Photocatalytic Abatement of Biofilms and VOCs for Cultural Heritage Museum Laboratories Human Health and Safety

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CEREALS


BANDAYAN

Destructive Biological Growth…

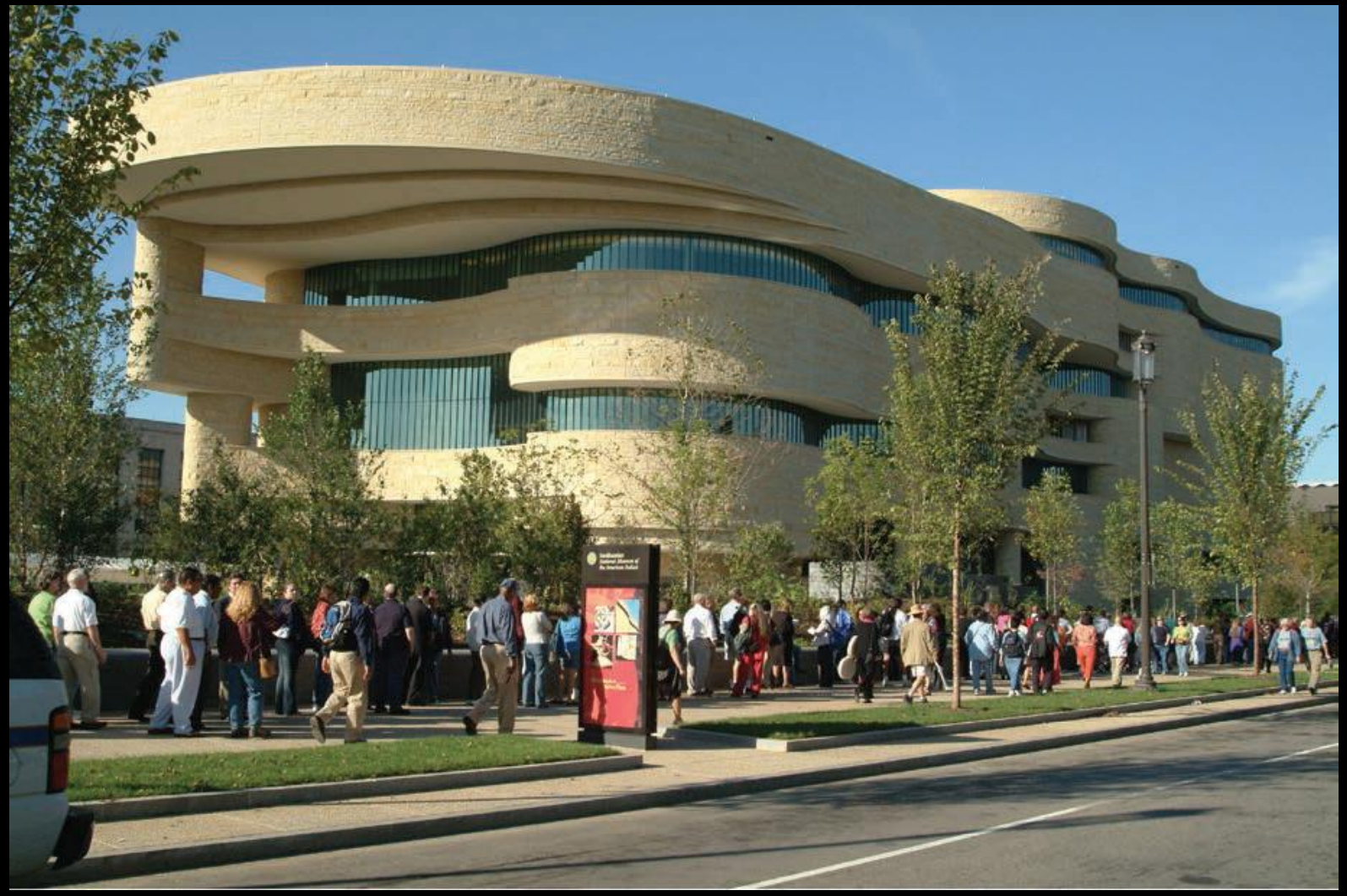
Can be Cleaned…

But Will Return

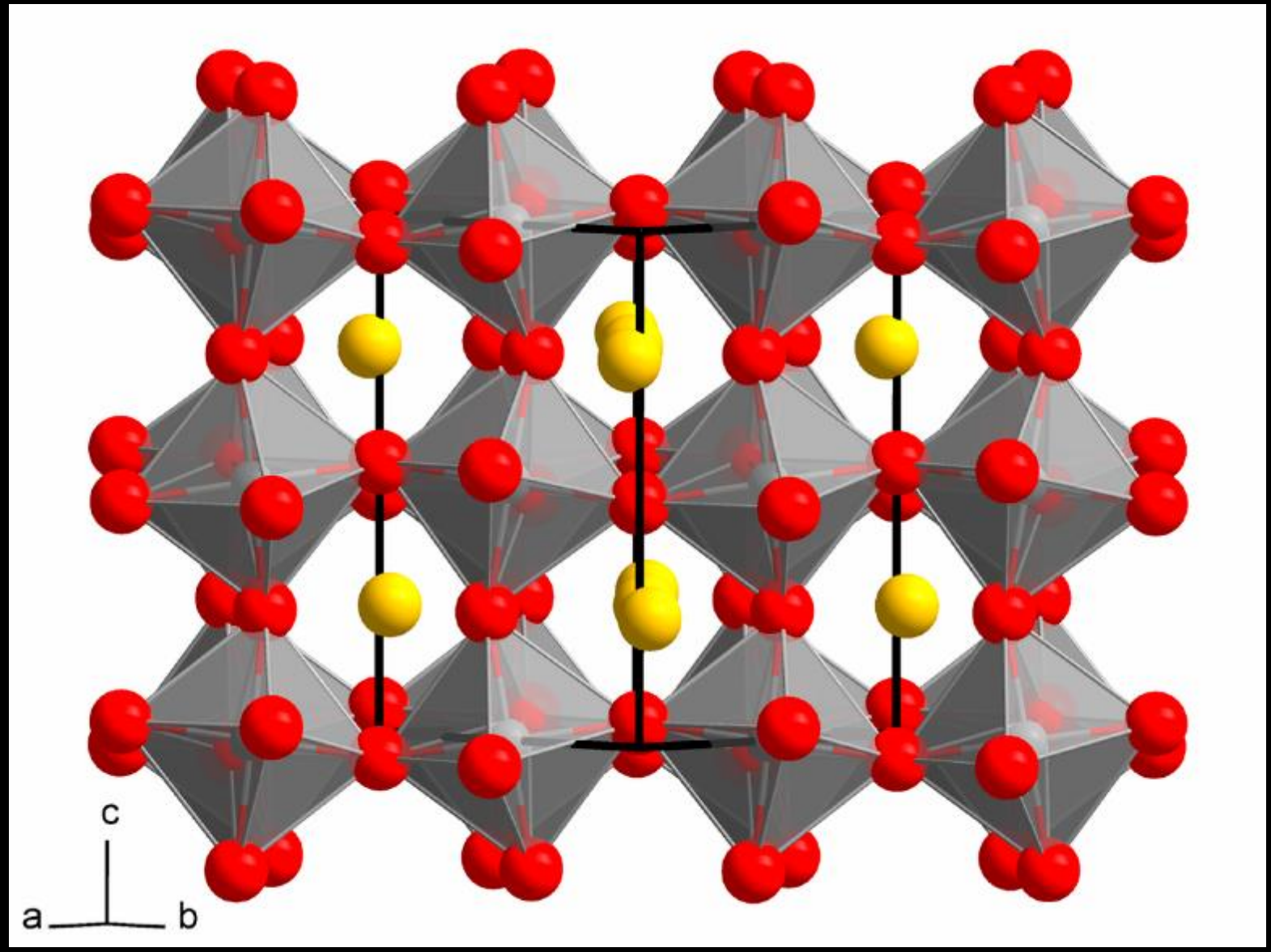
14 years old

Cleaned 3 times

Source:
