

Supplementary Materials: Examining the Potential of Enzyme-Based Detergents to Remove Biofouling from Limestone Heritage

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Citation: Schröer, L.; Fiers, G.; Deprez, M.; Boon, N.; Cnudde, V.; Soens, L.; De Kock, T. Examining the Potential of Enzyme-Based Detergents to Remove Biofouling from Limestone Heritage. *Coatings* **2022**, *12*, 375. <https://doi.org/10.3390/coatings12030375>

Academic Editors: Beatriz Prieto and Ana Zélia Miller

Received: 8 February 2022

Accepted: 9 March 2022

Published: 11 March 2022

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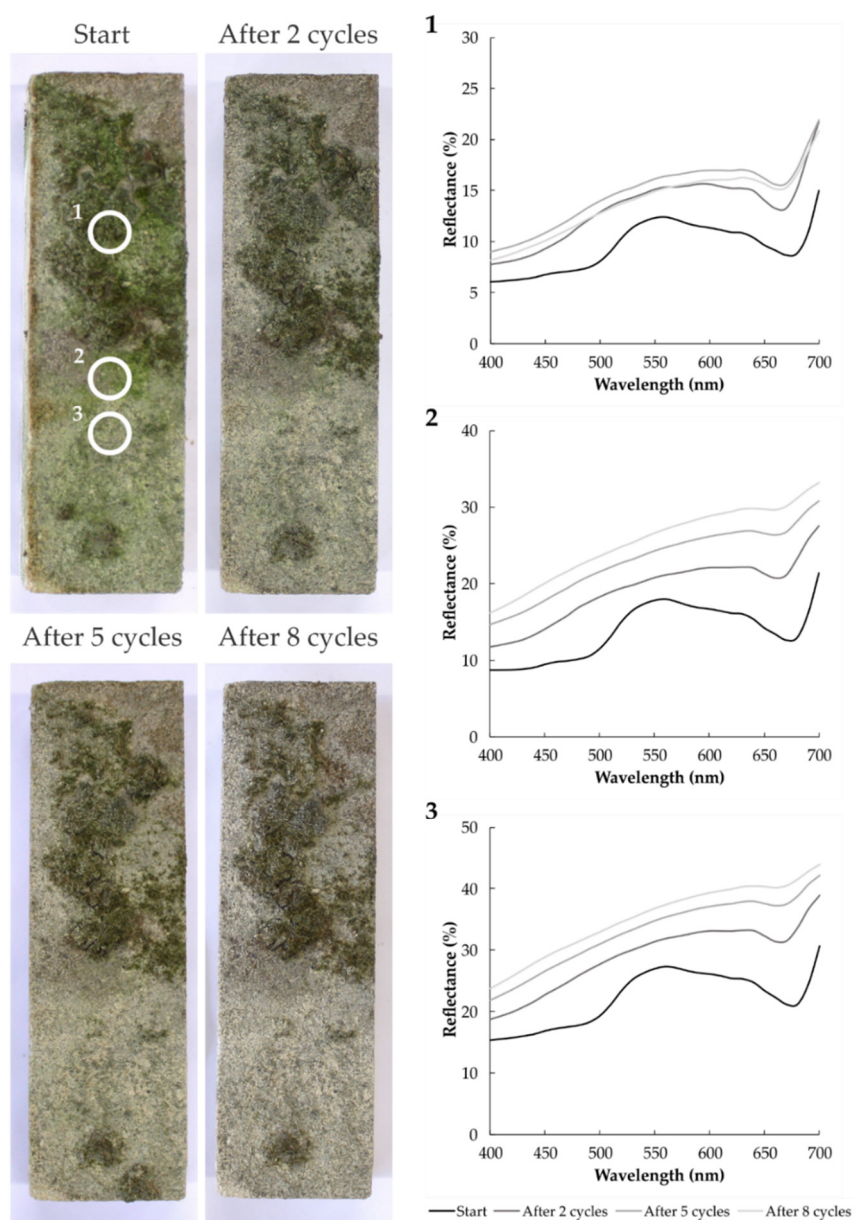


Figure S1. Appearance and spectral reflectance graphs determined at fixed locations 1, 2 and 3 of treated Sample 1 from the start and after different cycles of water runoff and drought.

