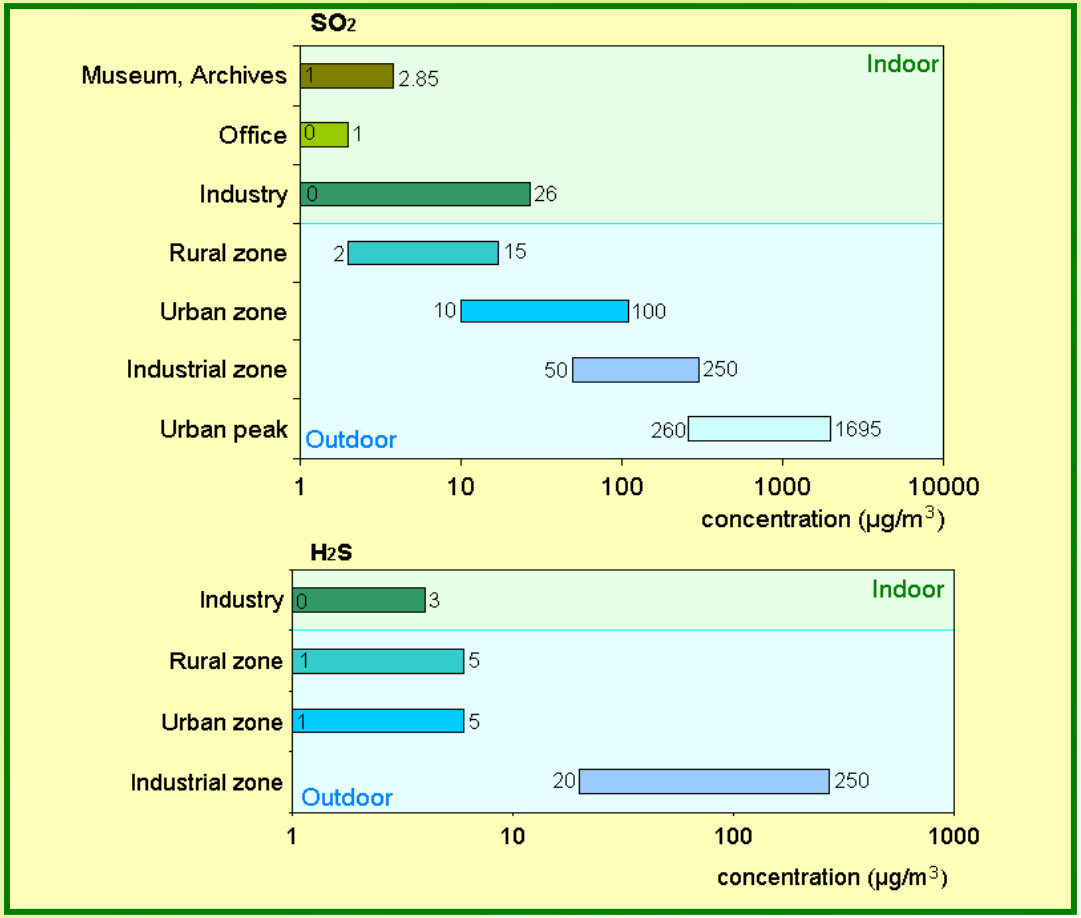
Standards and recommendations references

- ISO 9223
  - Mass loss on several metals after one year exposure
- ISA-S71.04-1985
  - Copper corrosion film thickness after 30 days exposure in industrial zones
- ISO/DIS 11844-1
  - Corrosion rate by mass change (loss and gain) on copper and silver
  - Spans of pollutant concentrations in rural, urban and industrial zones
- Livio de Santoli, Evandro Sacchi, Antonio Prina, Chris Muller*
  - Corrosion film thickness after 30 days exposure
  - Levels and peaks of gaseous pollutants in urban areas

* Control strategies for gaseous contamination in museums: a new method for assessing environmental risk, INTERNATIONAL WORKSHOP - ROMA 7 MAGGIO 2005, INDOOR ENVIRONMENT QUALITY IN MUSEUMS - LA QUALITA' DELL'AMBIENTE NEI MUSEI 7 mai 2005