Museum Conservation Institute
Smithsonian Institution
Photo by



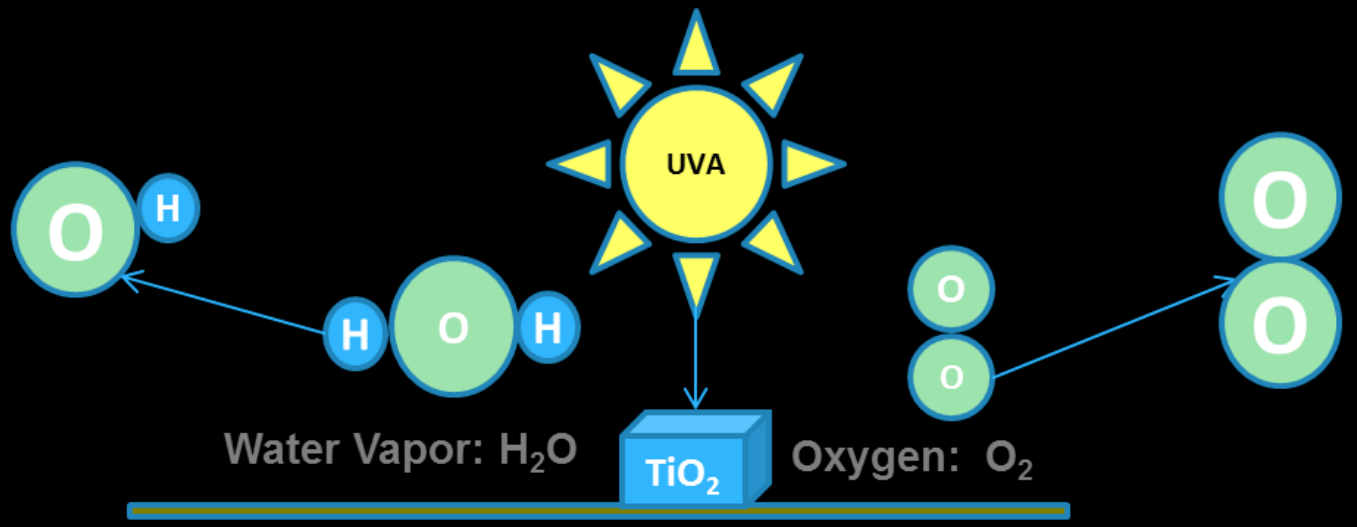
Anatase TiO_2



Effects of Photocatalysis

- Ultra Violet A creates “band gaps” on the crystal lattice.
- Breaks water (H_2O) into $OH^{\cdot}$ (hydroxide radicals) and H^+ (Hydrogen ion)
- Transforms atmospheric Oxygen (O_2) into a Super Oxide Anion (O_2^-)