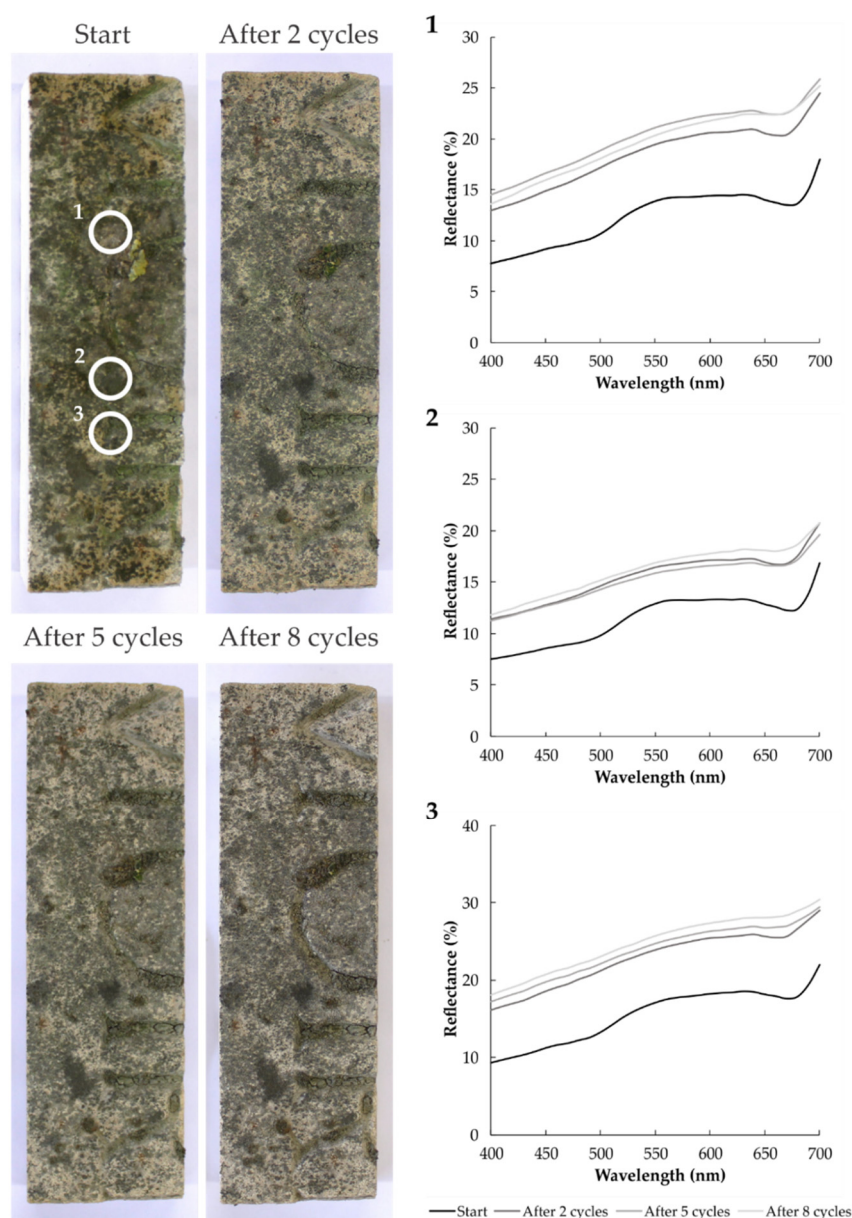
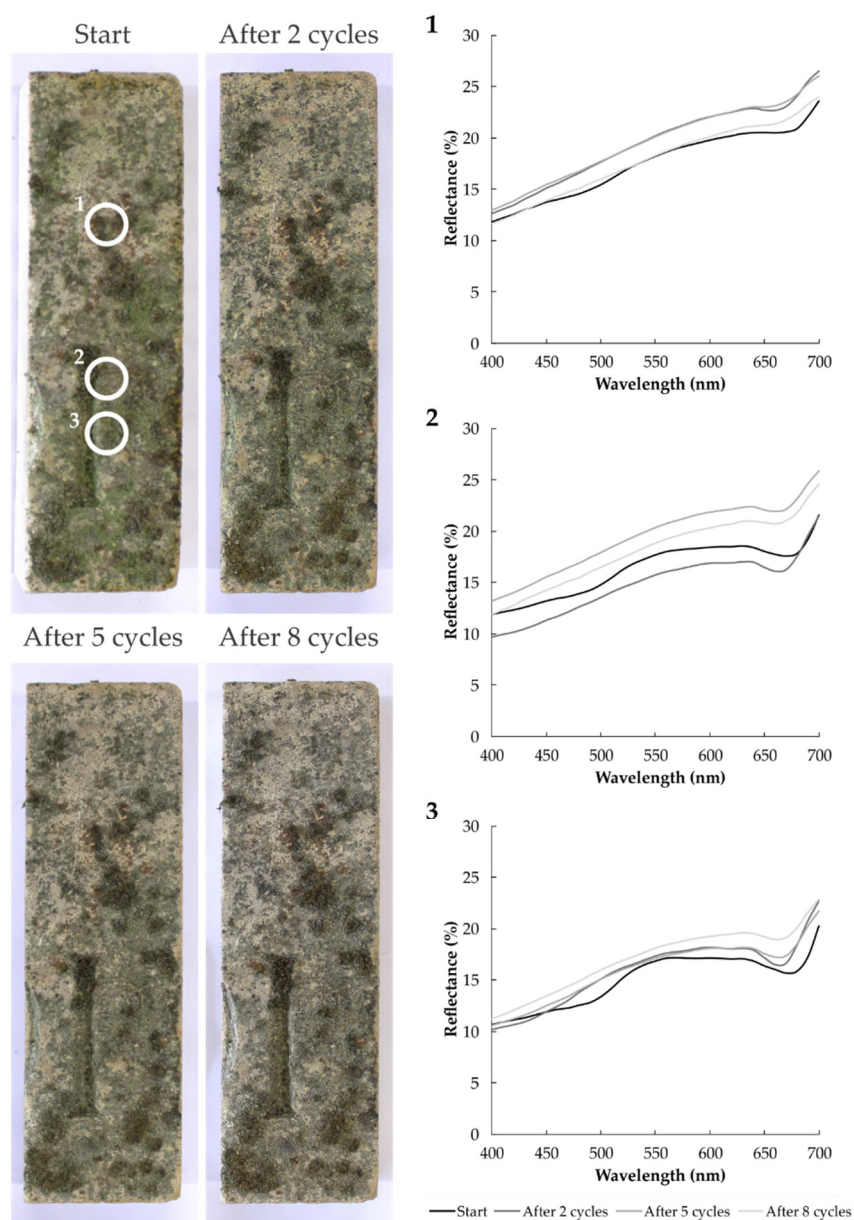


Figure S2. Appearance and spectral reflectance graphs determined at fixed locations 1, 2 and 3 of treated Sample 2 from the start and after different cycles of water runoff and drought.