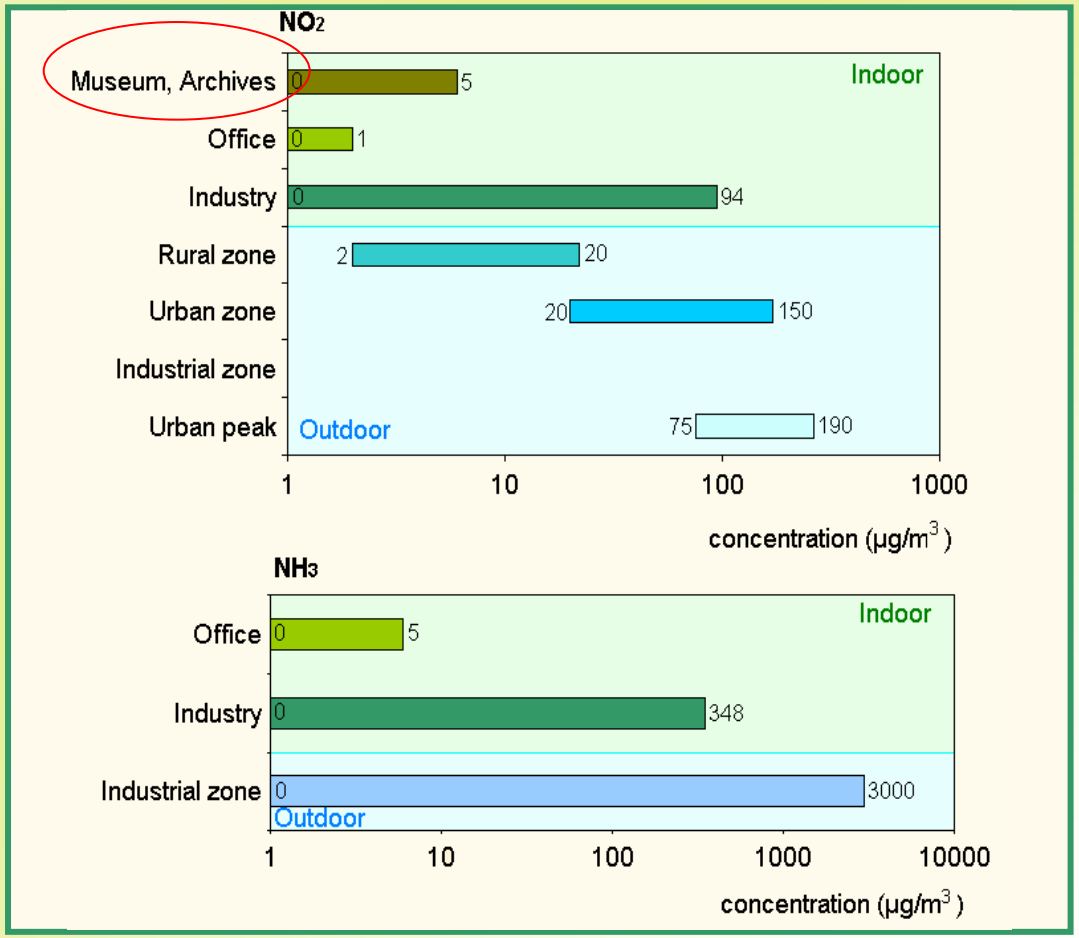
Sulfur compounds

- SO_2
  - Combustion products of sulfur-bearing fossil fuels
- H_2S
  - One of the predominant causes of atmospheric corrosion in the process industries



