The GoGreen Project: Developments of Green Technologies For Preventive And Remedial Conservation Practices

Project coordinator: prof. dr. Katrien Keune, University of Amsterdam, The Netherlands

Funded by the European Union

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@GoGreen Conservation
@GoGreenHorizon2023

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GoGreen promotes preventive and remedial conservation practices based on green principles to spearhead the green revolution within conservation.

GoGreen Objectives

1. **Define** parameters for what constitutes green conservation to influence the creation of sector-wide standards.
2. **Develop** preventive conservation practices and a decision-making model that utilizes ‘green thinking’ in conservation.
3. **Develop and introduce** green innovative materials and methods inspired by historical recipes and methods, biological processes and green chemistry practices.
4. **Create** a digital web-app that helps conservators evaluate the environmental impact of their actions and supports their search for greener alternatives.
5. **Empower** practitioners by creating a sector-wide paradigm shift, making green thinking the daily standard in conservation.

Funded by the European Union

GoGreen Work Package

WP1
Project coordination and management

WP2
Green preventive conservation

WP3
Green cleaning methods

+

WP5
Methodologies greener solutic

WP4
Green stabilization technologies

WP6
Web-App prototyping

WP7
Green Education

WP8
Communication Dissemination Exploitation

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Tools for greener preventive conservation (WP2)

Objective 2: Develop preventive conservation practices and a decision-making model that utilizes ‘green thinking’ in conservation.

Chemical Evolution of Oil Paints under Different Hygrothermal Ageing Conditions – Sander van Lith
Tuesday 4.50 pm

Tools for greener preventive conservation (WP2)

Green cleaning methods (WP3)

Objective 3: Develop and introduce green innovative materials and methods inspired by historical recipes and methods, biological processes and green chemistry practices.

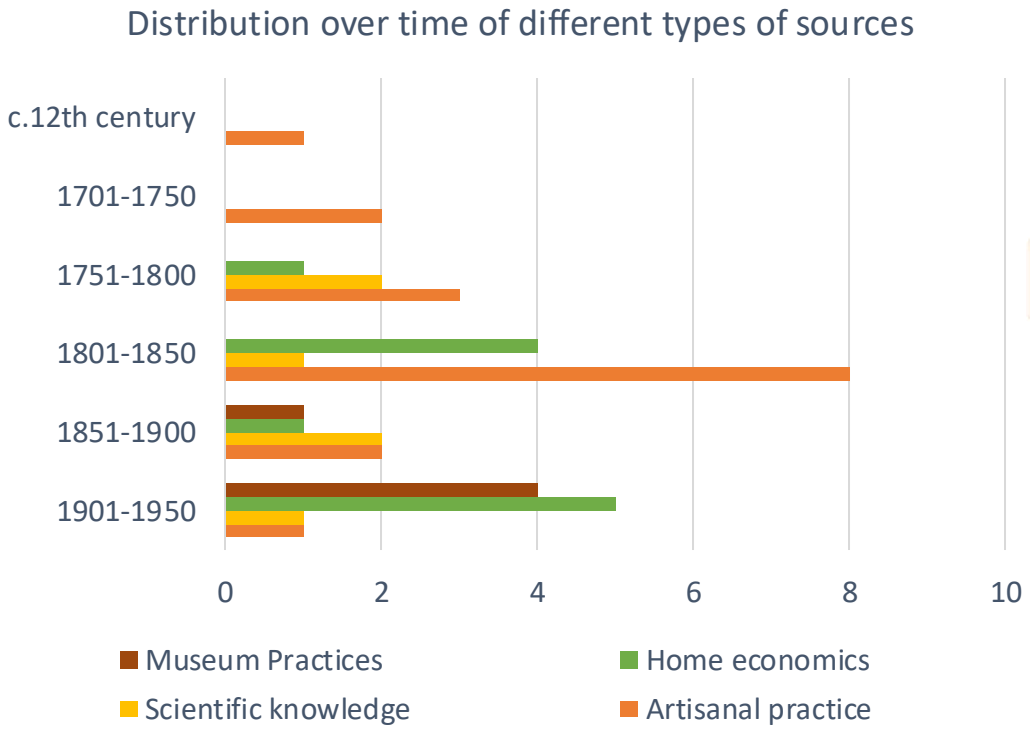
Development of Novel Green Cleaning Systems for the Removal of Dammar Varnish from Paintings – Burcu Keser
Today 11 am