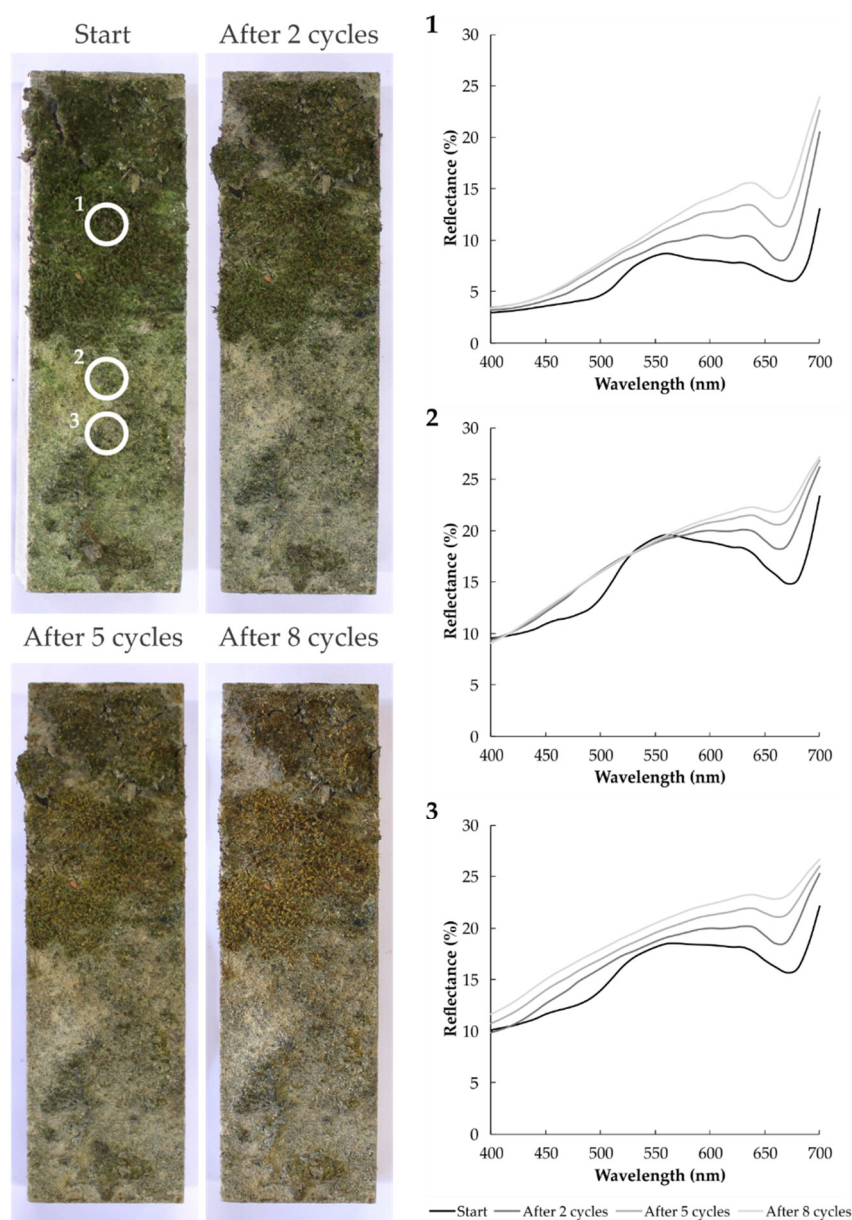


Figure S4. Appearance and spectral reflectance graphs determined at fixed locations 1, 2 and 3 of treated Sample 4 from the start and after different cycles of capillary absorption and drought.