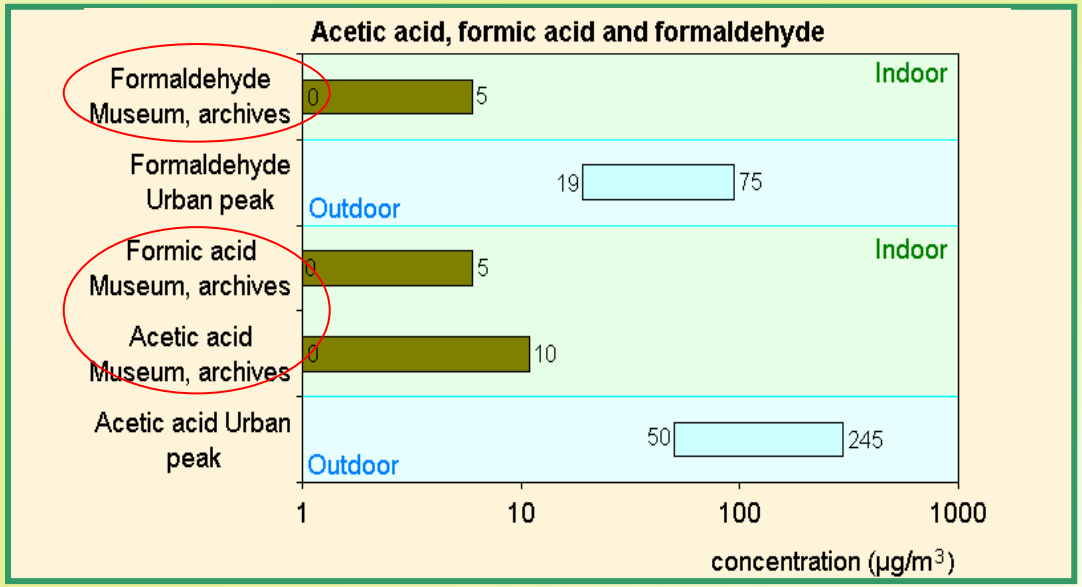
Nitrogen compounds

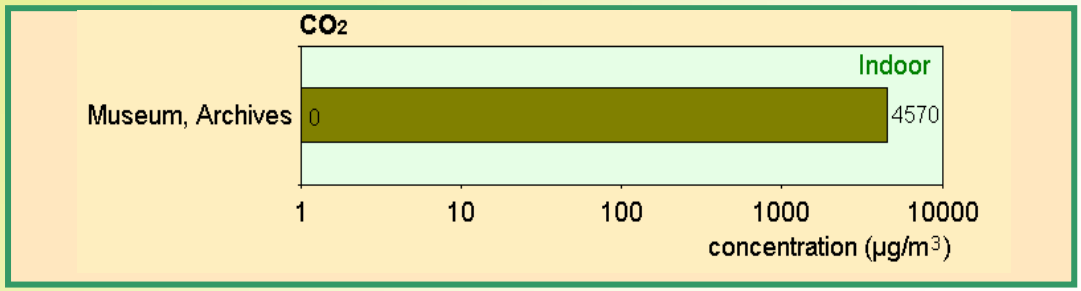
- NO_x
  - Combustion products of fossil fuels
  - Catalytic effect on corrosion
- NH_3
  - Fertilizer plants, agricultural applications and chemical plants



Volatil organic compounds and carbon dioxide

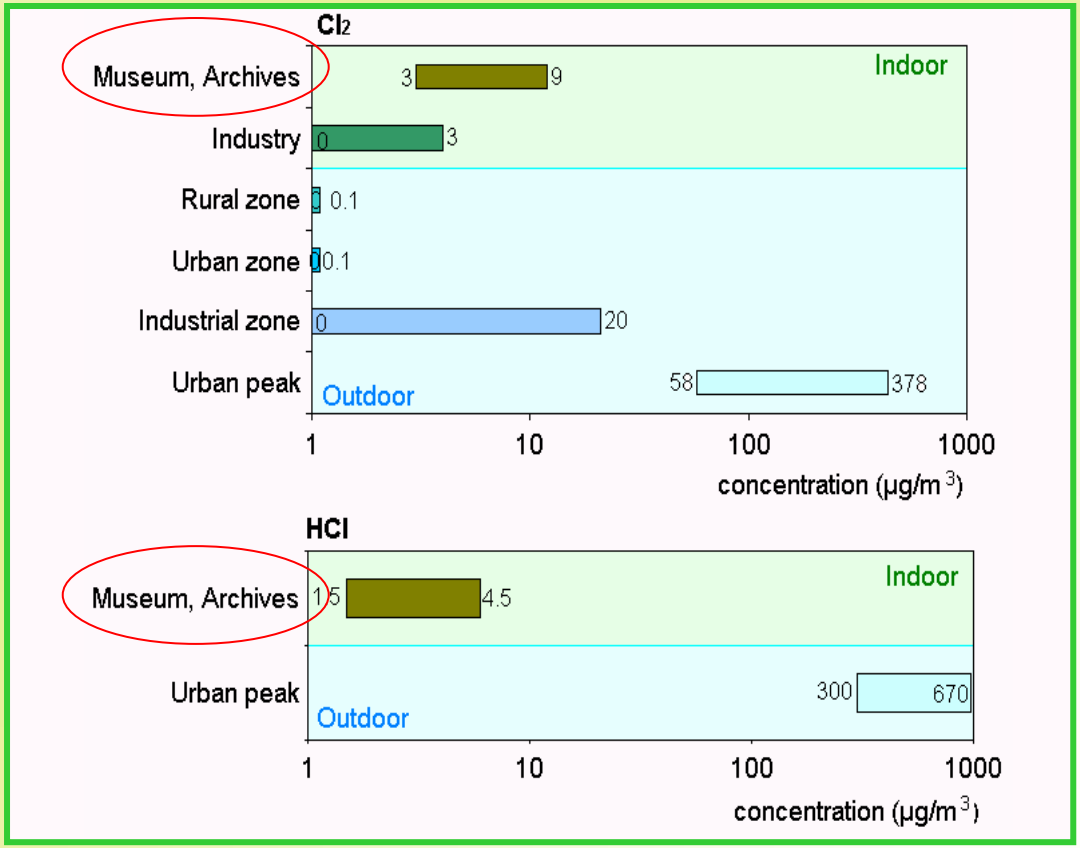
- Volatil organic compounds
  - Paints and lacquers
  - Wood and mediums
- CO_2
  - Human presence
  - Incomplete combustion





