

Supplementary

Removing Aged Polymer Coatings from Porous Stone Surfaces by Gel Cleaning Method

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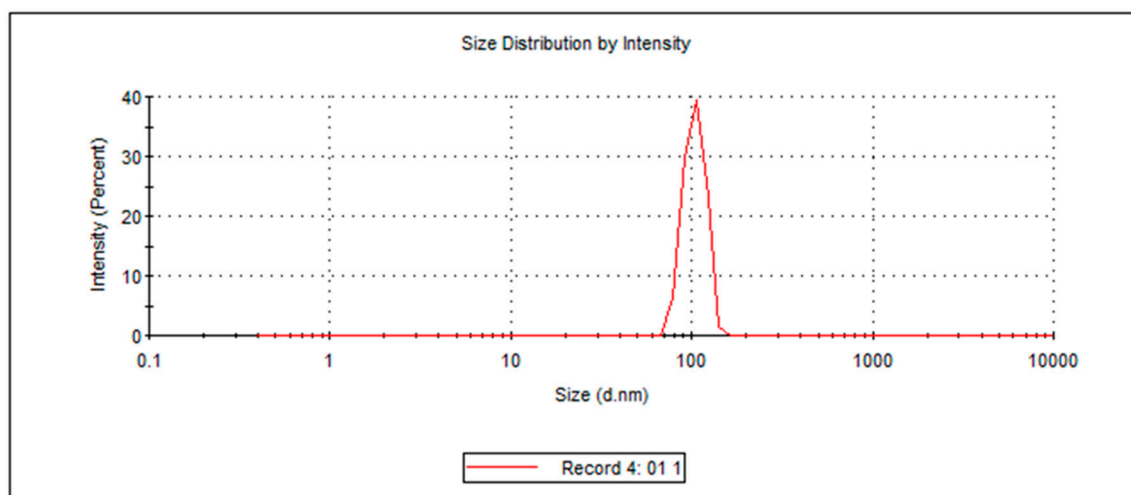


Figure S1. Dynamic light scattering (DLS) analysis of prepared NSE.

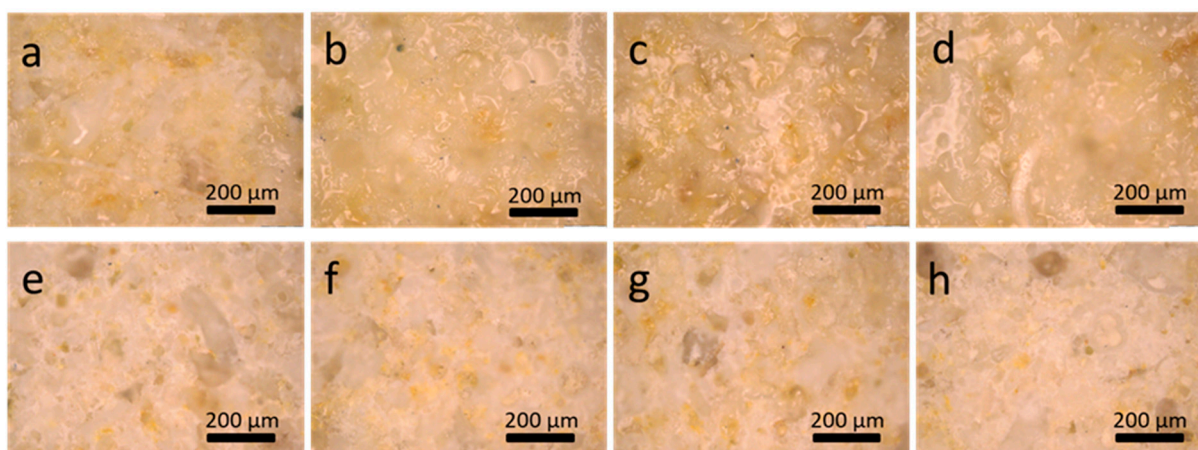


Figure S2. Optical microscope images of unaged and aged LS after polymer removal using emulsion-loaded hydrogels: (a) unaged LSPB; (b) 12d LSPB; (c) 25d LSPB; (d) 35d LSPB using EcoSurf/H₂O; (e) unaged LSPB; (f) 12d LSPB; (g) 25d LSPB; (h) 35d LSPB using NSE.