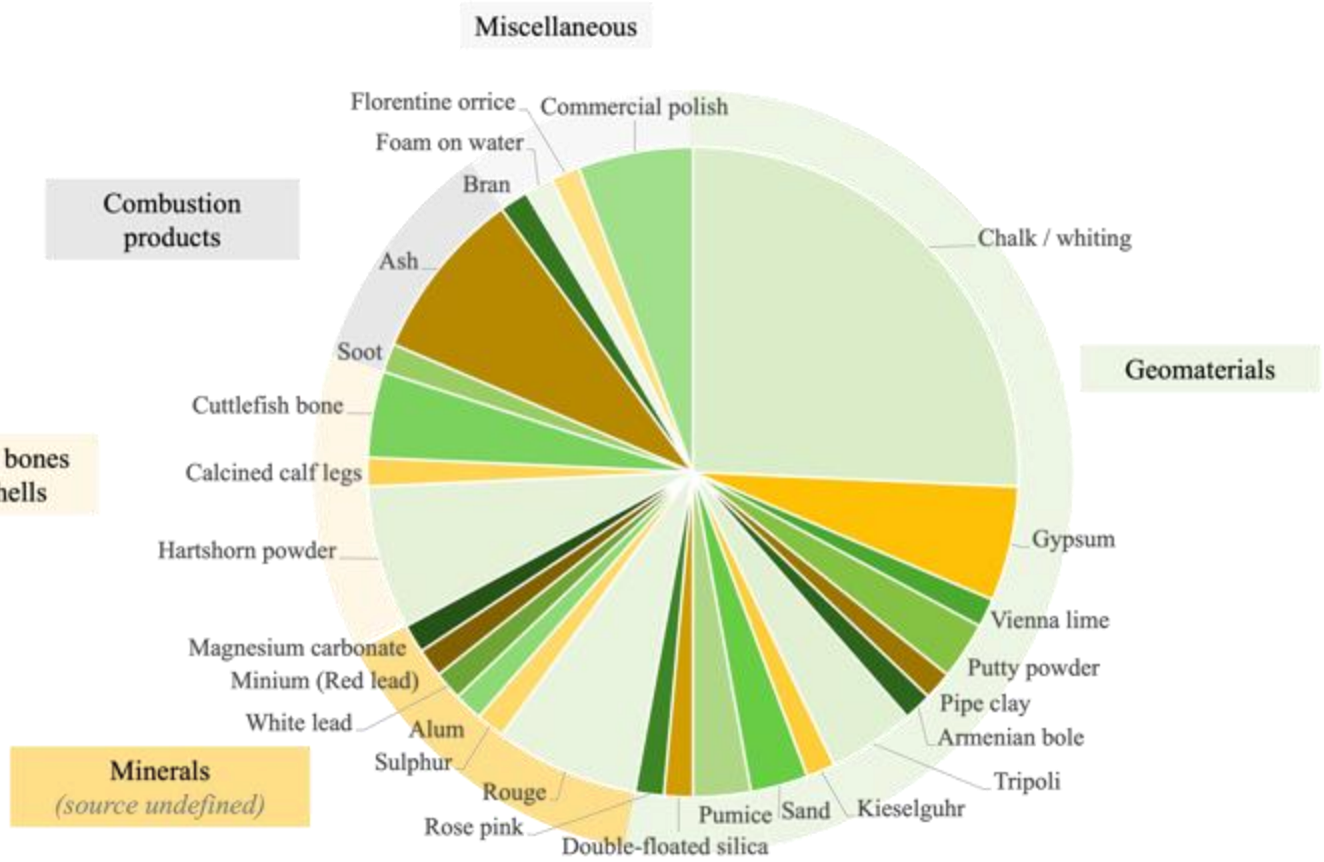
Assessment of Tarnished Silver Test Systems Prepared with Bio-based Green – Qing Wu
Thursday 4.15 pm

Study of Historical Recipe

for cleaning of silver tarnish

University of Amsterdam
Han Zhou, PhD candidate





Materials for mechanical cleaning mentioned in historical recipes

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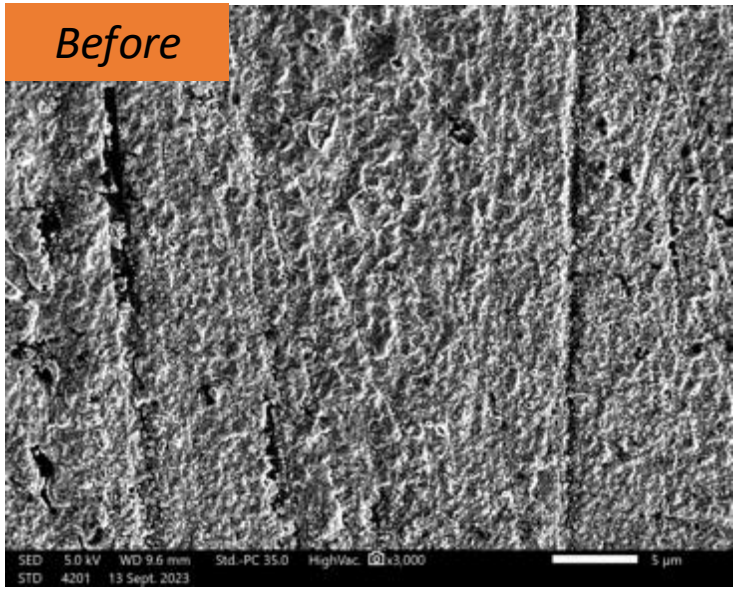
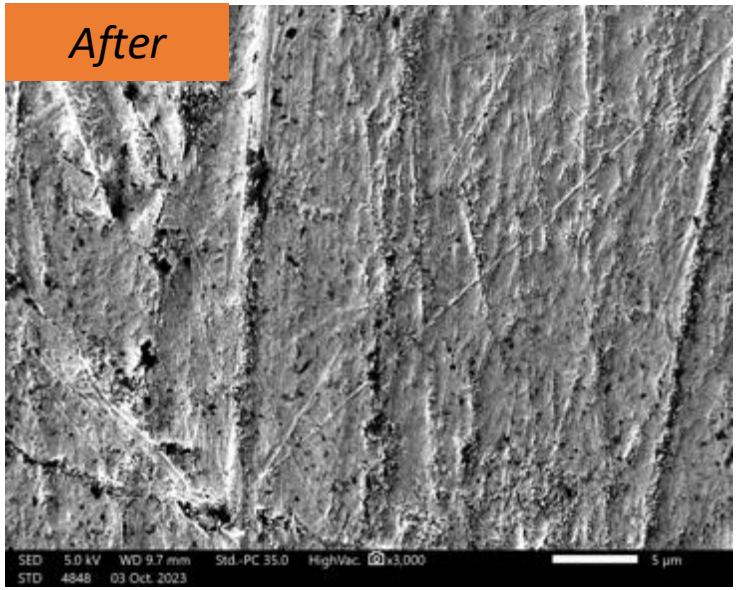
Recipe Reconstruction