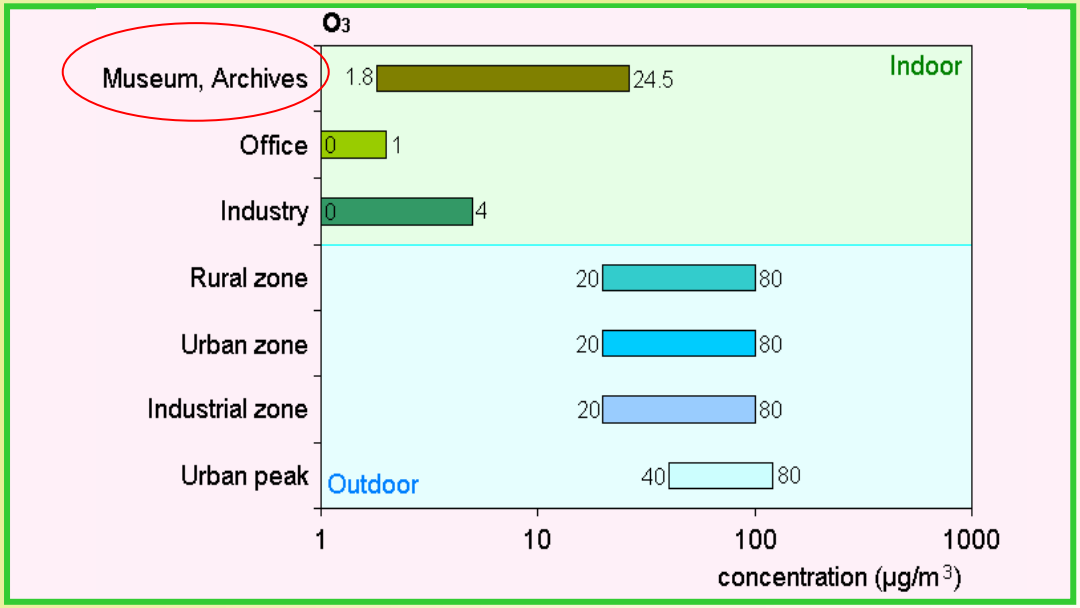
Chlorine containing compounds

- Sources
  - Cleaning compounds
  - Cooling tower vapors
- Severe cause of corrosion



Ozone

- Strong oxidant
- Probably catalytic effect in sulfide and chloride corrosion of metals

