

An Experimental Evaluation of
Vermiculite and Hugelkultur
Effectiveness in Remediating Metals
in Runoff

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Urban Runoff



Erich Ferdinand: Rain on Regensburg
<https://www.flickr.com/photos/68387408@N00/2570214865>

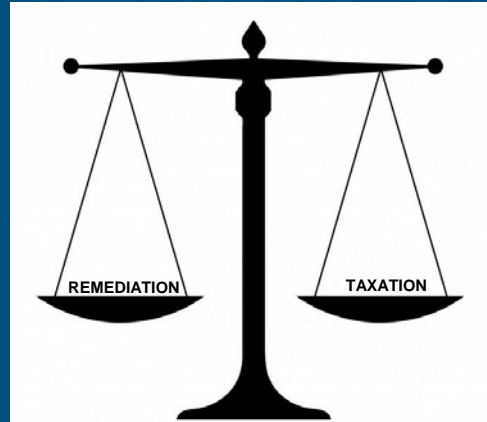


KOMUnews: Urban Drain
<https://www.flickr.com/photos/12801018@N00/4683128554>

Engineered Eco-Friendly Solutions



Alternatives to Taxation



What About the Soil?



<https://www.maxpixel.net/Garden-Earth-Nature-Soil-3401550>

Runoff contamination on previously engineered soils



Extensive Hugelkultur
for Efficient Water Harvest
and Storage

Hugelkultur

VERMICULITE - a highly absorbent clay mineral



<https://www.ebay.com/i/323540515908?chn=ps>

Methods (Construction)

- Created smaller columns of soil and ran RO water through to determine the amount of time the solutions were in contact with the matrix.
- Broke the hugelkulture layer apart with pliers
- Ground dried vermiculite in coffee grinder
- Columns constructed with 300 mL of vermiculite. Hugelkulture columns were constructed with 300 mL each of B horizon, hugelkulture, and of A horizon.
- Control was also run with RO water and the vermiculite or hugelkulture matrix



Methods (Pour Through)

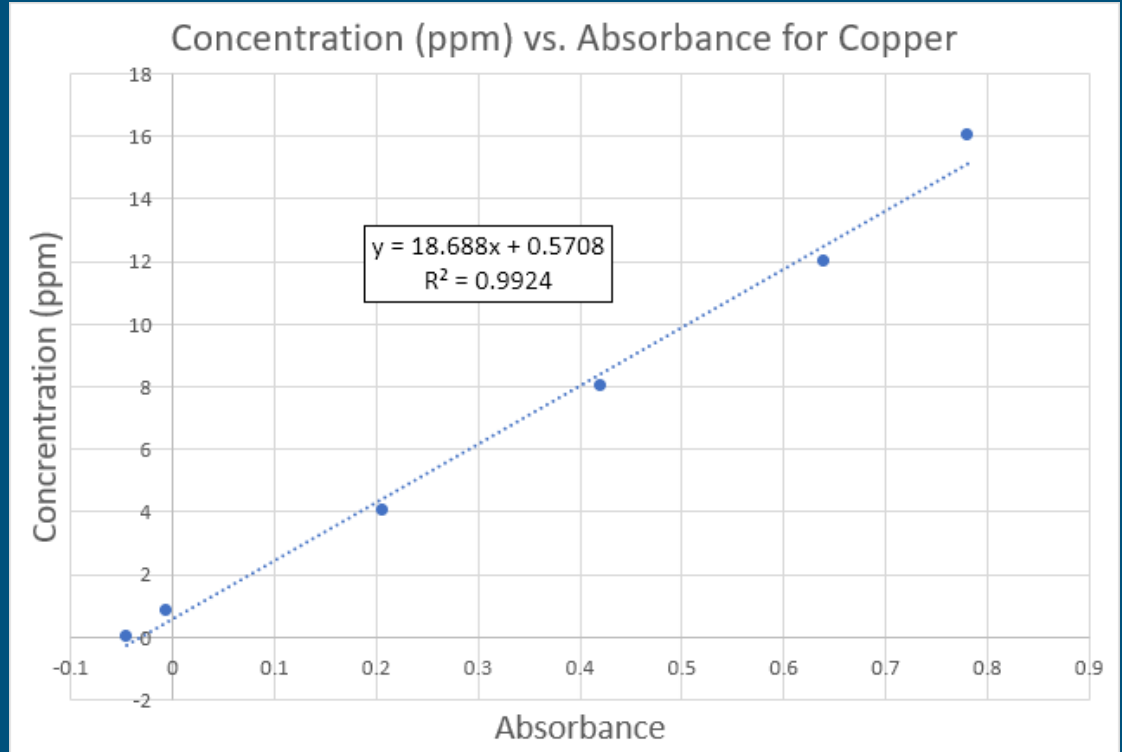
- Columns constructed as described and hung from ring stands
- Created drip apparatus which allowed for slower solution flow to matrix increasing contact time of the contaminant with the soil/vermiculite
- Concentrations: 10 ppm Cu, 15 ppm Pb, 5 ppm Zn
- Completed three trials of pour through for both hugelkulture and vermiculite

Methods (Analysis)

- Once pour through was complete effluent samples were filtered with 0.45 micron filters to remove any particulate matter
- Standards were created using serial dilutions to calibrate the AAS
- Once AAS was calibrated the effluent solutions were run
- Absorbance settings: Cu 324.8 nm, Pb 217 nm, Zn 213.9 nm
- Results recorded

Results (Calibration)

Concentration (ppm)	Absorbance
0	-0.045
0.8	-0.006
4	0.207
8	0.422
12	0.64
16	0.782



Results (Analysis)