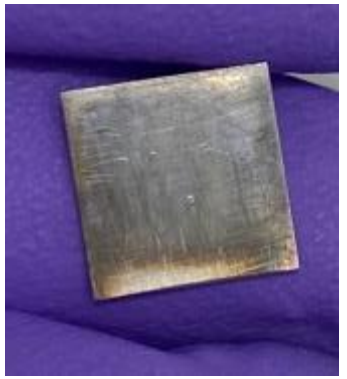
- Historically appropriate materials
- Re-enactment of the recipes
- Cleaning tests on mock-up systems
- Visual and Instrumental analysis

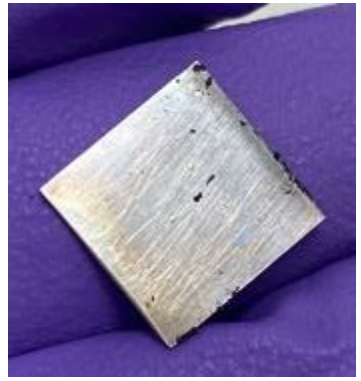
Straw ash mixed with deionised water as a polishing paste.





BSE image of Sterling silver coupons before and after cleaning with ash paste, 3,000x, scale bar = 5 µm



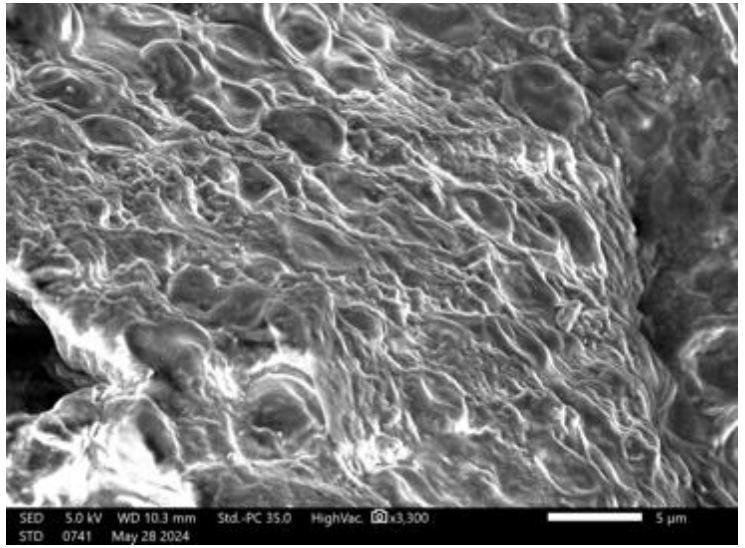


UNIVERSITY OF AMSTERDAM

Ash making

Soap making

Wine lees investigation



SE image of dried wine lees, magnification x3,300, scale bar = 5 µm

Cleaning as a conservation treatment

What is being cleaned/removed?
Objectives of cleaning
Evaluation cleaning criteria
…

Cleaning as a technique/technology

Technical choices
Know-how/scientific principles
…

CLEAN

Cleanliness as a subjective perception

What is considered clean for heritage objects in a museum context?
Whose perception matters?
…

Cleanliness as a constructed notion

Why (a) *clean* (object) matters?

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Green stabilisation technologies (WP4)

Objective 3: Develop and introduce green innovative materials and methods inspired by historical recipes and methods, biological processes and green chemistry practices.

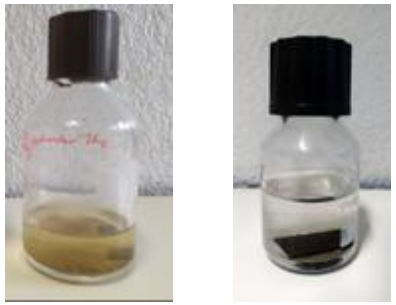
Biopassivation

Archaeological copper objects

Joseph, E. (2021). Biopassivation method for the preservation of copper and bronze artefacts. Frontiers in Materials, 7, 613169.