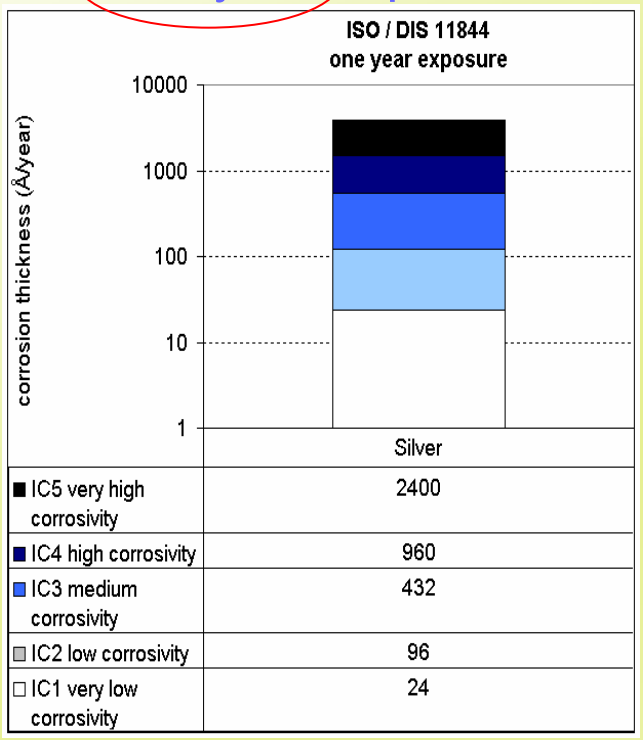


Precautions

- Influence of synergistic effects of different pollutants on corrosion
  - Comparison between results and measurements of corrosion attack on standard specimens
    - Estimation after one month or one year metal specimens exposure using different measurement methods
    - Comparison of results with standards and recommendations: **USE SAME EXPOSURE TIME AND METHOD**

Silver corrosion

One year exposure

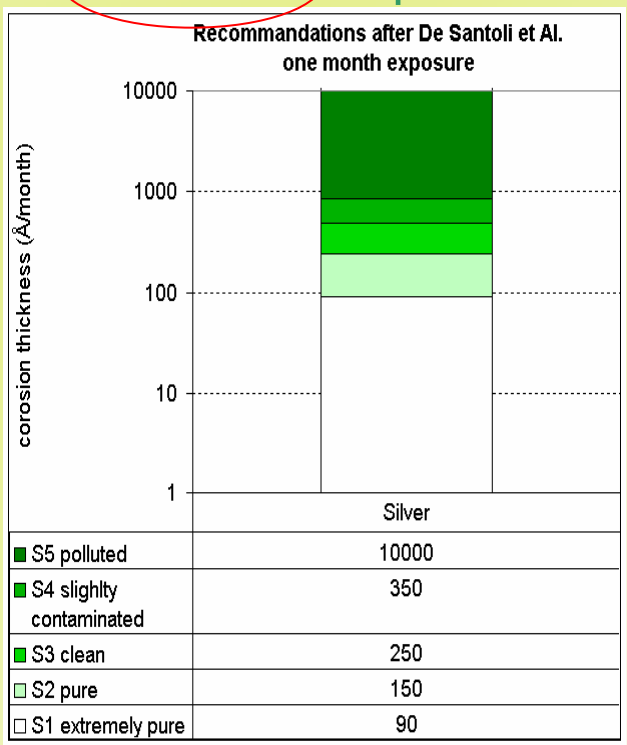


	Silver
IC5 very high corrosivity	2400
IC4 high corrosivity	960
IC3 medium corrosivity	432
IC2 low corrosivity	96
IC1 very low corrosivity	24

