

ReSoil

Remediation case #2

Remediation of Pb, Zn and Cd
contaminated soil from Arnoldstein for
production of safe vegetables

August 2018 – September 2020

Contaminated site

Lead mining and smelting for more than 300 years caused environmental accumulation of Pb, Zn and Cd. The extent of metal contamination in Arnoldstein, Austria is about 10 km², most of it in woody areas. Arable and grassland is affected in an area less than 1 km². The area used for housing and gardening in Arnoldstein and nearby Hohenturn is small (few ha) but highly contaminated.

TRADITIONAL LEAD SMELTER, ARNOLDSTEIN, AUSTRIA



A large lead smelter and a lead recycling plant that contributed to high lead exposure in the area - Drasch, 2000



For initial investigation the soil was collected from the upper 30 cm layer of active farmland.

Soil excavation, sieving & transportation



Soil remediation, Prevalje, Slovenia

Soil washing



EDTA, water recycle ...alkaline phase



Soil rinsing, separation

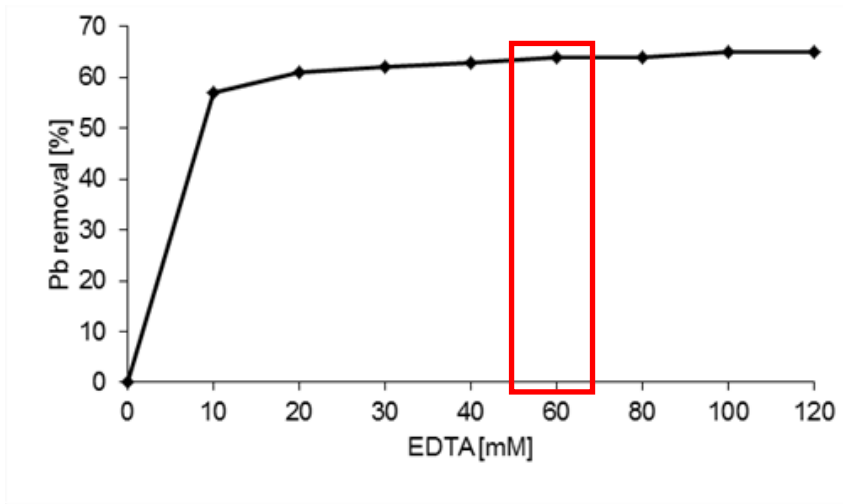


EDTA, water recycle ...acidic phase



Remediation efficiency

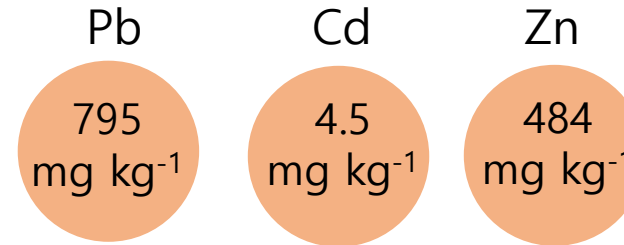
EDTA dose of 60 ± 10 mmol / ton of soil was used in remediation process.



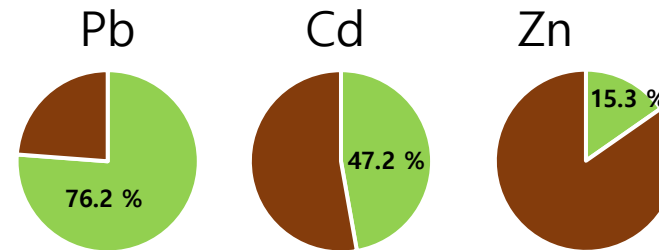
Effect of remediation on soil properties

	Original	Remediated
pH (water)	5.86	7.14
SOC (%)	2.86	2.93
C/N	9.5	10.1
P ₂ O ₅ (mg kg ⁻¹)	116	63
K ₂ O (mg kg ⁻¹)	91	132
Sand (%)	38.2	32.8
Silt (%)	47.2	49.9
Clay (%)	14.6	17.3
CEC _{eff} (cmol _c kg ⁻¹)	13.4	11.3