Photocatalytic Oxidation

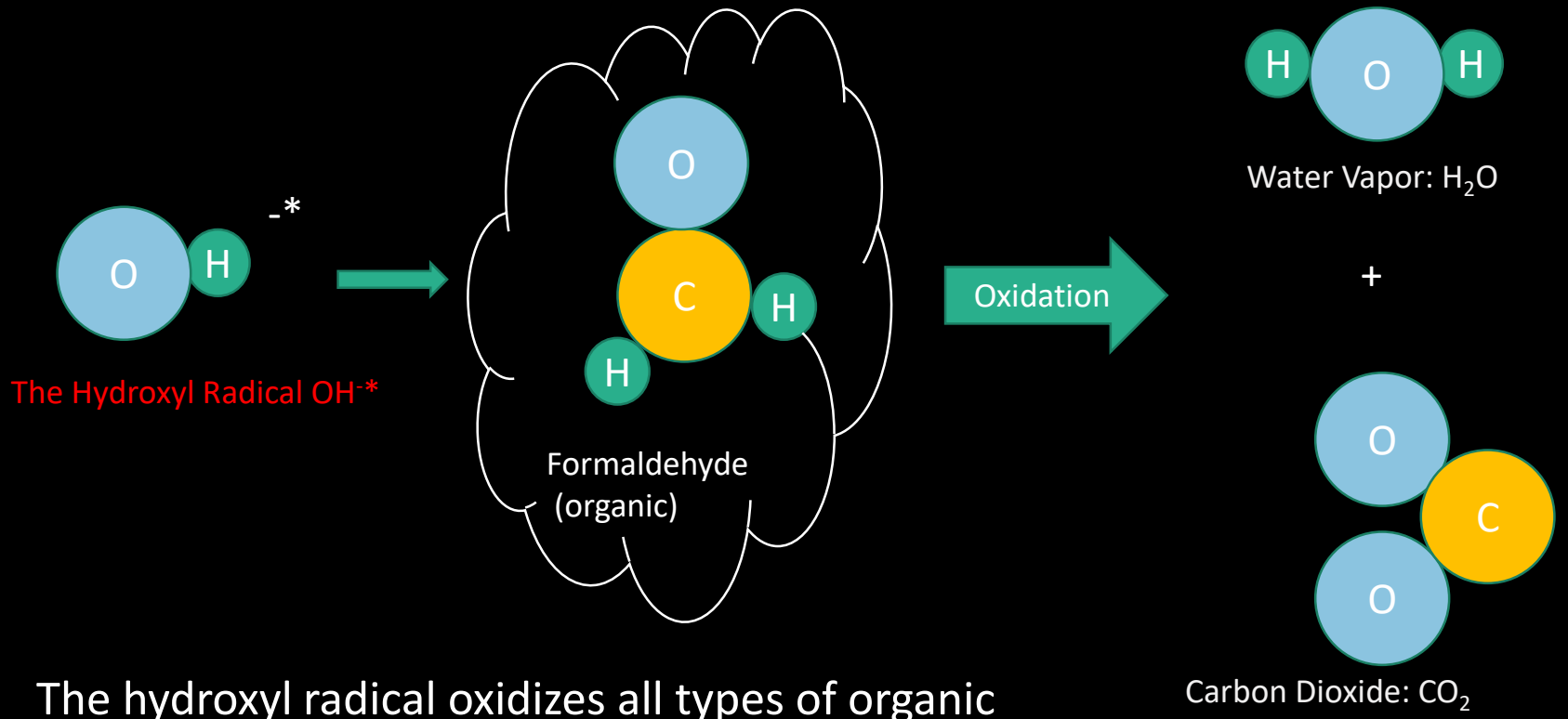


The Hydroxyl Radical OH^{-*}

The hydroxyl radical is the most powerful, non-poisonous scrubbing agent in nature - stronger than straight 100% chlorine in oxidative power.

The Super Oxide Anion O_2^{-*}
(Activated Oxygen)