Environment: indoor

Measurement: mass gain

One month exposure



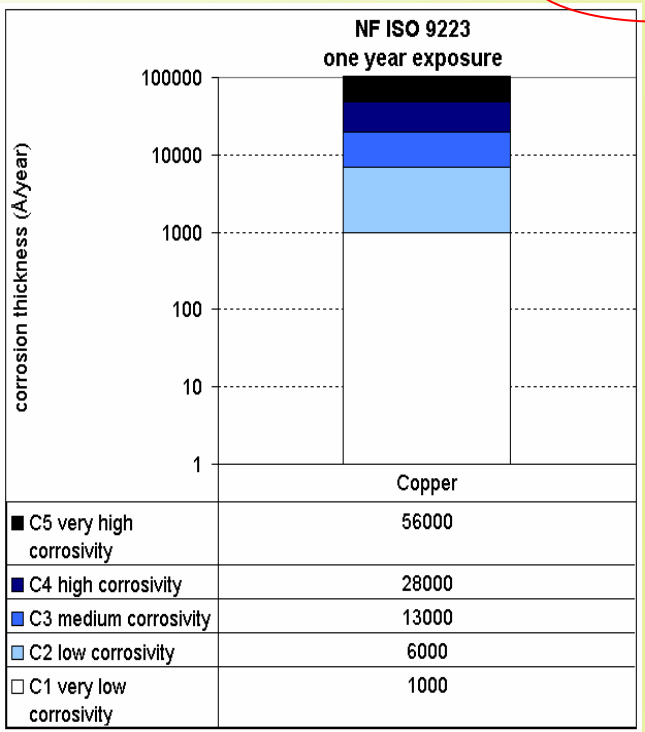
	Silver
S5 polluted	10000
S4 slighlty contaminated	350
S3 clean	250
S2 pure	150
S1 extremely pure	90