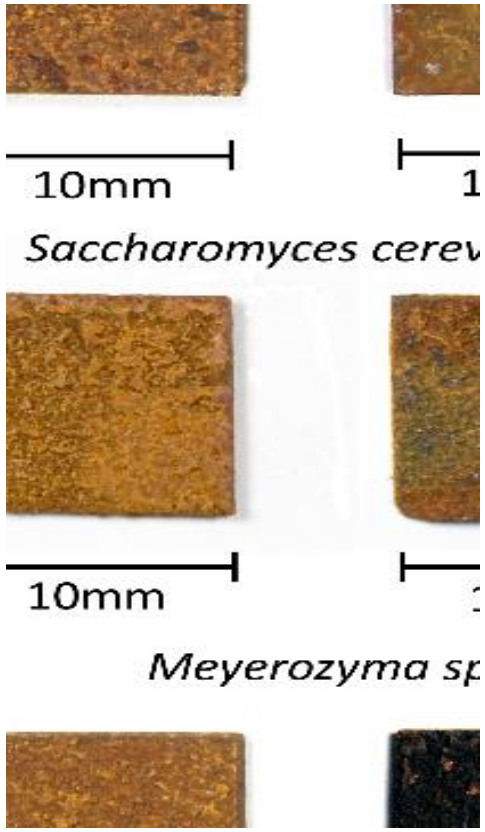
Green stabilisation technologies (WP4)

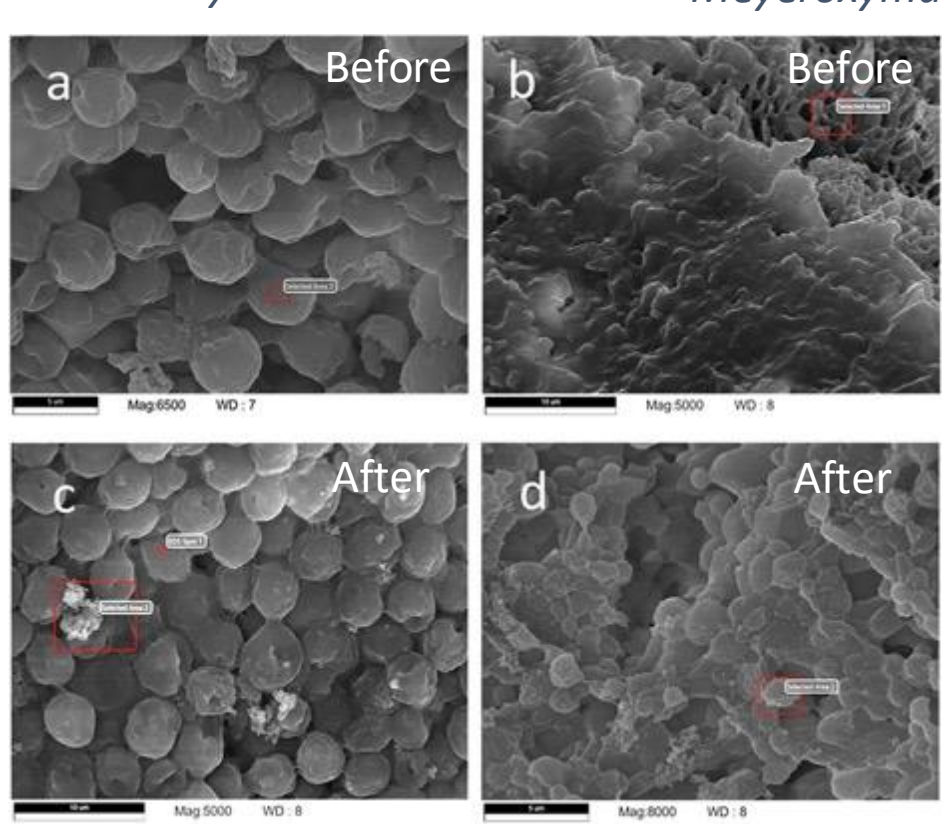
Patrycja Petrasz, PhD student



Stabilization of iron artefacts

- ✓ Pilot study with *Meyeroxyma* and *Saccharomyces cerevisiae*
- ✓ Preliminary tests on artificially aged steel samples





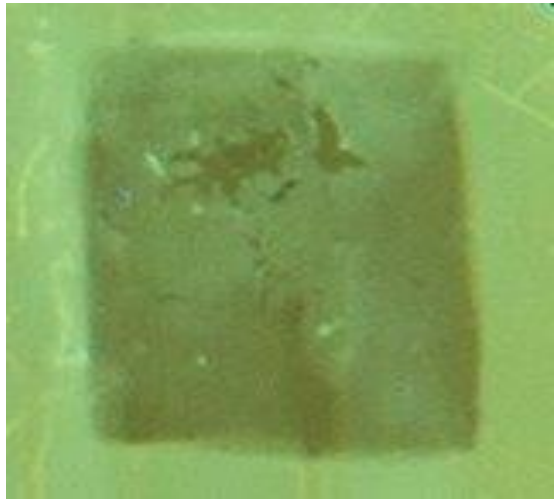
Petrasz, P., Zhioua, S., James, S., Bindschedler, S., Junier, P., & Joseph, E. (2024). Green Alternatives for Archaeological Iron Stabilization. Studies in Conservation, 1-11.

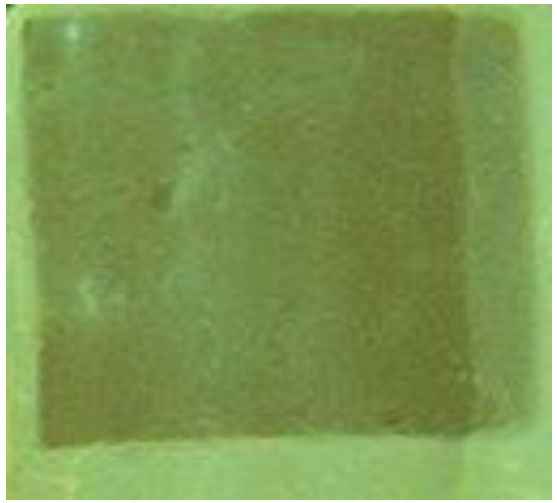
Methodologies for Greener Solutions (WP5)