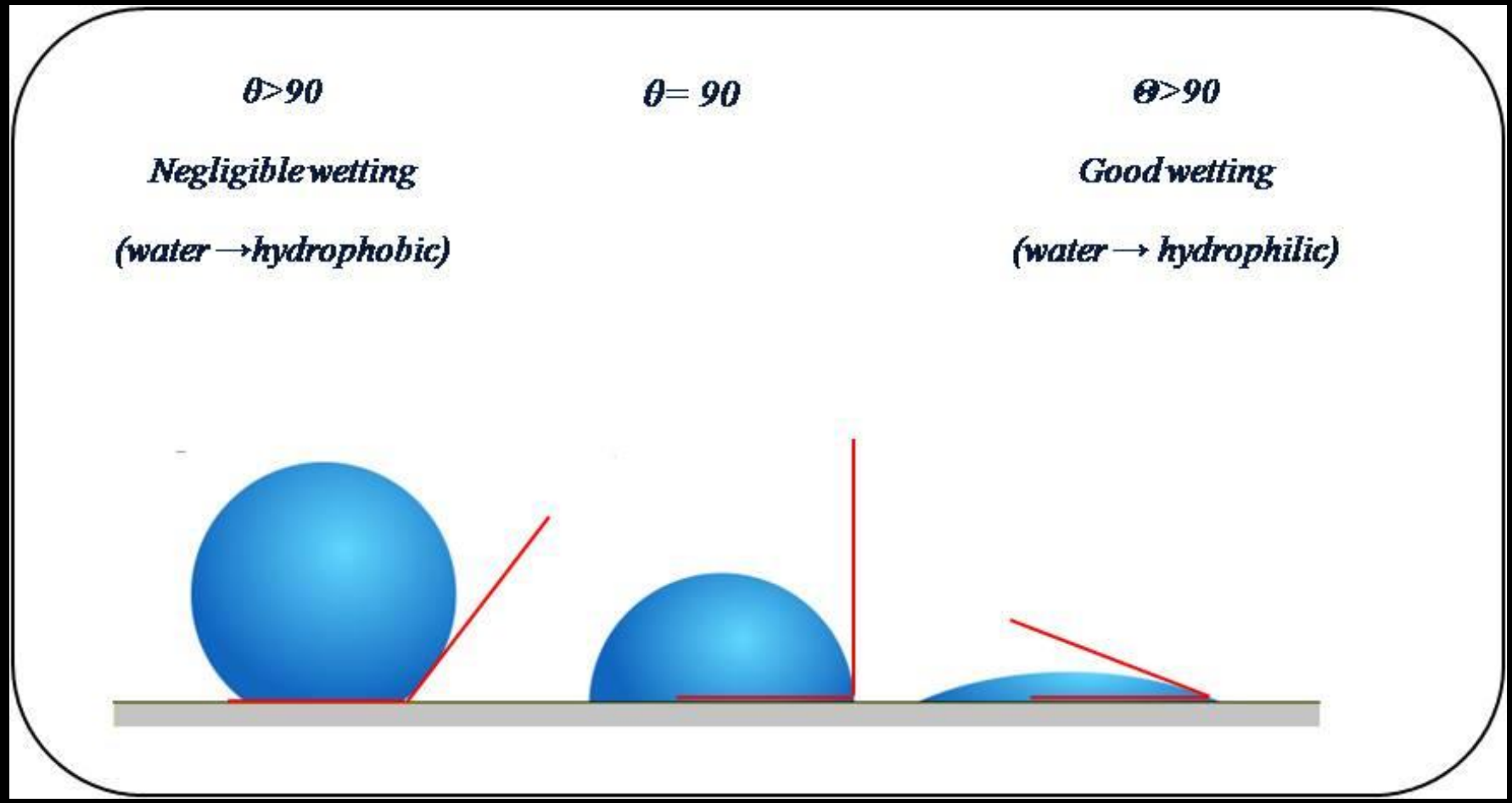
Photocatalysis: Oxidation Reaction



The hydroxyl radical oxidizes all types of organic compounds, including VOCs and formaldehyde, breaking them down to CO_2 and water vapor.

