# Air quality measurements for preservation of (astronomy) photographs





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Prague, 18<sup>th</sup> March, 2014



# Sensitivity of photographic material to the environment

Photogr. base	Ultra	Very sensitive	Sensitive
material	sensitive		
Plastic based	Sulfides	Light > High RH	Oxidising pollutants, Fluctuating RH
Paper based	Sulfides	Light > High RH > Organic pollutants	Fluctuating RH
Glass based	Sulfides	Light > High RH	Oxidising pollutants, Fluctuating RH

#### Sensitivity of image forming material:

E.g. "Color and B&W images have very different sensitivity to organic acids and sulphides."

(*Lavedrine Bertrand, 2003,* A Guide to the Preventive Conservation of Photograph Collections. Getty Publications)



## Demands to good preservation environments for photographs

- Low levels of sulphides and light/UV
- Climate control:
  - ✓ As low temperature (T) as possible at low relative humidity (RH).
    - But avoid dry conditions that can cause mechanical damage.
  - Avoid fluctuating RH and T, which can inflict mechanical damage due to dimensional change,
- Avoid presence of pollutants that can oxidize silver, dyes and polymeric materials, causing fading, yellowing and delamination.
- Avoid presence of acidic gases that can cause acid hydrolysis.



#### Air quality measurements Are essential to assure good storage environments.

#### The work flow



## **1. Parameter measurements**

Light/UV

#### Climate







## Air pollution Pollutant gas monitors:

#### **PTR-TOF-MS**









#### Inorganic gases

 $O_3$ : UV absorption NO<sub>x</sub>: Chemiluminescence SO<sub>2</sub>,H<sub>2</sub>S: UV flourescence

Traditionally: Large expensive instruments

**Cheap mikrosensors** are comming on the market. Lower detection limit, less accuracy

## **Passive samplers (P)**

# <image>

PASSIVE SAMPLERS OUTSIDE MC-FRAME

PASSIVE SAMPLERS INSIDE MC-FRAME

#### Badge samplers:



 $SO_2$  (IC of  $SO_4^{2-}$ )  $NO_2$  (Photometric,  $NO_2^{-}$ )  $O_3$  (IC of  $NO_3^{-}$ ) HCOOH, CH<sub>3</sub>COOH (IC)

## Badge samplers + formaldehyde

VOCs: (GC-MS)



## **Dust sampling**







Passive

Active

## **Dosimetry**







## **The MEMORI Dosimeter**



Two "glasses" sensitive to air pollutants and climate

1. Acidic effects

2. Photooxidation

#### 3 months exposure

Museum of Cultural History, Oslo



## SEVENTH FRAMEWORK



## **MEMORI – English Heritage results**



## MEMORI web results

pages



Home Product User guide Evaluation Air quality

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#### European heritage in danger

Airborne pollutants cause severe problems in art collections all over the world, in exhibitions, and in storage rooms. They are invisible, mostly odorless, destructive and endanger cultural heritage objects of all kinds; no matter whether paper, wood, clothes, paintings or metal objects.

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What is the MEMORI technology?	Why use	the MEMORI technolo	gy? Basic questions and answ	vers about the MEMORI technology
How do I get to use the MEMORI tech	nnology?	What is the cost?	Simple example case studies	References to user experiences

Email	Create an account
Password	Sign in

MEMORI homepage | NILU homepage | Fraunhofer homepage | Disclaimer | Acknowledgements









## Upload / Present results







Product	User guide	Results	Details	Evaluation	Air quality	Mitigation	C→ Log off	
1. Upload	d data							
Select								

#### 2. Update location and material

A start measurment and an end measurment is needed to calculate the results

= Missing values for calculations of result	= Very low risk
= Some risk for damage to sensitive objects	= High risk for damage

Sample	Location	Material	Measurment date	Result
0	monter 1	Lead	2013-05-02T13:09:53	
5	monter 2	Select material	2013-05-02T13:13:09	
6	monter 3	Silver	2013-05-02T13:08:43	
7	monter 4	Select material	2013-05-02T13:32:51	

MEMORI homepage | NILU homepage | Fraunhofer homepage | Disclaimer | Acknowledgements







## **Presentation in results diagram**



## **Other dosimeter systems**





OnGuard

(Purafil)



Piezo-electric quartz crystals (PQCs) Birkbeck, London



## Piezo electric quartz crystal dosimeters. "The Birkbeck" PQC (Lead or varnish coated) (C, O, P)

- Varnish or lead coated Piezo-electric Quartz Crystals (PQCs)
- Recommended response levels for cultural heritage environments. (PROPAINT FP6)
- Main responses (PROPAINT-indoor):
   Varnish coated: NO<sub>2</sub>, T
   Lead coated: CH<sub>3</sub>COOH, RH

PRO







## Mitigation

#### How reduce pollutant concentration by:

Avoid
Block
Dilute
Sorb:
Filter





- 2. Reduce relative humidity.
- 3. Reduce oxygen concentration.
- 4. Retest air quality (measurement).

# Thank you!

## astro 314 2014