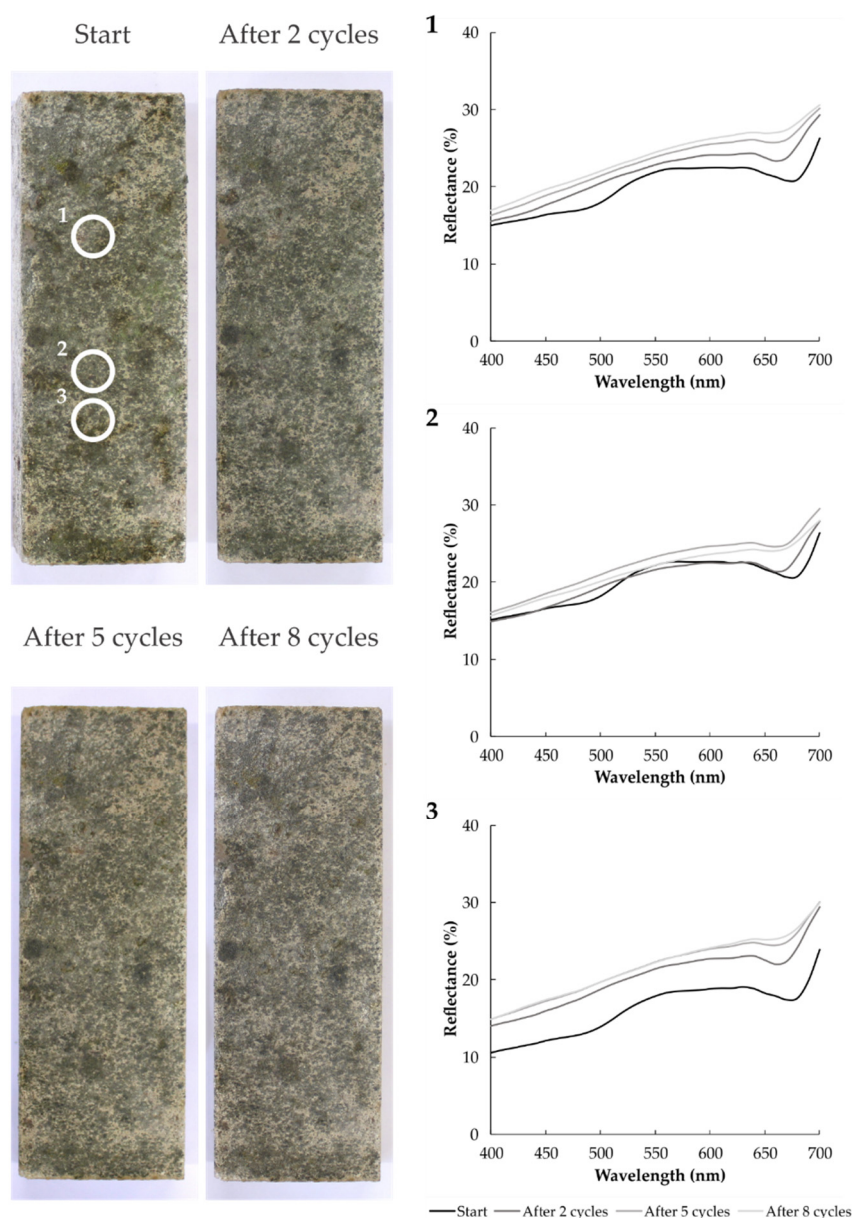


Figure S5. Appearance and spectral reflectance graphs determined at fixed locations 1, 2 and 3 of treated Sample 5 from the start and after different cycles of capillary absorption and drought.

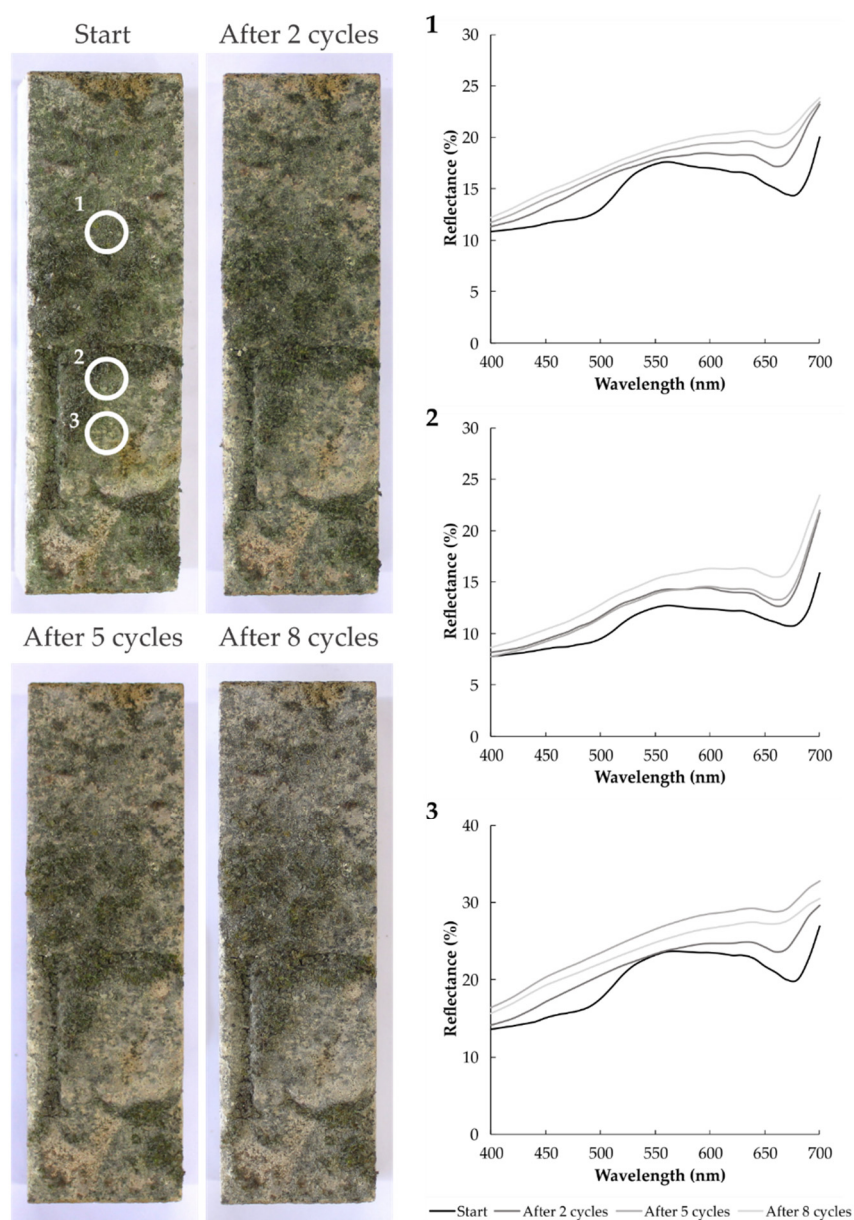


Figure S6. Appearance and spectral reflectance graphs determined at fixed locations 1, 2 and 3 of treated Sample 6 from the start and after different cycles of capillary absorption and drought.

