Docket #: S18-064

Fast, low-cost electrochemistry filtration process for remediating heavy-metal contaminated soil

Stanford researchers within the Cui Lab have developed a low-cost, recirculating soil washing and filtration system to selectively remove heavy metals including copper, lead, and cadmium, from contaminated soil in a short time while preserving nutrients for agricultural use.

Soil remediation efforts for heavy metal contamination can be costly, energy and time intensive, and can produce secondary toxic products or pollution. By using alternating current instead of a direct current electric field, energy consumption for this technology is greatly reduced compared to conventional electrochemical remediation. This sustainable method achieves high degrees of contaminant removal for heavy metals at initial concentrations varying from 100 to 10,000 ppm, all reaching corresponding regulation levels for residential scenarios after a treatment time between 30 minutes to 6 hours with no resulting secondary toxic pollution.

Figure:

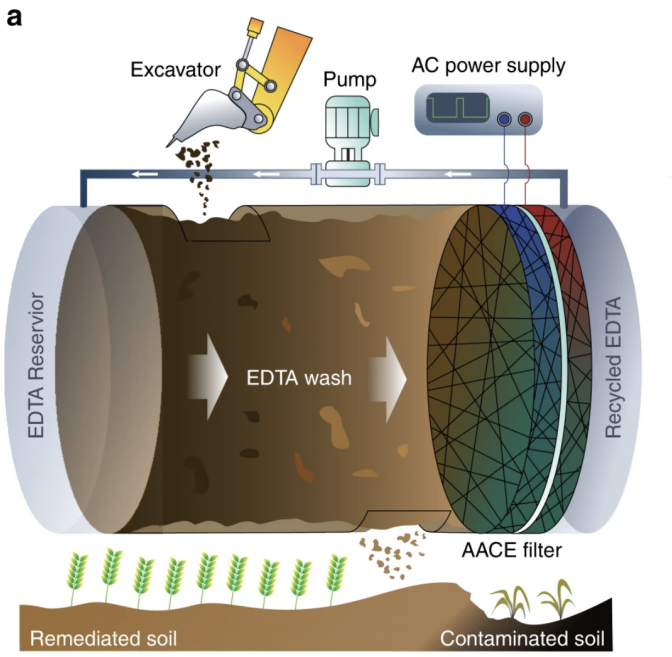

Figure description:
Schematic of an AACE remediation system. EDTA solution is recirculated to wash the contaminated soil. The AACE filter recovers heavy metal cations from the washing effluent and recycles the EDTA solution for repeated use.

Image credit:https://doi.org/10.1038/s41467-019-10472-x

Stage of Development

- Proof-of-Concept

Stanford News
Stanford develops an experimental process to rinse heavy metals from toxic soils, 06.04.2019

Applications

- **Soil remediation** for heavy metal contamination

Advantages

- **Cost efficient -** energy costs ~$3-4/ton of soil (85-100 kWh/ton), reagent costs reduced by recycling EDTA wash – can be recycled more than 25 times without

decay in extraction performance

- **Cleaner -** no excessive nutrient loss and no secondary toxic product process is selective for heavy metals and does not strip away calcium, magnesium and iron
    - **Rapid -** Return to regulation levels for a residential scenario between 30 min to 6 hours
- **Sustainable -** Scalable and promising long-term solution, resulting in soil that is feasible for agricultural use
- **Effective -** high degrees of contaminant removal for different heavy metals (copper, lead, cadmium) at different initial concentrations (from 100 to 10,000 ppm)

Publications

- Xu, J., Liu, C., Hsu, P. C., Zhao, J., Wu, T., Tang, J., ... & Cui, Y. (2019). Remediation of heavy metal contaminated soil by asymmetrical alternating current electrochemistry. *Nature communications, 10*p(1), 2440.

Patents

- Issued: 11,517,950 (USA)

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