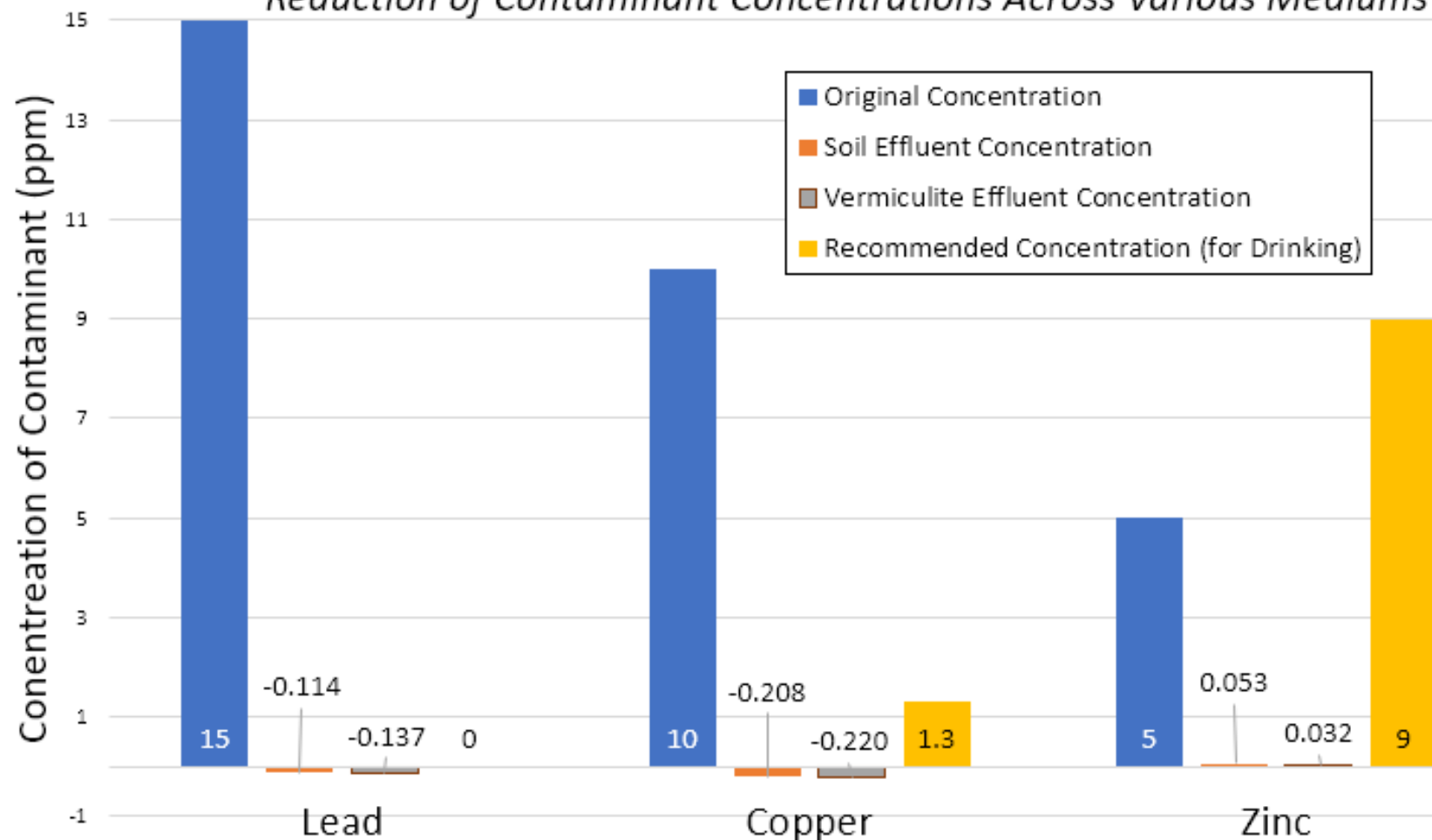
Control Solutions		
Tested for:	Vermiculite (ppm)	Soil (ppm)
Lead	0.018	0.038
Copper	0.002	0.004
Zinc	0.003	0.006

Trial Solutions		Soil		Vermiculite	
Contaminant Pb (ppm)	15	Absorbance	Calculated Concentration (ppm)	Absorbance	Calculated Concentration (ppm)
Trial 1		0	0.000	-0.002	-0.137
Trial 2		-0.003	-0.206	-0.001	-0.069
Trial 3		-0.002	-0.137	-0.003	-0.206

Trial Solutions		Soil		Vermiculite	
Contaminant Cu (ppm)	10	Absorbance	Calculated Concentration (ppm)	Absorbance	Calculated Concentration (ppm)
Trial 1		-0.042	0.197	-0.044	0.170
Trial 2		-0.042	0.197	-0.041	0.210
Trial 3		-0.041	0.210	-0.042	0.197

Trial Solutions		Soil		Vermiculite	
Contaminant Zn (ppm)	5	Absorbance	Calculated Concentration (ppm)	Absorbance	Calculated Concentration (ppm)
Trial 1		0.003	0.032	0.003	0.032
Trial 2		0.002	0.021	0.005	0.053
Trial 3		0.01	0.105	0.001	0.011

Reduction of Contaminant Concentrations Across Various Mediums



Sources of Error

- Range of Calibration Curve
- Soil Organisms



Conclusion

Based on our promising preliminary analysis, we recommend further testing on both hugelkultur and vermiculite for use in the remediation of runoff contaminants.

What's Next?

Field testing of vermiculite and hugelkultur systems



<https://www.ebay.com/i/323540515908?chn=ps>



http://s2.djyimg.com/n3/eet-content/uploads/2014/03/Garden_12_Apr_2012_6925991616-160x104.jpg

What About the Soil?



A Horizon

Hugelkultur

B Horizon

Vermiculite



Sources

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