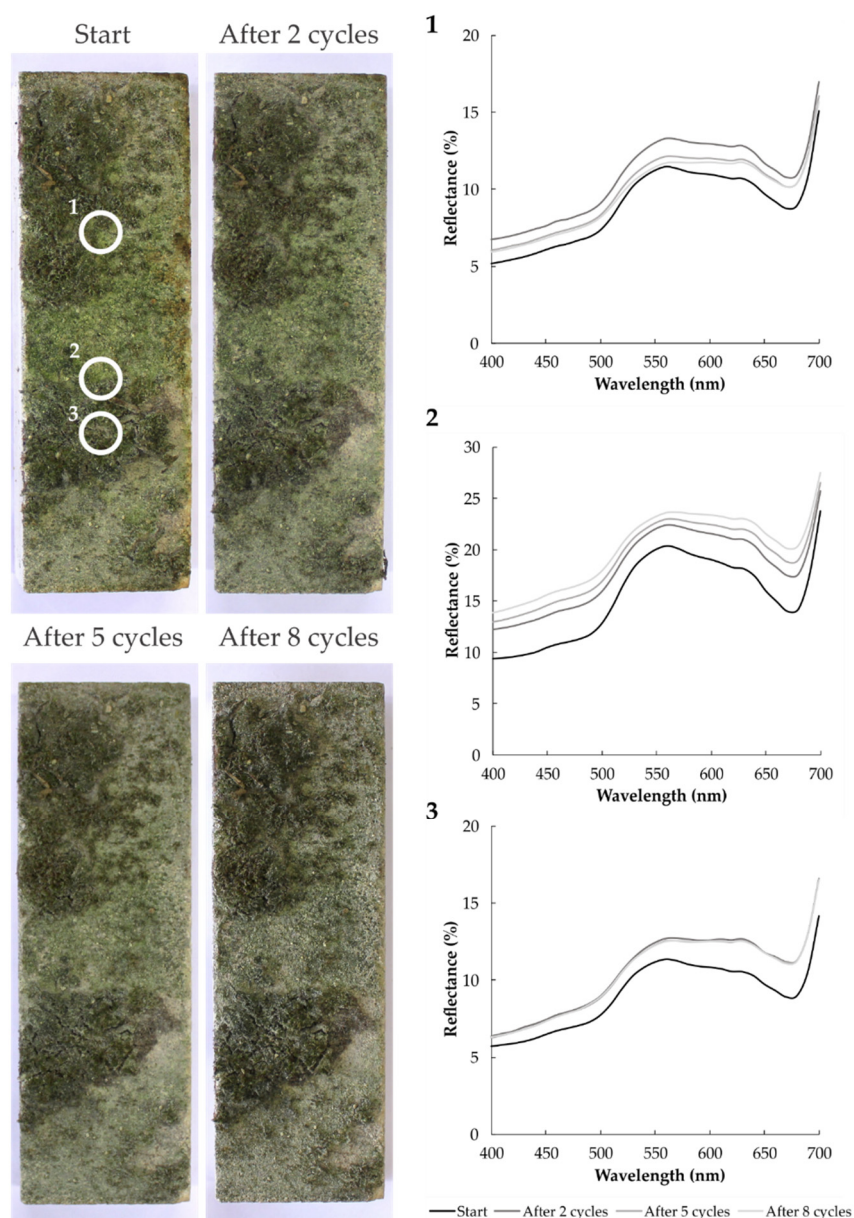


Figure S7. Appearance and spectral reflectance graphs determined at fixed locations 1, 2 and 3 of untreated Sample 7 from the start and after different cycles of water runoff and drought.

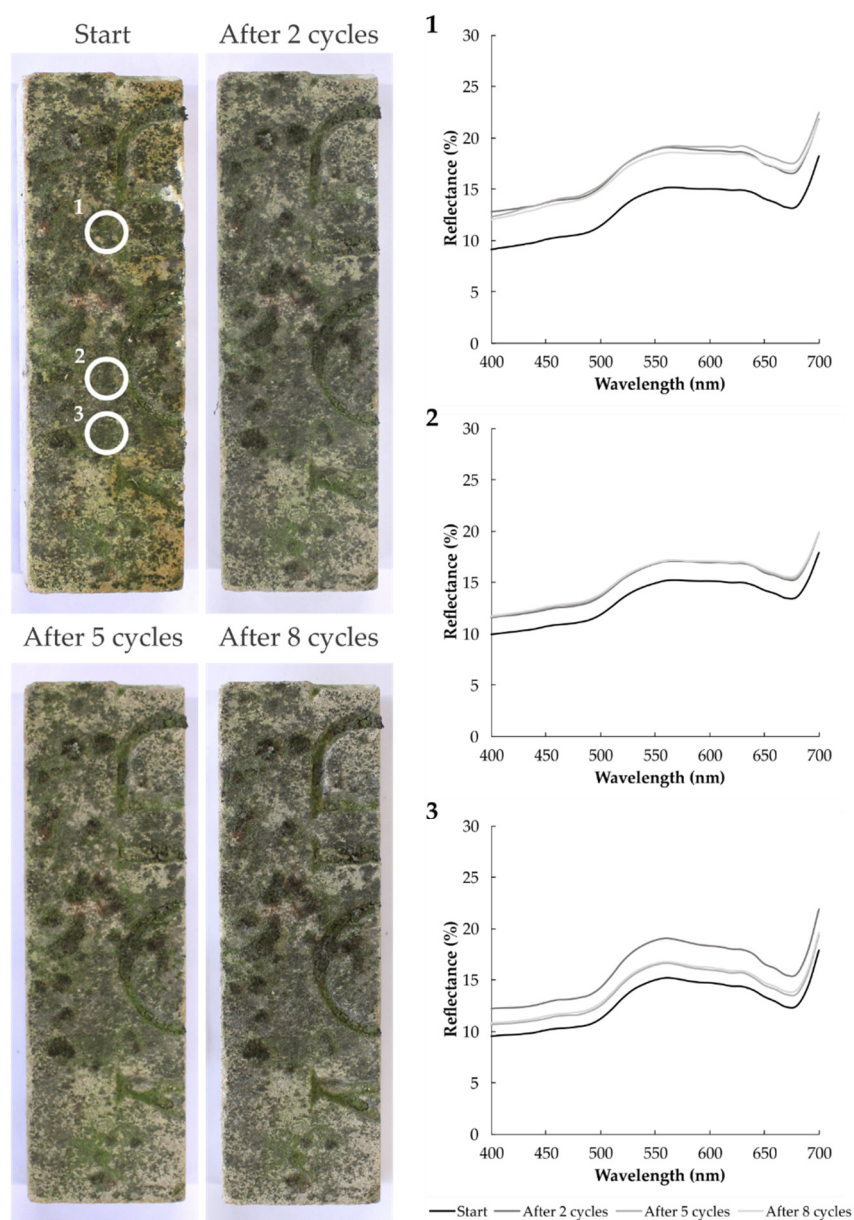


Figure S8. Appearance and spectral reflectance graphs determined at fixed locations 1, 2 and 3 of untreated Sample 8 from the start and after different cycles of water runoff and drought.