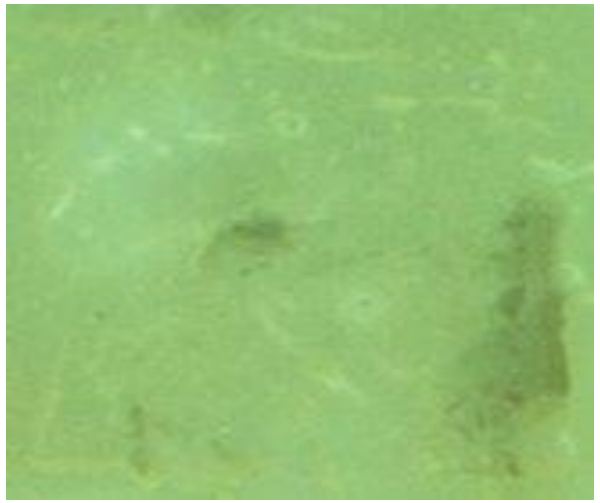
Laure Cazals,
PhD candidate

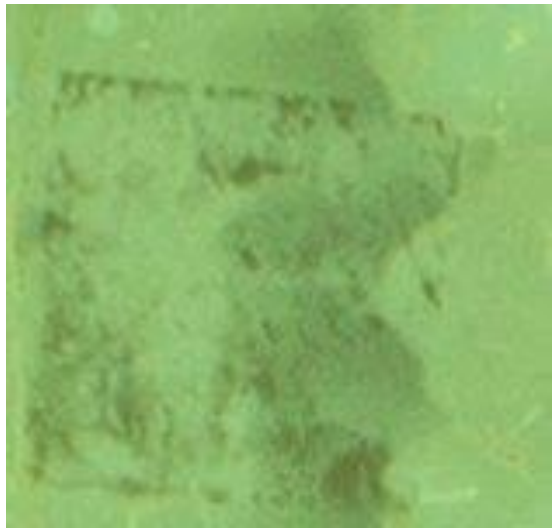
Francesca Ramacciotti, post-doc

ASSESMENT METHODS CLEANING PERFORMANCE





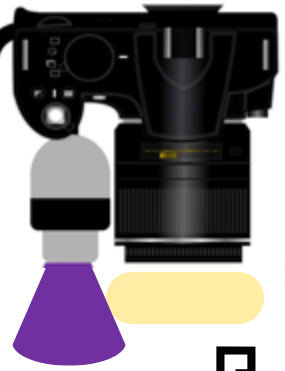




Ramacciotti, F., Sciutto, G., Cazals, L., Biagini, D., Reale, S., Degano, I., ... & Prati, S. (2024). Microporous electrospun nonwovens combined with green solvents for the selective peel-off of thin coatings from painting surfaces. Journal of Colloid and Interface Science, 663, 869-879.

Methodologies for Greener Solutions (WP5)

Photoluminescence macro imaging

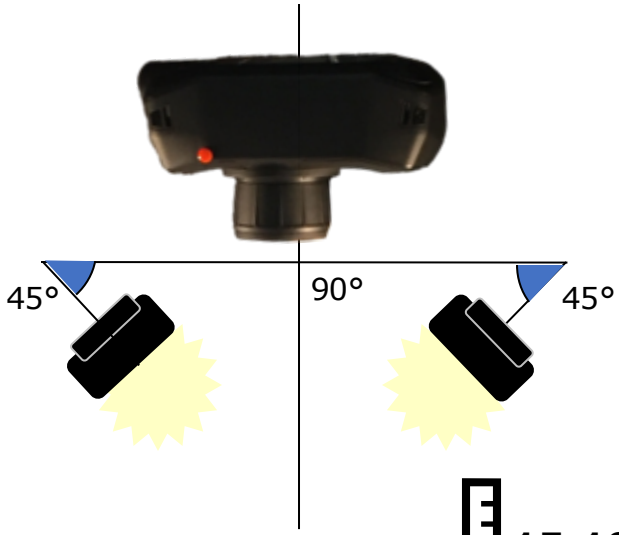


Low-noise 1 megapixel Si EM-CCD camera fitted with UV-VIS-IR 60 mm 1:4 Apo Macro lens