Water Contact Angle

Sheeting Action Leads to Self-Cleaning Exteriors

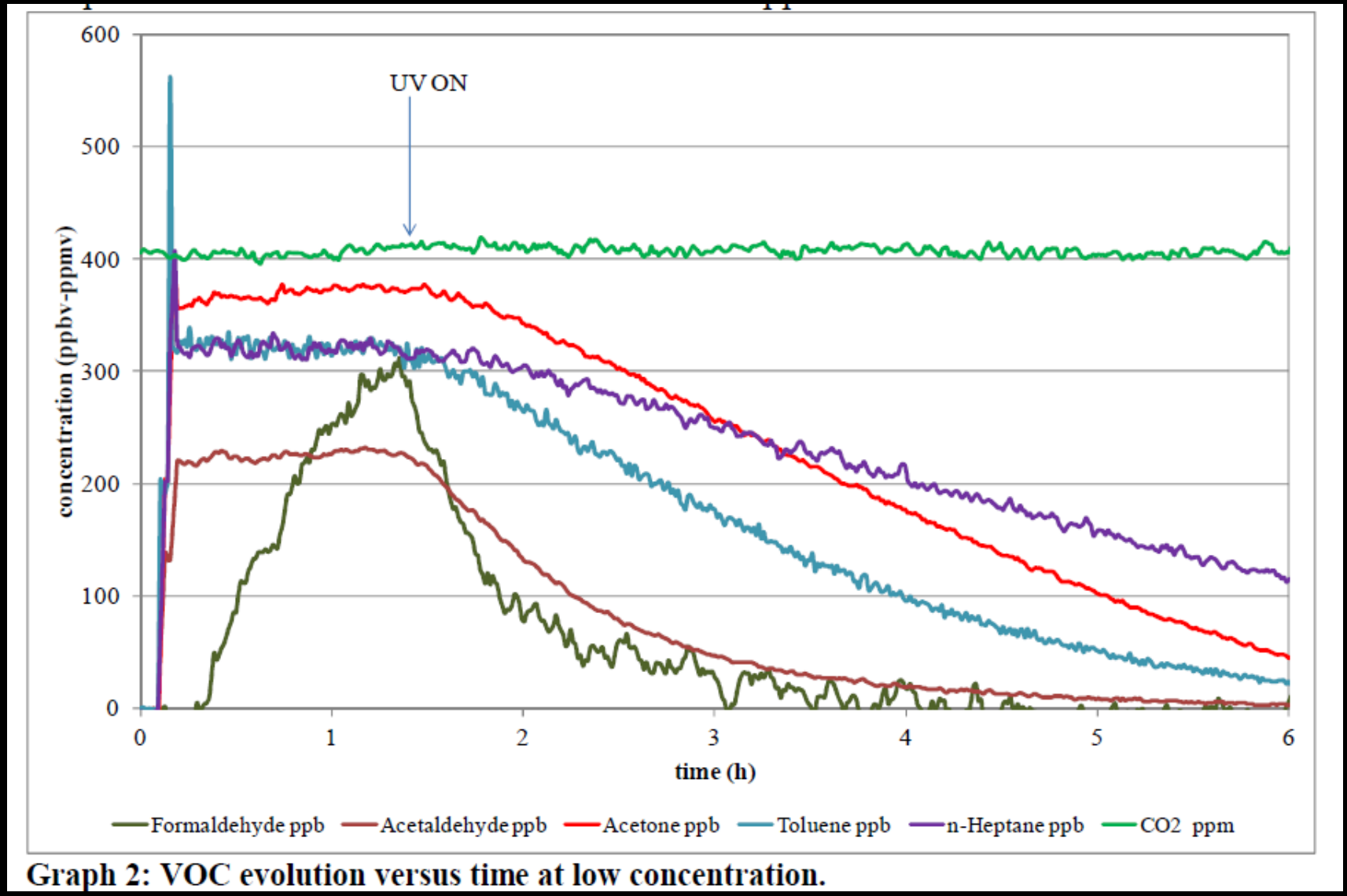



LOUISA C.
1851 — 1932
LILLIAN E.
1875 — 1963

Requirements

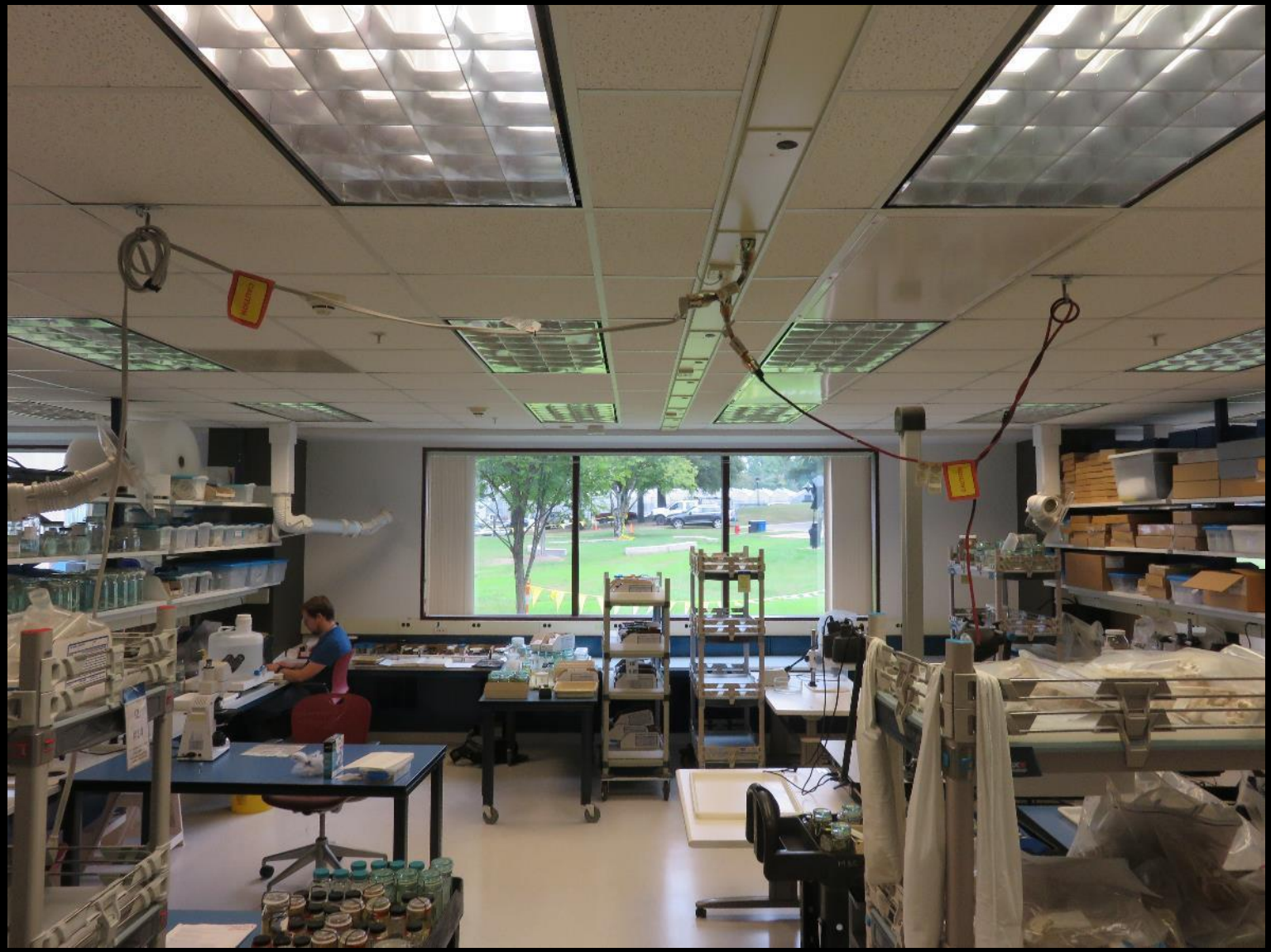
- Humidity
- UVA (natural or artificial)
- Circulation
- Catalyst
- Surface Area