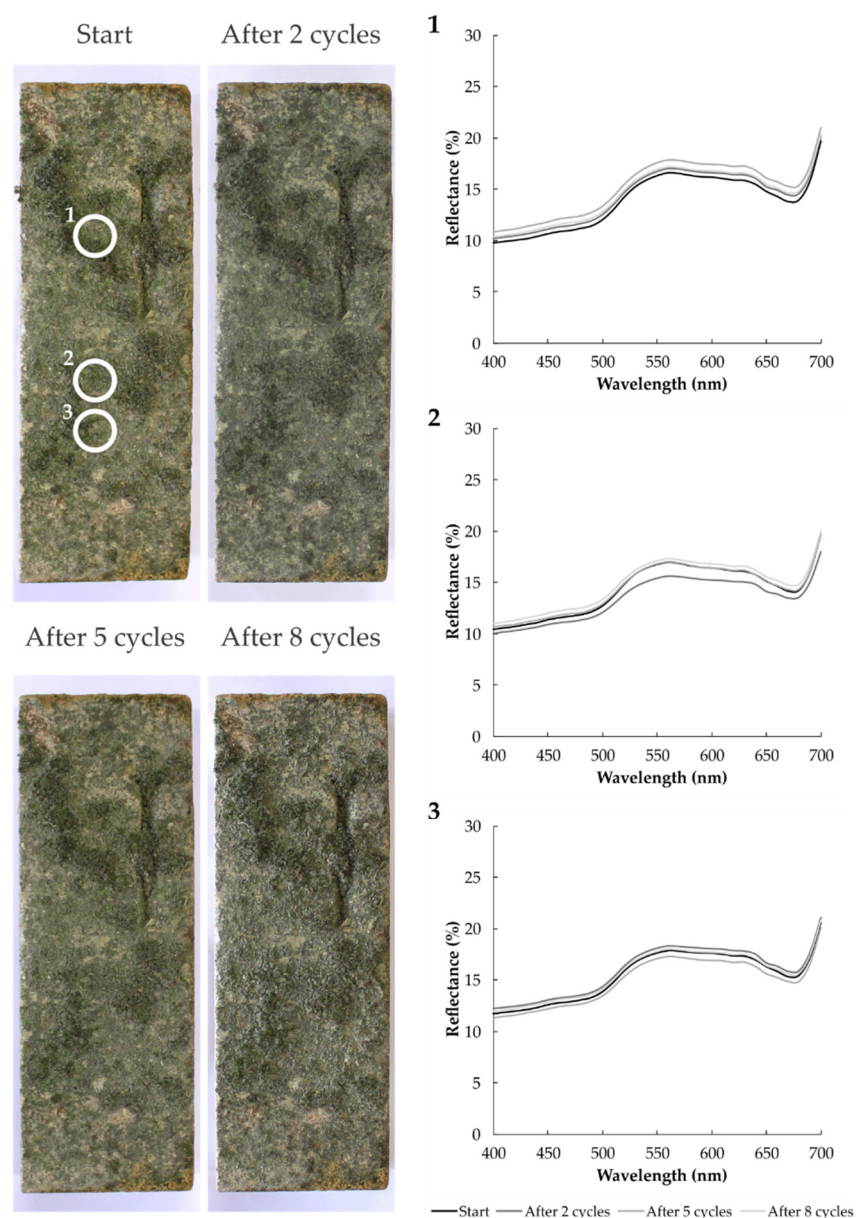


Figure S9. Appearance and spectral reflectance graphs determined at fixed locations 1, 2 and 3 of untreated Sample 9 from the start and after different cycles of capillary absorption and drought.

Table S1. Initial CD (%) of 30 measurements at Site A before enzyme-based treatment and Δ CD (%) during subsequent field surveys (per date).

–	CD		Δ CD (%)					
Sample	29/04	06/05	13/05	27/05	18/06	05/08	09/09	03/10
1	2.05	−0.49	−6.83	−22.44	−10.24	−5.37	18.05	1.95
2	2.13	−12.21	−11.74	−21.60	−7.04	−22.54	−2.82	−2.35
3	5.61	−34.05	−36.36	−26.56	−40.29	−40.46	−68.63	−19.96
4	5.69	−39.02	−54.48	−12.48	−59.93	−61.51	−72.41	−21.79
5	5.26	−45.63	−55.70	−54.56	−59.32	−61.03	−54.75	−50.57
6	5.87	−51.11	−57.92	−57.41	−65.25	−64.91	−62.69	−58.94
7	2.96	−35.81	−34.12	−40.54	−41.55	−33.11	−25.68	−28.38
8	2.43	−14.40	−25.10	−31.69	−30.04	−28.40	−11.52	−25.10
9	2.80	−18.93	−52.14	−23.21	−33.21	−27.50	−21.43	−13.21
10	5.05	−58.22	−39.41	−41.39	−47.92	−53.47	−65.35	−34.06
11	2.94	−9.18	−25.17	−13.95	−30.27	−28.23	−37.07	6.46
12	2.88	−10.42	−25.00	−20.83	−23.96	−35.76	−42.71	−5.90
13	1.73	2.89	0.58	−19.65	−15.03	−20.81	−4.62	−12.14
14	2.99	−34.78	−44.48	−45.82	−50.17	−47.83	−40.13	−37.46
15	3.91	−37.85	−41.18	−33.76	−51.92	−50.13	−50.90	−37.60
16	4.00	−33.25	−39.00	−31.00	−43.50	−51.75	−53.75	−14.75
17	3.63	−32.23	−39.39	−13.50	−40.22	−34.71	−54.55	−3.03
18	3.58	−34.08	−45.53	−25.14	−48.88	−46.09	−41.06	−45.81
19	2.16	−6.48	−26.85	−25.93	−22.69	−26.39	−15.74	−23.61
20	2.48	−20.16	−20.56	−34.68	−34.68	−25.00	−27.02	−31.85
21	3.70	−34.59	−45.14	−33.78	−40.54	−44.59	−41.35	−23.24
22	3.57	−19.89	−57.14	−30.25	−37.25	−37.54	−48.18	3.08
23	3.28	−7.62	−34.15	−28.05	−24.09	−16.77	−37.50	−10.98
24	4.04	−27.72	−49.01	−29.95	−47.03	−46.53	−43.32	−30.45
25	1.93	10.36	15.54	−9.33	−6.74	0.52	31.09	0.00
26	2.79	−20.07	−51.97	−32.26	−29.03	−20.43	−36.56	−12.90
27	2.31	−30.74	−24.24	−29.44	−10.82	−15.15	−39.83	2.16
28	7.15	−55.94	−57.90	−40.70	−54.41	−60.00	−71.05	−44.06
29	6.71	−46.94	−51.71	−29.21	−52.01	−50.07	−76.60	−30.40
30	4.35	−38.85	−47.82	−46.90	−44.60	−53.10	−48.05	−44.37