λ_{ex}= 365 nm

Interference band-pass filter

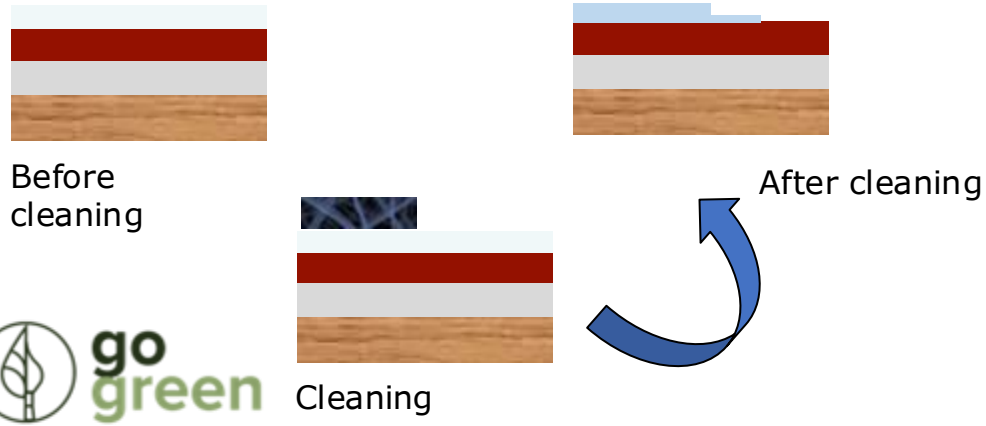
15-20 cm

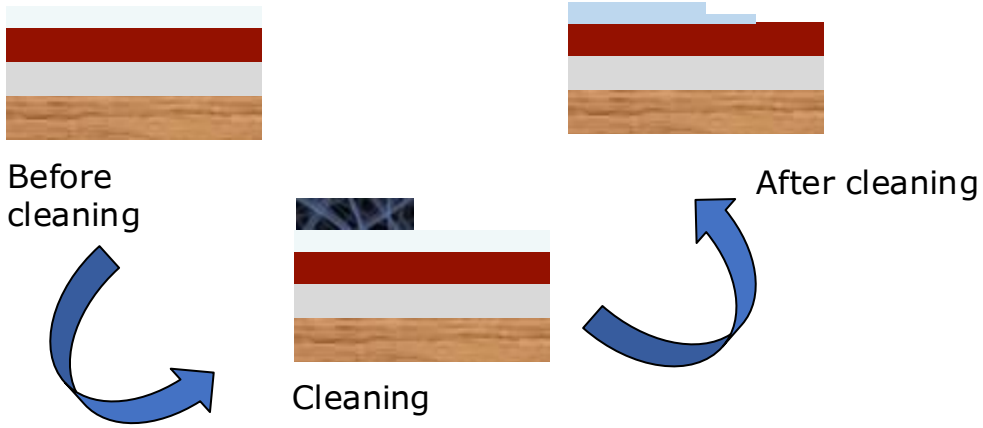


15-18 cm

SPECHIM IQ

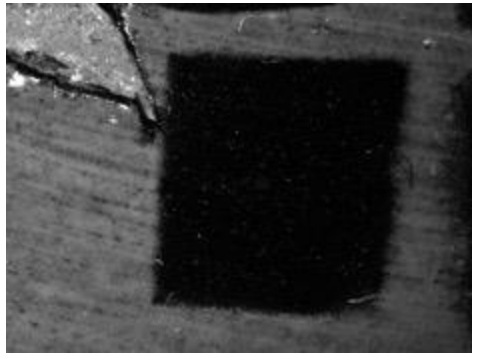
Features	Values
Spectral camera	VNIR
Wavelength range	400-1000 nm
Spectral resolution FWHM	7 nm
Spatial Sampling	512x512 pix
Spectral bands	204
Approx pixel size @18 cm	0.3x0.3 mm



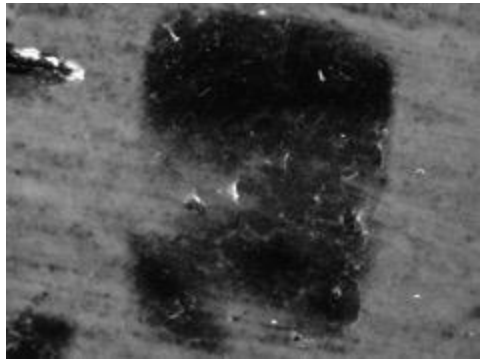


Methodologies for Greener Solutions (WP5)

