

Heavy metal adsorption using extracellular polymeric substances (EPS) from wastewater.



Eliane Rodenburg en Gerjanne Bergsma

Motivation

- Heavy metals (such as lead, copper, silver, gold) are valuable for our lifestyle and the economy.
- But they are toxic when consumed, depletable and have economic value.
- *What if we can recover them with the cheapest possible way, such as using a waste from wastewater treatment plants?*
- Extracellular polymeric substances (EPS) are waste biopolymers that bacteria (that treat wastewater) produce to keep themselves safe.
- EPS are negatively charged and can adsorb to positively charged metals.

Project aim

- Use EPS as a cheap way to remove heavy metals from water.

Experimental

- A bioreactor was operated to treat wastewater containing glycerol and ethanol (Fig. 1). Outlet was analysed to see how much organic carbon was removed.
- EPS was extracted from the reactor.
- Batch experiment was done to test the ability of EPS to adsorb heavy metals such as lead, silver and gold.
- Column experiment was done to make the process continuous. For this, EPS was attached to a column packed with silica gel and polyethyleneimine (PEI). - Fig. 2



Fig. 1. Bioreactor for treating wastewater and producing EPS

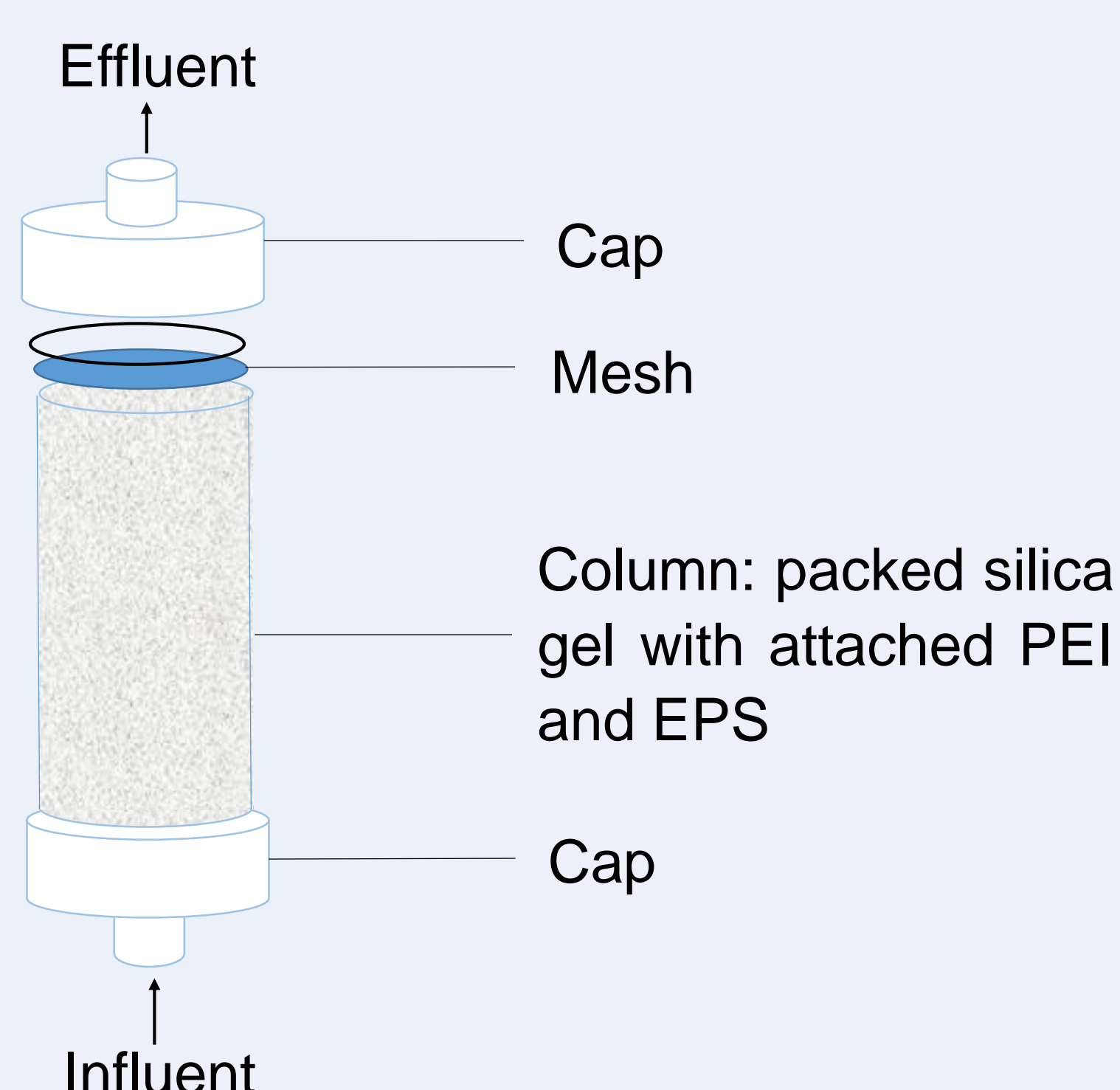


Fig. 2. Column for heavy metal removal

Results

Wastewater treatment and EPS extraction

- Excellent wastewater treatment: >80% organic carbon was removed – Fig 3.
- EPS were successfully extracted. – Fig 4.