Eliminates VOCs in the Presence of UV-A

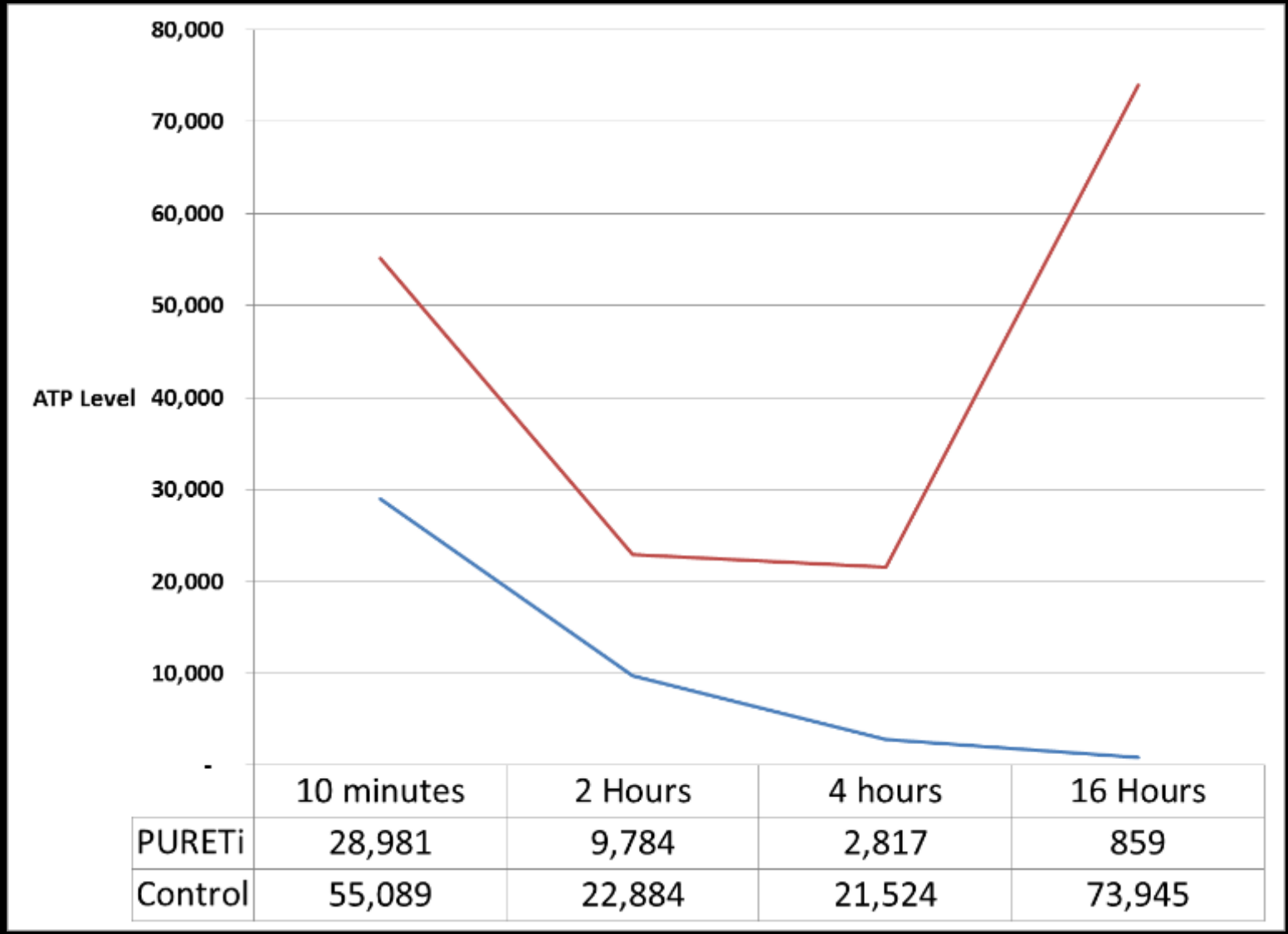


Graph 2: VOC evolution versus time at low concentration.


