Leading the Lead Out!

Low-cost Household Biochar Water Filter for Lead Removal

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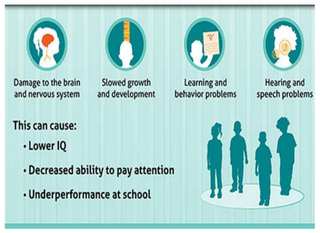
Motivation

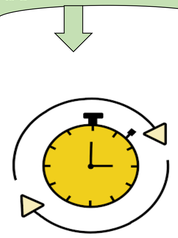
- Expensive and difficult to install the traditional filter
- Prefers to drink from the tap to avoid the cost and hassle

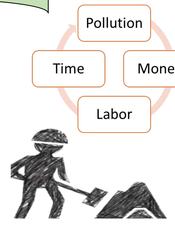
Exposure to lead can seriously harm a child's health.

- 6-10 million US homes have lead-pipes
- More than 500,000 kids in the U.S. have elevated levels of lead in their blood



Replacing the lead service lines or distributing bottles during crisis like Flint, MI can be

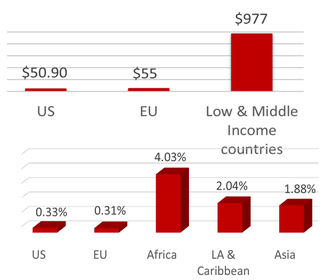




Widespread impact on Quality of life for the Developing and Developed region

Economic impact estimation linked to childhood lead exposure

This Filter can be a solution for entire lead-contamination problem of the world



Basic Features of the Proposed Biochar Water-Filter

Feedstock can be yard-waste

Extensive lead-removal potential

Affordable to all-small, rural, tribal and disadvantaged communities

Sustainable biochar system is carbon negative

Objective & Scope

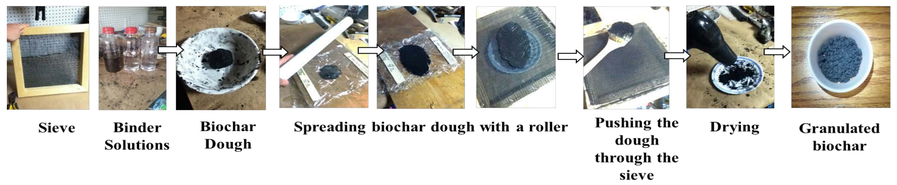
Goal 1	• Theoretical Investigation • Building a Prototype • Demonstrating the Efficiency
Goal 2	• Determination of design parameters • Packing of biochar in the filter • Testing in real-time setting • Creating a business plan
Goal 3	• Formation of Enterprise • Partnership with NGOs • Applying to EPA Small Business Innovation Research

Research & Development

Construction of Biochar-maker and Production of Biochar

Construction of the small-scale production unit | Feedstock | After pyrolysis | Produced biochar

Step-by-step Process of Granulating the Biochar



Sieve | Binder Solutions | Biochar Dough | Spreading biochar dough with a roller | Pushing the dough through the sieve | Drying | Granulated biochar

Granulation Parameters

	Binder Solution	Biochar used	Binder Used	Biochar Produced	Results
1st Trial	30% isopropyl	50 g	26 g	26 g	uniform, med. sized granules
2ndTrial	25% molasses	50 g	114 g	15 g	large, non-uniform granules
3rd Trial	90% isopropyl	50 g	97 g	21 g	very uniform, small granules

Granules after Drying

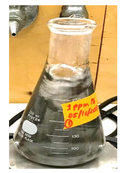
30 % Isopropyl | 25 % Molasses | 90 % Isopropyl

Tied-up with a company: Diamond Science & Technology

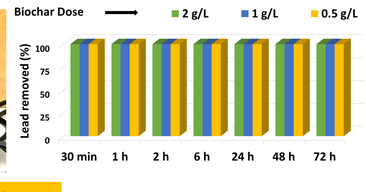
Submitted proposal for EPA Small Business Innovation Research

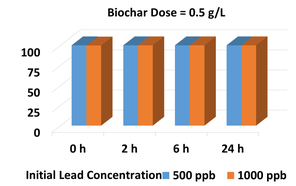
Lab-scale Performance

Batch Study



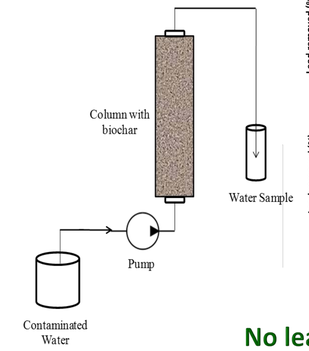
Batch Reactor

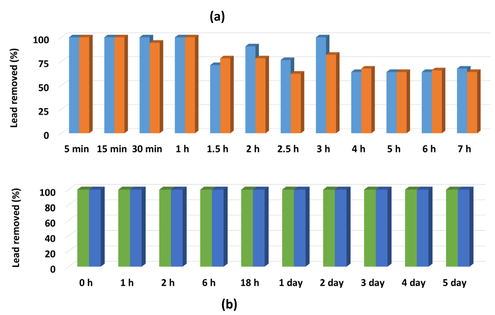




Column Study

Schematic of lab-scale column study apparatus





(a) Initial Pb Concentration = 0.5 ppm, Flow rate = 10 ml/min, Amount of Biochar = 15 g
(b) Initial Pb Concentration = 0.5 ppm, Flow rate = 2 ml/min, Amount of Biochar = 15 g

No lead in effluent sample – even after 5 days!

Quantifiable Benefits of the Filter

Component	Unit Price ($)	Effort/Cost
Biochar-maker Unit	0	Man-hour, Used food cans
Feedstock	0	Man-hour, Twigs, wood chips
Filter Material	0.56	Plastic Cup
Mesh/Screen/cheese cloth etc.	0.43	Household Item
Installation Cost	0	Easy to Install
Total	0.99	Inexpensive!!

Conclusion

- More efficient binder solution for granulating biochar needs to be explored further
- Lower flow rate increases the biochar adsorption potential
- Breakthrough time was reached within 1 h of total run time for higher flow rate
- Total amount of Pb adsorbed was 51 mg/g biochar for initial concentration of 0.5 ppm and 2ml/min flow rate

Acknowledgements

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