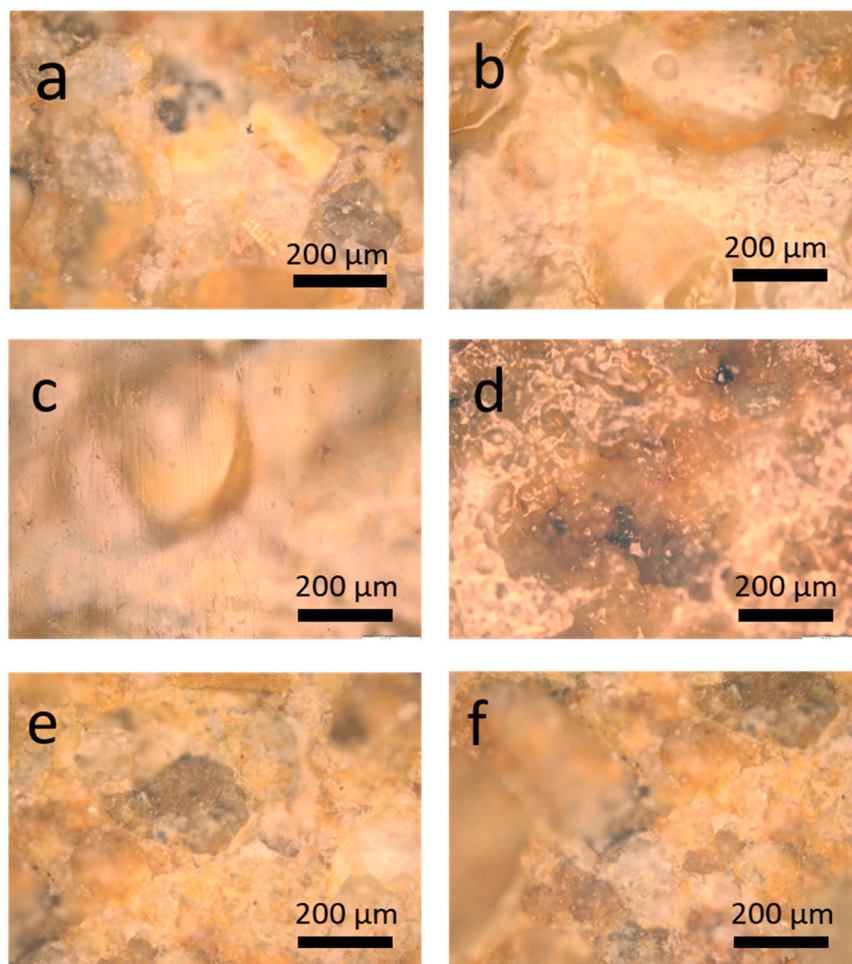


Figure S3. Optical microscope images of AS: (a) original/ natural AS; (b) coated ASPB before cleaning; (c) unaged ASPB; and (d) 35d ASPB cleaned using EcoSurf/H₂O; (e) unaged ASPB; (f) 35d ASPB cleaned using NSE.

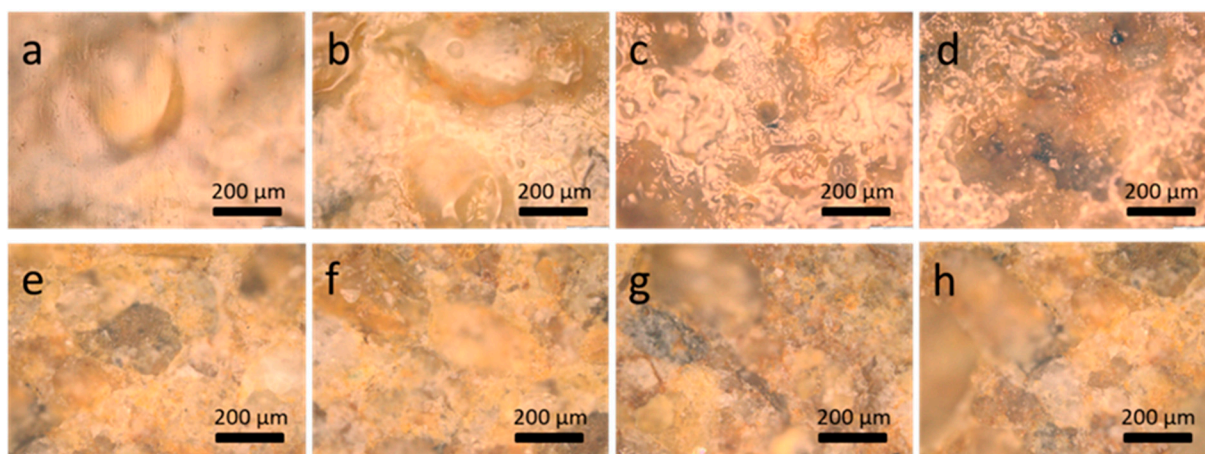
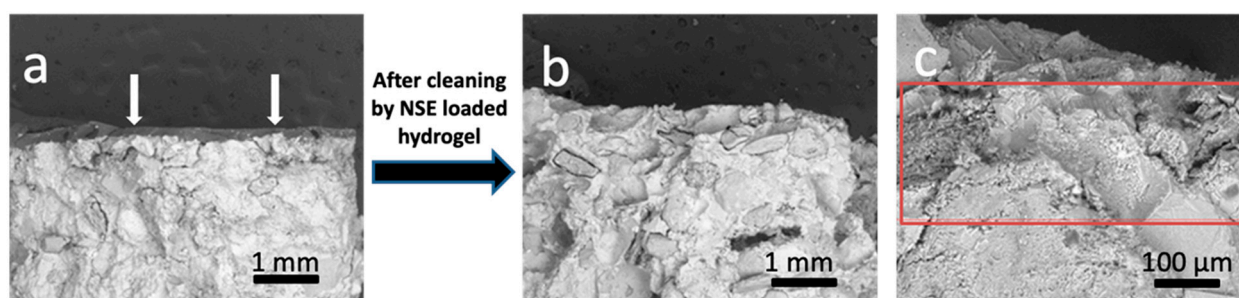