FIRE
CLOROX

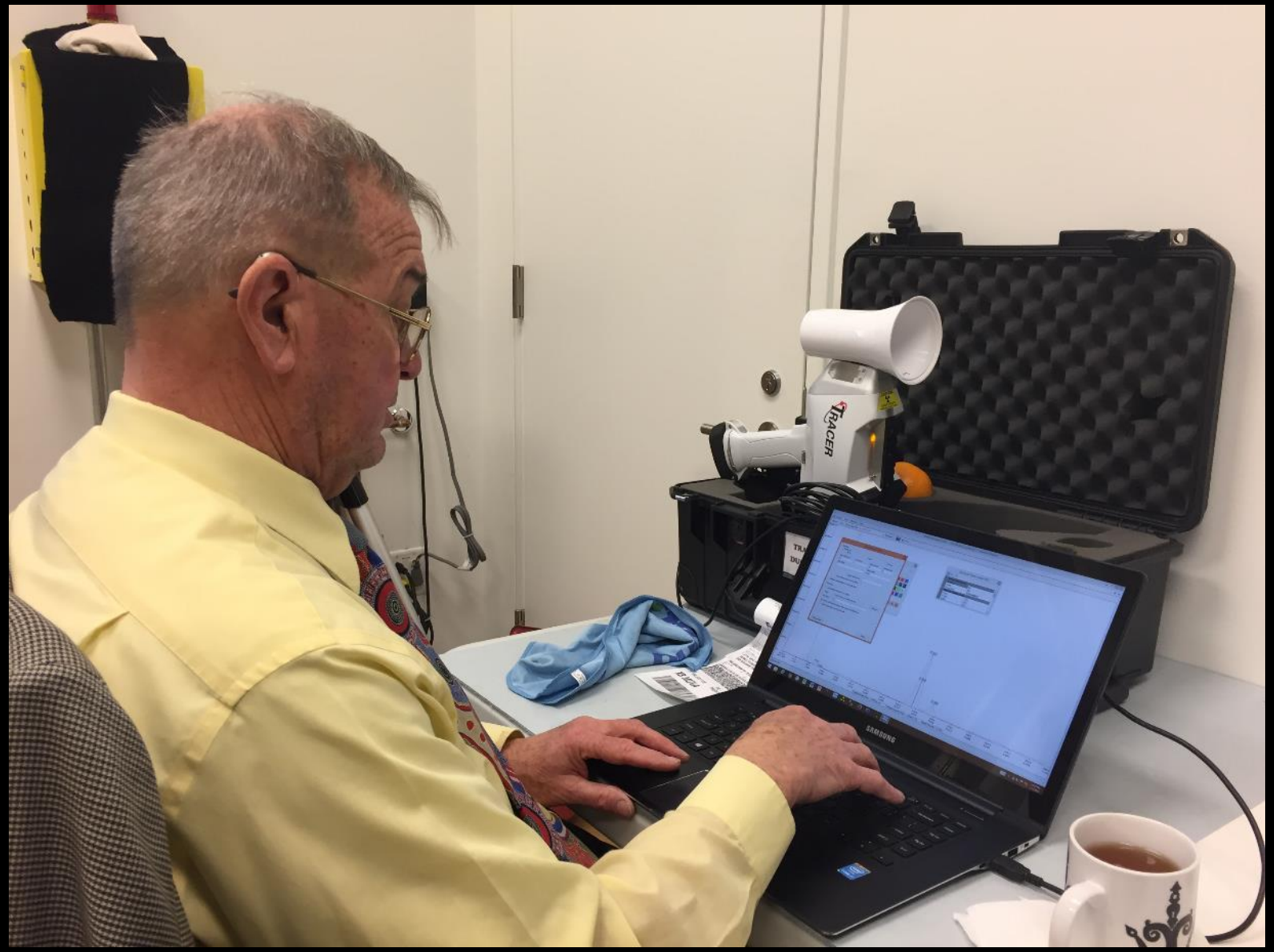


Reduction in Contact Surface ATP Levels



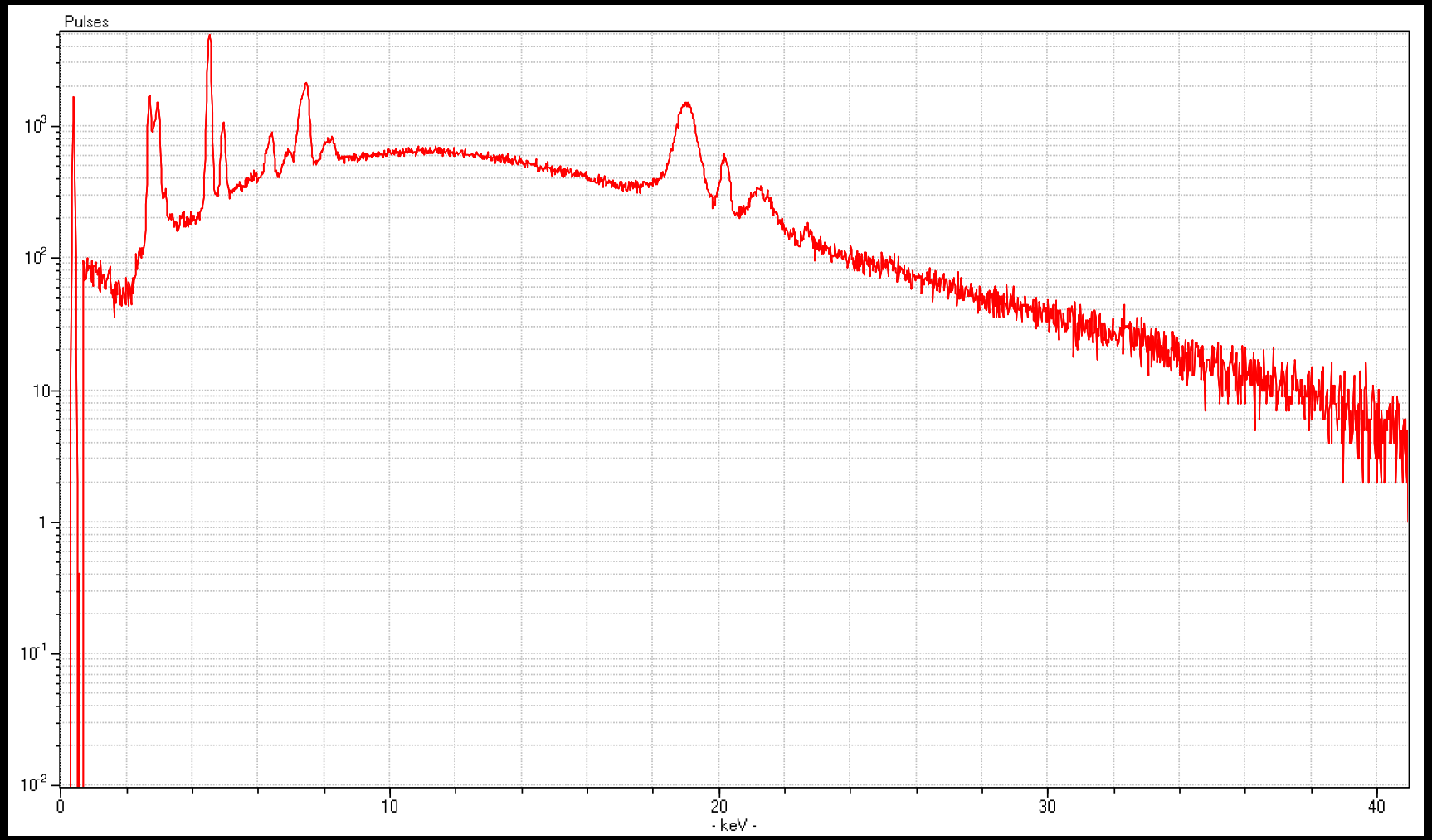
	10 minutes	2 Hours	4 hours	16 Hours
PURETi	28,981	9,784	2,817	859
Control	55,089	22,884	21,524	73,945