ASSESMENT METHODS: CLEANING EFFICACY



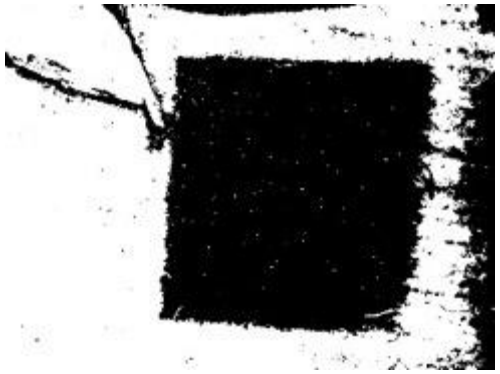
PA04 386 um, 19 uL DMC



PA2 393um, 16 uL DMC

PL images: 16 bit

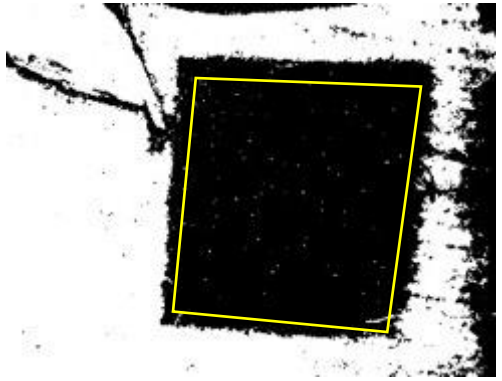
Selection of upper and lower thresholds



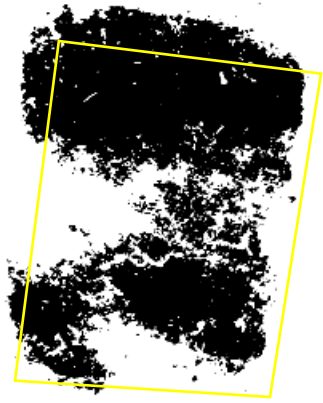
Binary image

Area selection

Count white pixels



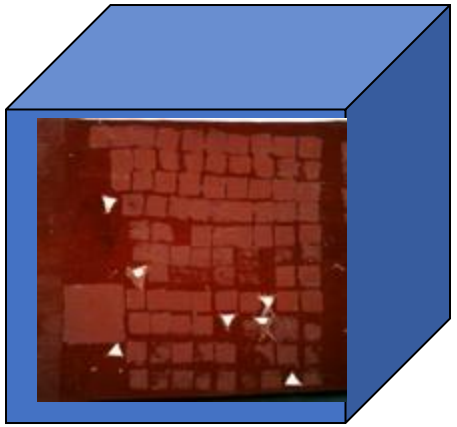
0.5 % of residues



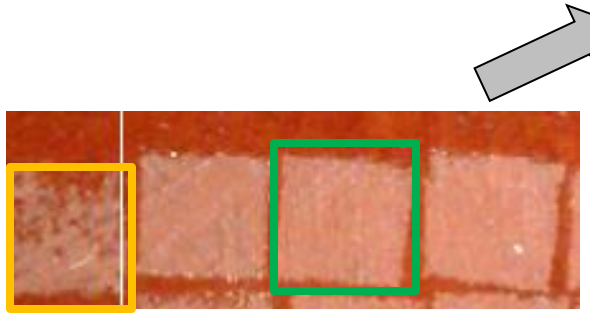
34 % of residues

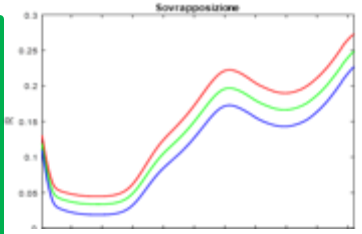
LED 100%, ex 365, filter 514-30, 10 sec

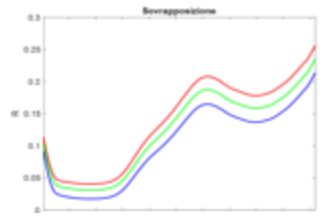
Methodologies for Greener Solutions (WP5)

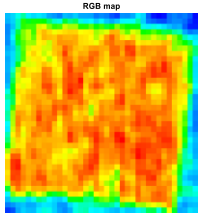


Principal Component Analysis (PCA)