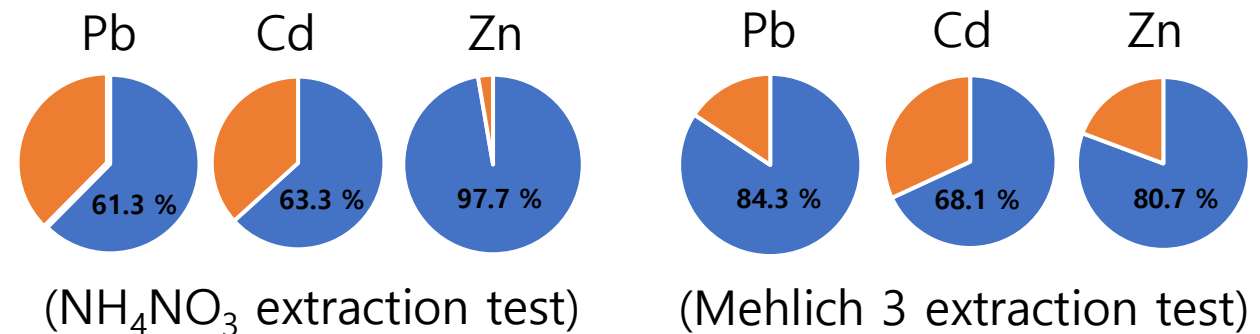
Initial metal concentration



Reduction in metal concentration



Hazard mitigation



Raised beds with remediated soil, BOKU, Tulin, Austria



Photo: Cristoph Noller



Photo: Cristoph Noller



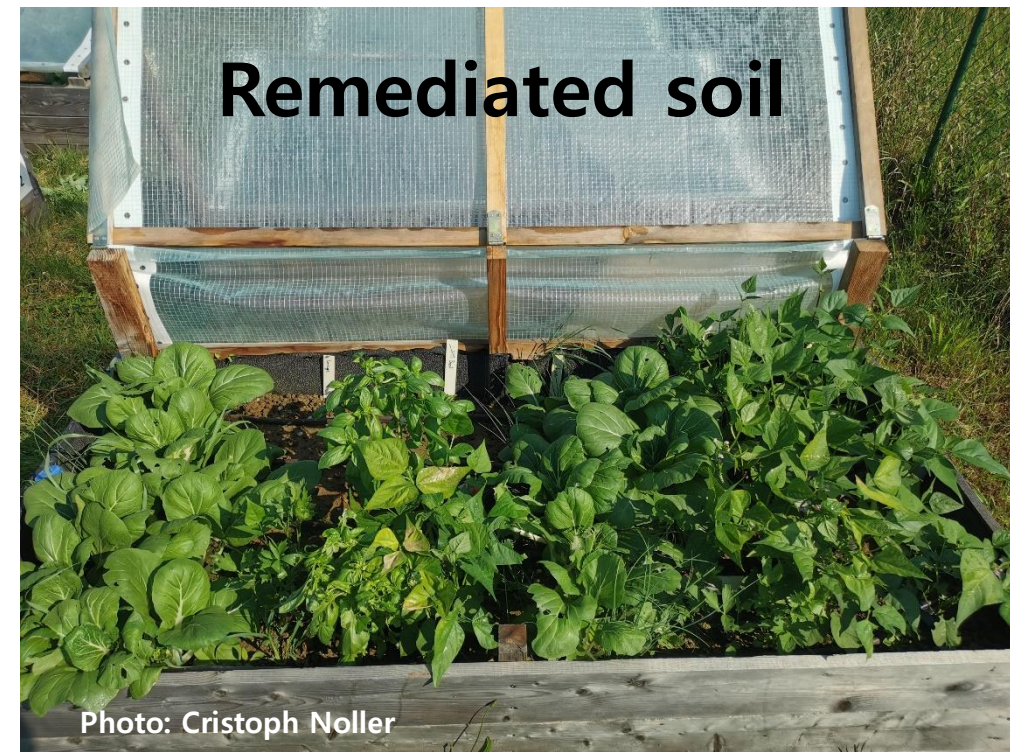
Photo: Cristoph Noller



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Remediated soil as a plant substrate

Remediation enables growth of healthy and safe vegetables on Arnoldstein soil. Toxic metal uptake in Spinach, Radish, Chinese Cabbage and Bush Beans was reduced by over 80%. Biomass production on the remediated soil was systematically increased for all vegetables.



Second crop rotation: Chinese cabbage and Cab beans (June 2020 – September 2020).

Remediated soil as an active ecosystem

Analyzing soil total soil C and N, DOC, NH_4 , NO_3 , microbial community (total microbial biomass, PLFA) and soil respiration indicated higher ecosystem activity and C/N turnover in remediated soil. Key soil micro- and mesofauna was preserved.



Stabile isotope experiment to investigate C and N cycle (October 2019 – March 2020).

Published paper on this study case

(Open access)

Noller, C., Friesl-Hanl, W., Hood-Nowotny, R., Puschenreiter, M. and Watzinger, A., 2021. Effect of Chelant-Based Soil Washing and Post-Treatment on Pb, Cd, and Zn Bioavailability and Plant Uptake. *Water, Air, & Soil Pollution*, 232(10), pp.1-14.

<https://doi.org/10.1007/s11270-021-05356-0>