Table S2. Initial CD (%) of 30 measurements at Site B before enzyme-based treatment and Δ CD (%) during subsequent field surveys (per date).

–	CD		Δ CD (%)					
Sample	29/04	06/05	13/05	27/05	18/06	05/08	09/09	03/10
1	1.70	−12.94	−24.12	−28.82	−25.88	−28.82	−20.59	−33.53
2	2.85	−46.32	−56.84	−54.04	−57.54	−57.54	−55.09	−52.98
3	4.97	−67.61	−71.63	−68.61	−64.99	−64.19	−68.81	−68.61
4	5.83	−72.90	−75.81	−71.18	−69.98	−73.41	−75.81	−75.13
5	5.63	−63.94	−67.67	−59.15	−66.61	−68.56	−73.18	−69.98
6	4.17	−58.51	−59.95	−50.84	−58.27	−53.72	−56.83	−57.31
7	5.49	−44.63	−58.47	−58.11	−59.74	−59.56	−60.29	−62.48
8	6.67	−46.18	−61.32	−61.17	−64.92	−63.42	−64.32	−71.81
9	13.91	−72.03	−82.67	−82.96	−83.82	−83.47	−82.24	−83.03
10	13.38	−72.72	−83.71	−83.93	−86.10	−83.26	−84.23	−83.78
11	11.89	−70.23	−79.06	−78.47	−80.40	−83.35	−79.65	−80.15
12	12.38	−73.10	−81.02	−80.94	−81.74	−81.74	−80.78	−80.78
13	2.19	−9.59	−31.51	−30.14	−24.20	−23.74	−24.66	−27.85
14	2.97	−57.91	−65.66	−63.97	−60.94	−61.95	−65.99	−62.29
15	4.27	−48.95	−56.21	−64.87	−61.36	−65.81	−57.14	−64.64
16	10.18	−58.64	−68.17	−70.73	−75.15	−77.31	−75.05	−75.74
17	8.32	−55.65	−67.07	−67.19	−72.60	−72.48	−72.60	−73.68
18	7.94	−62.34	−76.32	−73.43	−70.91	−76.45	−72.54	−73.68
19	2.69	−10.41	−29.00	−15.61	−13.38	−13.01	−13.38	−26.39
20	2.21	−10.41	−38.01	−35.29	−11.76	−10.86	−11.31	−25.34
21	4.43	−55.53	−62.98	−63.43	−63.43	−59.37	−58.01	−59.59
22	5.49	−51.18	−68.67	−64.12	−64.85	−63.93	−63.21	−62.11
23	4.80	−60.21	−72.29	−63.75	−60.83	−63.13	−63.54	−59.17
24	3.29	−34.65	−55.62	−48.02	−44.98	−46.20	−45.29	−42.55
25	7.90	−73.92	−76.20	−78.10	−78.99	−76.08	−81.14	−79.87
26	4.87	−65.09	−74.74	−66.32	−71.46	−68.38	−71.66	−68.17
27	6.04	−57.45	−65.73	−70.36	−69.54	−64.40	−67.55	−68.71
28	3.03	−15.84	−44.22	−45.87	−37.29	−31.35	−31.35	−37.29
29	3.26	−29.75	−50.31	−50.31	−46.01	−43.87	−52.15	−48.47
30	5.15	−57.48	−66.02	−70.10	−64.08	−63.11	−66.02	−64.85

Table S3. Initial CD (%) of 30 measurements at Site C before enzyme-based treatment and Δ CD (%) during subsequent field surveys (per date).