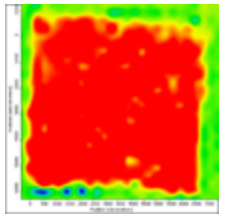




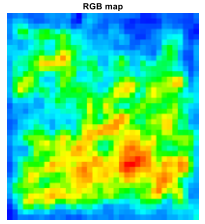




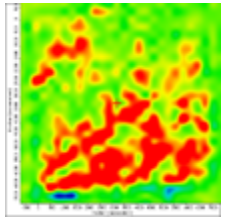
Vis-NIR



FTIR



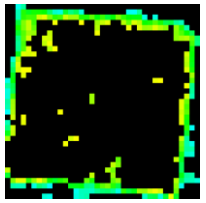
Vis-NIR

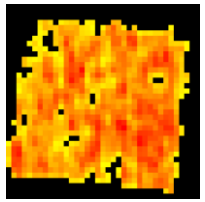


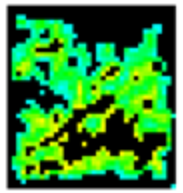
FTIR

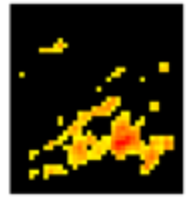
Residues: 24% of the treated pixels

Cleaned: 76% treated pixels







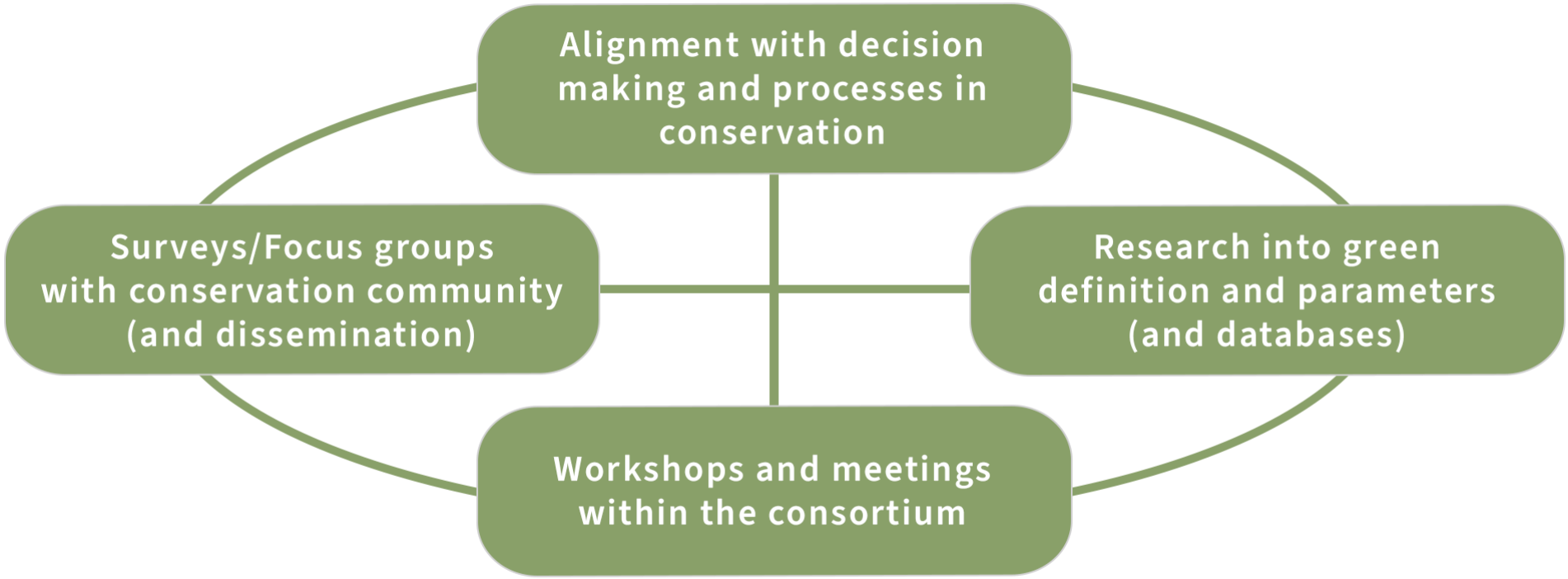


Presence of residues: 75% of pixels

Cleaned 25 % of pixels

Communication, Dissemination and Exploitation (WP8)

Objective 1: Define parameters for what constitutes green conservation to influence the creation of sector-wide standards.



Connecting research and Feedback. Strategy of connected processes for defining Green in Conservation.

Communication, Dissemination and Exploitation (WP8)

Green Parameters key factors for green conservation

HAZARD impacts on human and environment

- **Toxicity** (and hazard metrics) environment direct and indirect.
- **Toxicity** (and hazard metrics) user direct and indirect.

Impacts on CLIMATE CHANGE

- **Energy** - Climate indoor control and outdoor user location.
- **Energy** - Consumption specific application (preventive requirements, active conservation, analyses) and after treatment implications.
- **Energy** - Carbon Footprint materials used (STiCH Calculator/GHG emissions/CO2e/GWP).

Impacts on RESOURCES

- **Availability** materials – water use & resource depletion.
- **Availability** materials - biodiversity impacts.
- **Waste** – disposal, re-usability, recycling.
- **Material** selection and application method.

ART WORK specific / professional parameters

- **Number** of applications (quantity).
- **Longevity** of treatment (retreat and durability/lifetime of materials).
- **Accessibility** – availability in production & purchasing in location, product information, cost of materials.
- **Quality** of result.
- **Accessibility** – Ease of use (working properties). Time for testing/ adaptations during treatment. Time needed for treatment.

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Defining Green for Conservation Decisions & Practices

Work in progress definition / 26.06.2024

Holistic Definition for Cultural Heritage Conservation

Conservation has a uniquely positive and powerful role to play in shaping a sustainable future: it preserves cultural heritage for current and future generations and increases economic and societal resilience. Cultural Heritage is endangered because of climate change and environmental destruction. Assessing and adapting professional practices to help combat these ultimate 'agents of deterioration' is therefore, in itself, cultural heritage conservation. A green conservation approach prioritises the environment and human health through holistic, heritage conservation decision-making. Aligned with conservation ethics and values it allows for future developments in the conservation field, and considers the entirety of consequences before, during and after interventions. Cultural heritage professionals should actively advocate adopting a green conservation approach, with support in accordance with the economic, social and environmental pillars of sustainability.

Green Conservation

'Green conservation' is not harmful to the environment or to the conservator, it is carbon neutral, zero-waste, accessible and available. Green conservation is an ideal which we strive for through greener conservation, which takes all these aspects into consideration in line with current and continuing research. Greener conservation practices encompass the decisions made within the context of collection management, any preventive measure or treatment, the materials used, the frequency of treatment and long-term impacts. Greener conservation reinforces and furthers the positive role of conservation in the sustainability of our culture.

Green Parameters key factors for green conservation

HAZARD impacts on human and environment

- **Toxicity** (and hazard metrics) environment direct and indirect.
- **Toxicity** (and hazard metrics) user direct and indirect.

Impacts on **CLIMATE CHANGE**

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- **Quality** of result.
- **Accessibility** - Ease of use (working properties). Time for testing/ adaptations during treatment. Time needed for treatment.

The associated parameters for defining green conservation, considering conservation's strategic impact areas within the sustainable development goals

'Green conservation' is informed by the larger context of sustainability and defined by the parameters considered most relevant to conservation. This definition aims to outline environmental impacts alongside professional responsibilities and requirements within conservation decisions and practice, hereby considering the pertinent socio-economic aspects. The parameters are linked with the strategic impact areas as illustrated in the adjacent figure. This definition focuses solely on conservation. The broader environmental impacts, social aspects and implicit value of cultural heritage itself are not directly included herein.

Figure. Strategic impact areas identified within the United Nations 17 Sustainable Development Goals. Model diagram based upon the approach from the World Green Building Council.*

*The content of this publication has not been approved by the United Nations and does not reflect the views of the United Nations or its officials or Member States.

Want to know more?

gogreenconservation.eu/

info-gogreen@uva.nl

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Funded by the European Union

Defining Green for Conservation Decisions & Practices

Holistic Definition for Cultural Heritage Conservation

Green Conservation

Green Parameters

Strategic impact areas

www.gogreenconservation.eu

Manifesto for Sustainable Cultural Heritage Conservation – 2023

greenculturalheritage.eu

Thank you!

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