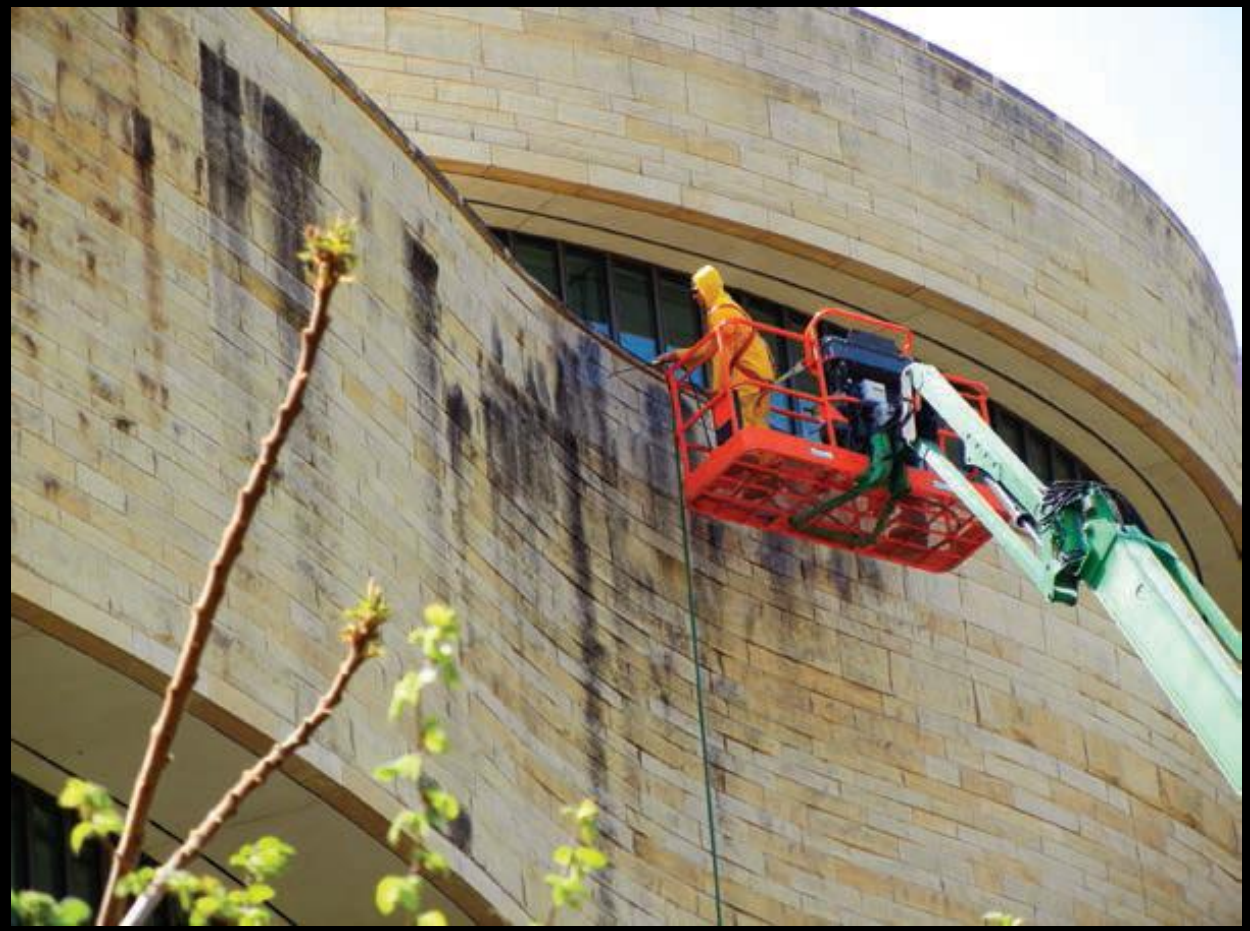
Validation using X-Ray Fluorescence




TRACER

X-Ray Fluorescence Spectra





Source:
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Smithsonian Institution
Photo by Carol A. Grissom