Figure S4. Optical microscope images of unaged and aged AS after polymer removal using emulsion-loaded hydrogels: (a) unaged ASPB; (b) 12d ASPB; (c) 25d ASPB; (d) 35d ASPB using EcoSurf/H₂O; (e) unaged ASPB; (f) 12d ASPB; (g) 25d ASPB; (h) 35d ASPB using NSE.

Table S1. The results of the EDS semi-quantitative analysis of both LS and AS (carbon/calcium Wt%): uncoated, coated, and after cleaning with two different emulsions (unaged and 35 day aged).

Stones	Carbon/Calcium (Wt%)						
	Uncoated	Coated		Cleaned—EcoSurf/H ₂ O		Cleaned—NSE	
		Unaged	35d aged	Unaged	35d aged	Unaged	35d aged
LS	0.30±0.02	26.9 ±0.6	2.7 ±0.8	13.2 ±1.2	2.1 ±0.5	0.20 ±0.01	0.20 ±0.03
AS	0.30±0.06	45.4 ±0.5	44.5 ±1.7	36.4 ±0.4	34.5 ±0.7	0.40 ±0.01	0.30 ±0.02

**Figure S5.** SEM images of the cross-sections of 35d aged AS before and after polymer removing using NSE-loaded hydrogels: (a) before cleaning ASPB; (b) after cleaning ASPB; (c) at a higher magnification of (b).**Table S2.** Chromatic coordinates of coated (Paraloid B-72) stone specimens after being exposed to 35 days of ageing cycles and after being removed by hydrogels loaded with two different emulsions (EcoSurf/H₂O and NSE): variations refer to the uncoated/natural stone surfaces.

Samples	Coated 35d-aged			Cleaned-EcoSurf/H ₂ O			Cleaned-NSE		
	ΔL*	Δa*	Δb*	ΔL*	Δa*	Δb*	ΔL*	Δa*	Δb*
LSPB	-6.63±0.44	1.80 ±0.52	8.22 ±0.26	-6.01 ±2.33	1.21 ±0.44	6.70 ±0.18	0.75 ±0.31	0.71 ±0.56	0.21 ±0.10
ASPB	-12.53 ±1.37	2.61 ±0.63	4.20 ±1.44	-11.21 ±0.40	2.88 ±1.32	2.06 ±0.11	2.84 ±0.35	-1.46 ±0.20	0.26 ±0.10