–	CD		Δ CD (%)					
Sample	29/04	06/05	13/05	27/05	18/06	05/08	09/09	03/10
1	5.89	−65.53	−75.89	−66.72	−66.38	−68.42	−69.78	−60.44
2	4.52	−54.87	−67.04	−61.50	−63.94	−60.18	−63.27	−48.89
3	5.60	−50.00	−66.61	−58.39	−64.64	−63.04	−65.00	−39.11
4	2.58	−31.01	−37.21	−32.17	−40.70	−38.37	−32.56	−8.91
5	4.32	−45.83	−55.32	−48.38	−52.78	−54.40	−53.70	−25.23
6	3.66	−58.47	−59.02	−52.46	−56.56	−54.37	−49.18	−44.26
7	5.84	−67.12	−66.61	−70.21	−68.49	−69.86	−70.89	−60.45
8	5.35	−57.94	−66.92	−64.30	−72.71	−71.03	−68.41	−62.06
9	4.07	−43.24	−63.14	−55.04	−63.64	−54.79	−64.62	−33.91
10	4.23	−46.10	−70.45	−56.97	−56.74	−50.35	−52.96	−19.62
11	3.44	−45.64	−63.66	−52.03	−42.15	−38.95	−54.65	−35.47
12	2.95	−36.61	−48.47	−40.68	−42.37	−38.64	−43.39	−38.31
13	3.85	−56.62	−61.30	−60.00	−60.78	−58.44	−58.70	−45.97
14	10.96	−82.76	−87.68	−85.04	−85.68	−86.50	−85.95	−81.57
15	2.10	−15.71	−66.19	−31.90	−37.14	−37.14	−48.10	−27.14
16	2.42	−14.05	−51.65	−34.71	−43.80	−31.40	−42.98	−12.40
17	2.28	−14.04	−61.40	−35.96	−28.95	−30.70	−44.30	−35.09
18	12.86	−87.09	−91.06	−85.93	−88.10	−89.42	−86.86	−84.84
19	5.14	−49.22	−63.62	−56.42	−3.31	−53.11	−51.36	−47.67
20	4.88	−47.75	−58.20	−49.18	−9.43	−53.07	−51.23	−48.36
21	4.95	−61.21	−70.30	−64.04	−24.44	−58.59	−63.03	−48.69
22	4.17	−59.95	−64.75	−53.96	−15.11	−53.96	−55.64	−55.64
23	3.14	−32.17	−52.87	−53.18	−46.82	−44.59	−43.63	−39.17
24	2.87	−39.37	−47.74	−40.77	−41.11	−36.93	−42.51	−23.34
25	8.98	−72.05	−79.40	−77.39	−77.95	−75.95	−75.28	−68.93
26	6.82	−64.37	−72.87	−72.87	−70.53	−67.74	−65.40	−58.65
27	6.18	−61.97	−73.14	−65.86	−67.15	−63.27	−66.02	−64.08
28	3.11	−41.80	−66.88	−47.91	−54.34	−48.87	−51.45	−50.80
29	4.88	−57.99	−71.93	−67.21	−63.73	−58.61	−62.70	−53.89
30	3.32	−49.70	−59.04	−57.23	−64.76	−63.55	−67.47	−58.73

Table S4. Initial CD (%) of 30 measurements at Site D before enzyme-based treatment and Δ CD (%) during subsequent field surveys (per date).

–	CD		Δ CD (%)					
Sample	29/04	06/05	13/05	27/05	18/06	05/08	09/09	03/10
1	4.19	−51.79	−60.14	−55.13	−54.18	−54.89	−58.71	−12.17
2	4.58	−51.09	−54.15	−51.75	−53.06	−60.26	−64.63	−53.71
3	11.47	−56.41	−72.97	−75.41	−75.33	−73.58	−66.00	−31.91
4	10.26	−53.51	−72.90	−73.29	−76.71	−73.59	−71.35	−48.54
5	9.67	−38.78	−70.32	−72.70	−73.73	−69.80	−71.46	−52.74
6	10.86	−51.75	−74.68	−75.14	−75.41	−72.65	−71.27	−55.06
7	3.61	−37.40	−37.12	−43.77	−48.48	−45.98	−39.34	−10.25
8	3.57	−34.73	−36.41	−71.15	−42.30	−38.38	−33.61	−11.48
9	5.36	−47.76	−54.66	−56.72	−54.48	−53.36	−53.17	−36.57
10	5.59	−54.38	−58.14	−60.29	−58.14	−56.53	−56.71	−43.83
11	5.49	−51.91	−51.73	−54.10	−52.64	−50.82	−41.53	−23.13
12	6.86	−38.48	−54.52	−52.04	−50.00	−59.48	−42.71	−2.33
13	3.76	−54.26	−50.00	−47.07	−50.00	−48.40	−37.77	13.56
14	3.65	−46.30	−44.38	−40.27	−42.74	−45.48	−45.48	−41.37
15	5.54	−59.21	−57.94	−60.83	−57.22	−58.84	−41.70	9.57
16	5.61	−55.97	−57.58	−56.86	−58.11	−55.44	−39.22	−13.37
17	4.58	−48.25	−47.38	−52.18	−47.16	−41.92	−26.42	0.00
18	6.58	−58.51	−60.79	−63.83	−62.61	−61.09	−54.56	−2.43
19	5.24	−50.76	−46.76	−49.05	−56.30	−58.40	−52.29	−23.66
20	6.53	−51.61	−51.15	−58.35	−57.27	−56.81	−60.64	−48.24
21	7.32	−49.73	−61.34	−60.79	−61.61	−65.16	−62.02	−40.16
22	8.03	−51.56	−64.13	−62.52	−62.89	−66.13	−64.38	−50.93
23	7.41	−52.36	−58.57	−61.27	−60.73	−59.38	−52.90	−39.14
24	7.90	−49.62	−61.90	−65.19	−62.03	−64.30	−57.34	−43.04
25	5.21	−51.44	−69.87	−62.00	−54.89	−59.69	−50.10	−62.57
26	4.05	−46.67	−54.07	−46.67	−42.96	−46.42	−40.25	−37.78
27	2.72	−23.16	−38.97	−23.90	−30.88	−23.16	−24.63	1.10
28	5.93	−56.49	−59.87	−55.14	−58.35	−54.47	−54.64	−43.68
29	5.03	−41.75	−51.29	−42.94	−47.32	−44.93	−33.80	16.70
30	4.39	−51.03	−56.95	−50.11	−48.97	−41.69	−41.46	−27.56