Environment: museum, archives

Measurement: quartz crystal microbalance

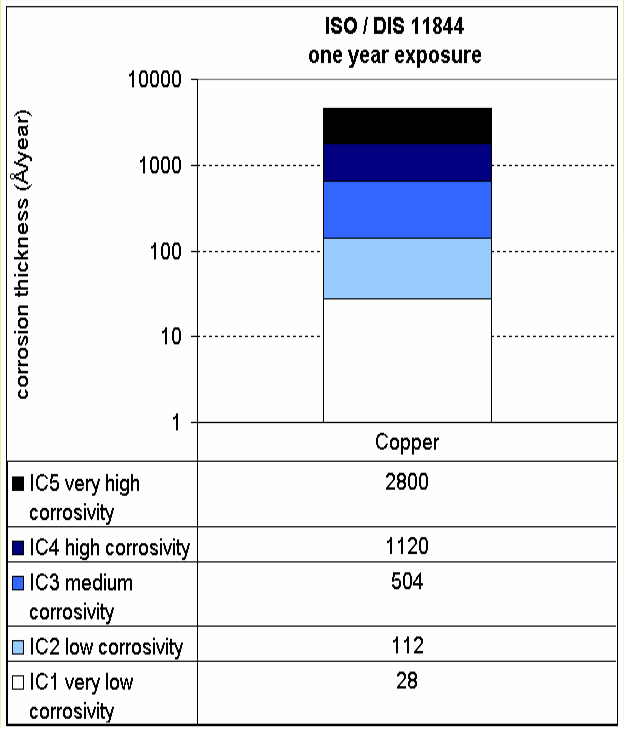
Copper corrosion

One year exposure



Environment: indoor

Measurement: mass loss

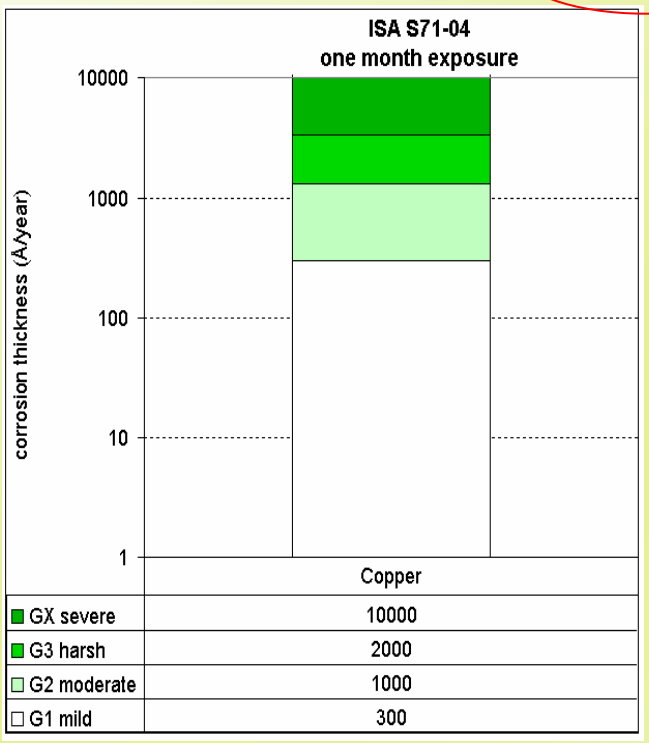


Environment: indoor, office

Measurement: mass gain

Copper corrosion

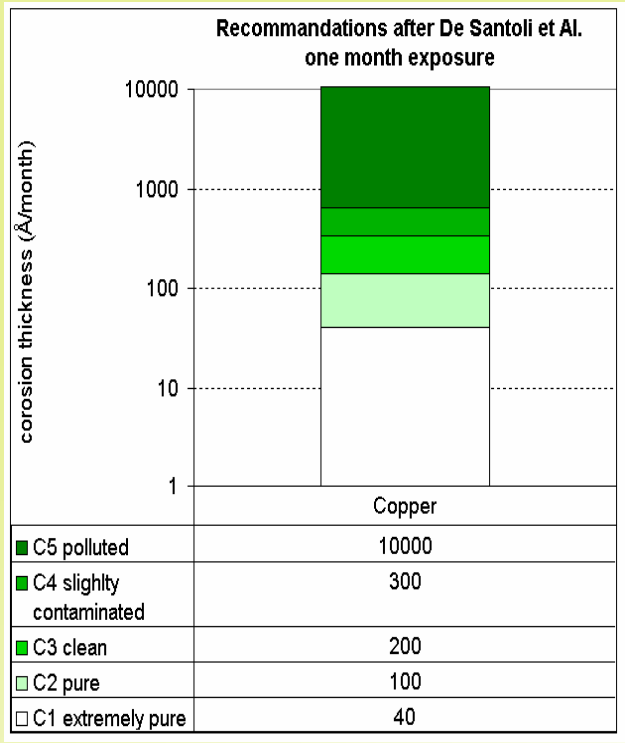
One month exposure



Environment: indoor

Measurement: electrolytic cathodic reduction

more sensitive



Environment: museum, archives

Measurement quartz crystal microbalance

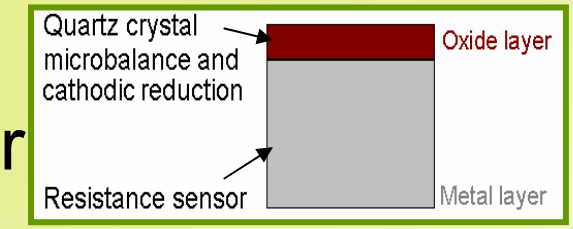
Measurements

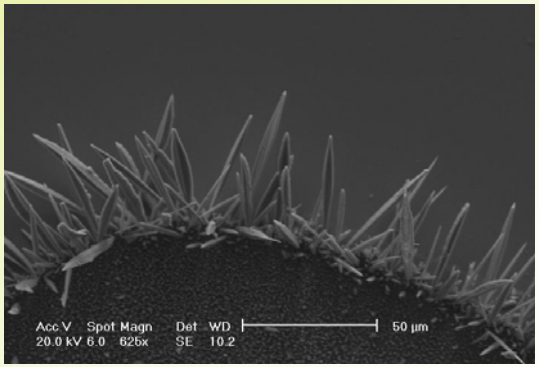
- 3 methods of measurements to estimate corrosivity categories
  - Mass changes (mass loss, mass gain)
  - Electrolytic cathodic reduction
  - Resistance measurement
- Methods complete each other and can not be compared because they don not provide the same informations

Measurements

- Cathodic reduction and quartz crystal microbalance
  - Mass gain
  - Influence of adsorbed water
  - dust deposit
  - need to know the porosity of corrosion products

  → the nature of corrosion products





- Resistance sensor
  - Metal loss
  - Locally attacks due to edge effects

Conclusions

- Dependence of corrosion profiles from corrosion mechanisms
  - Impossible to convert the corrosion rate obtained from a year exposure into a mean corrosion rate based on a monthly exposure
  - no coherence between industrial standards based on one month exposure with museums and archives requirements
  - more useful information with the cumulated thickness of the corrosion layer to assess the overall corrosivity of environments in museums and archives

CENTRE DE RECHERCHE ET DE RESTAURATION DES MUSÉES DE FRANCE

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IAQ in museums and archives

Thank you for your attention