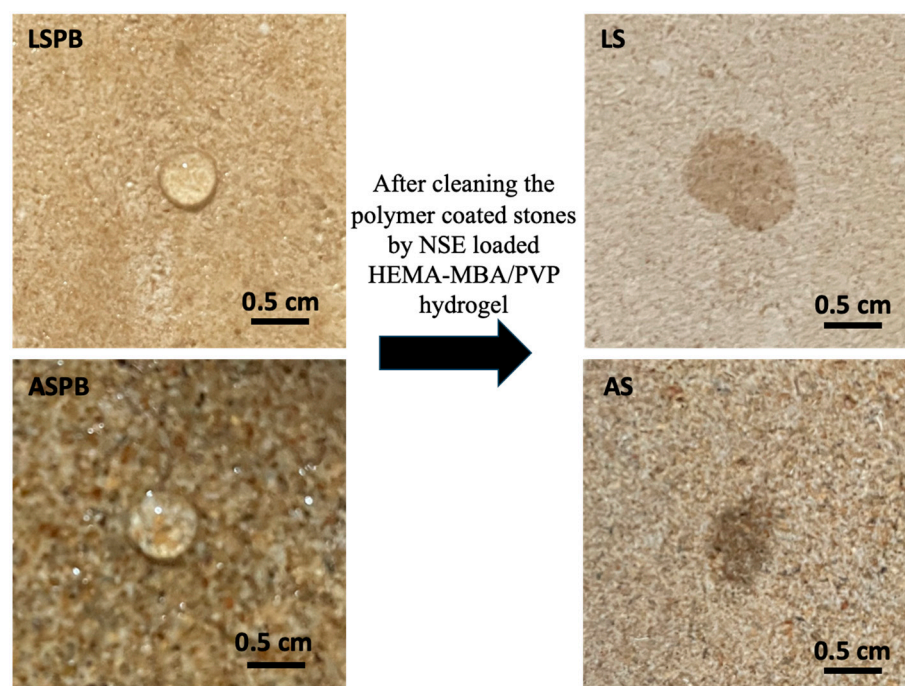


Figure S6. Deposition of water droplets on coated stone specimens (LSPB and ASPB) and on the same specimens after cleaning using NSE-loaded hydrogels.

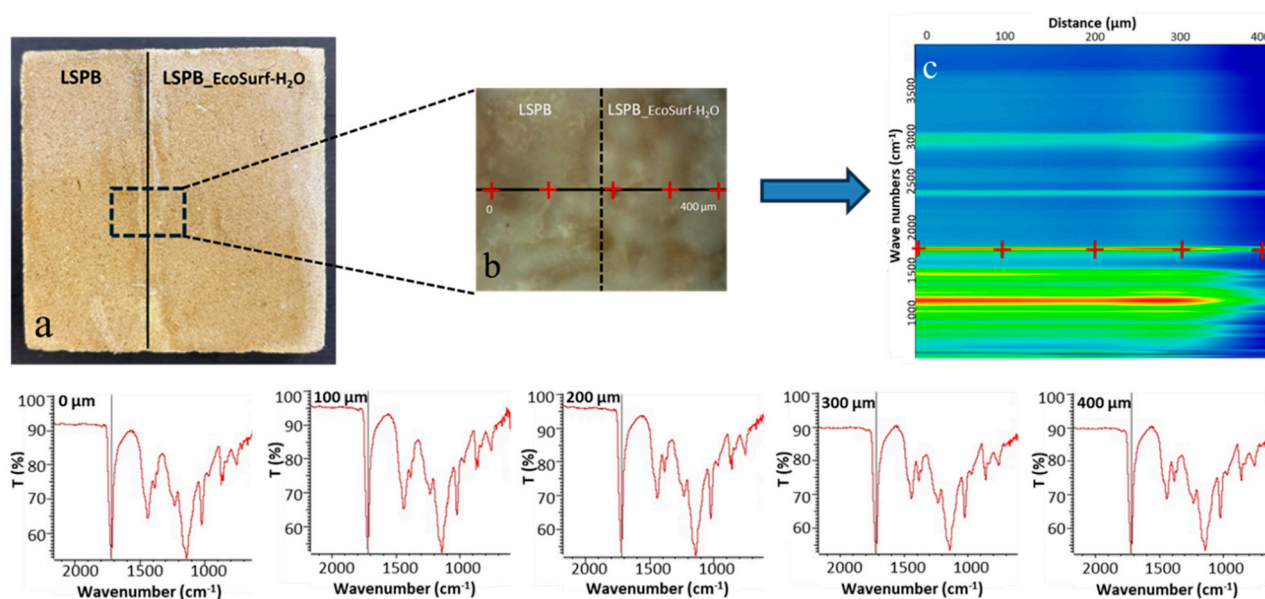


Figure S7. Micro-FTIR (ATR mode) mapping analysis performed on 35d coated LS surface before and after applying EcoSurf/H₂O-loaded hydrogels. Upper side from the left: (a) the examined specimen with a vertical bar separating the coated surface on the left from the cleaned one on the right; (b) the examined area with the considered points and their distances; (c) the resulting false-color μ-FTIR map. Lower side: FTIR spectra taken at the different points in the examined area (from 0 to 400 μm distance); vertical bar indicates the position of the carbonyl stretching peak characteristic of the polyacrylate coating.