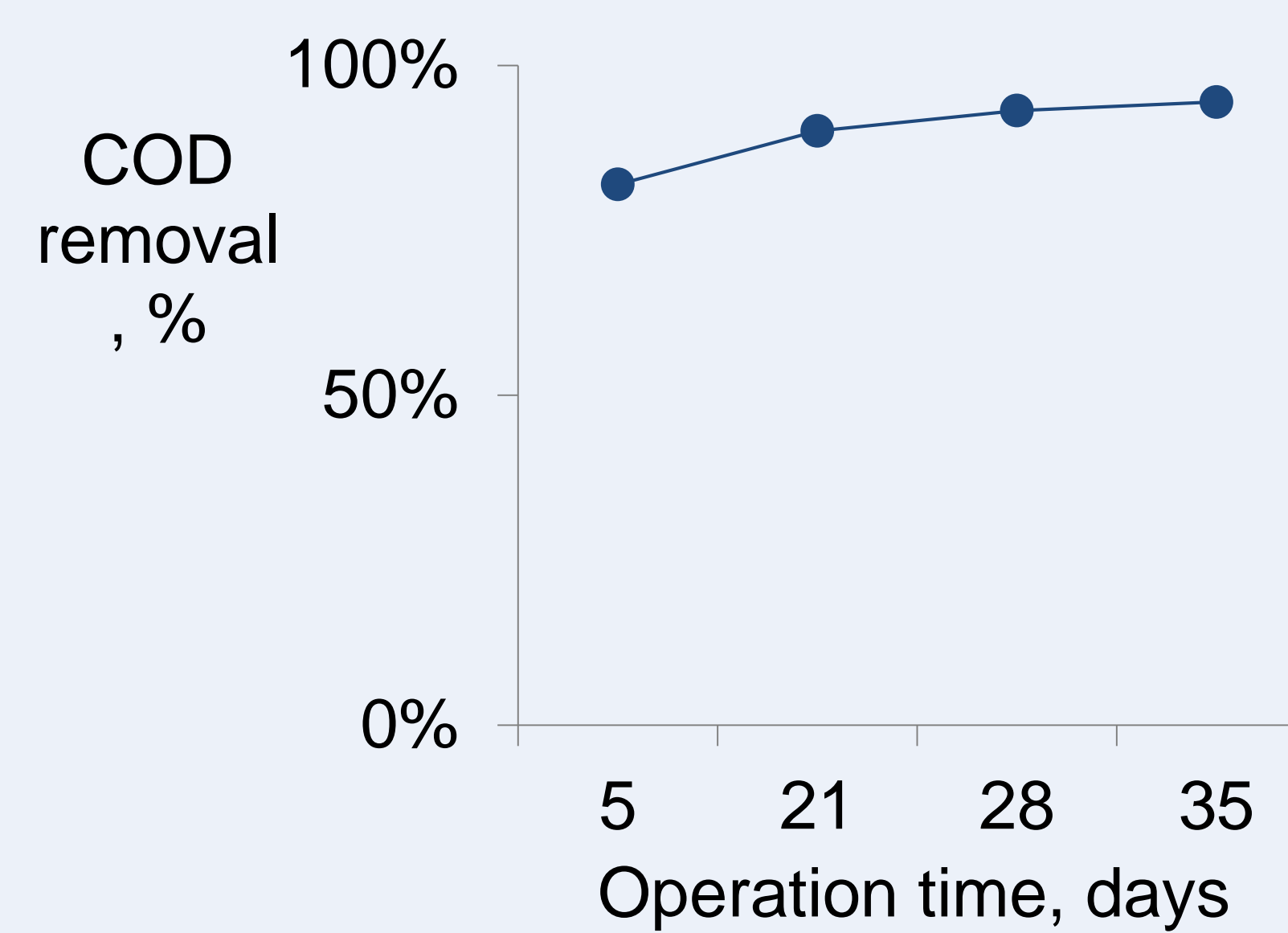


Fig. 3. COD removal from wastewater



Fig. 4. Dried extracted EPS

Batch test for silver removal

- About 80% of silver was removed at the beginning – Fig. 5.
- But not all sticks to the EPS, but about 60% sticks.

Column test for lead removal

- 99.8-100% adsorption of lead (Pb) by EPS – Fig. 6.

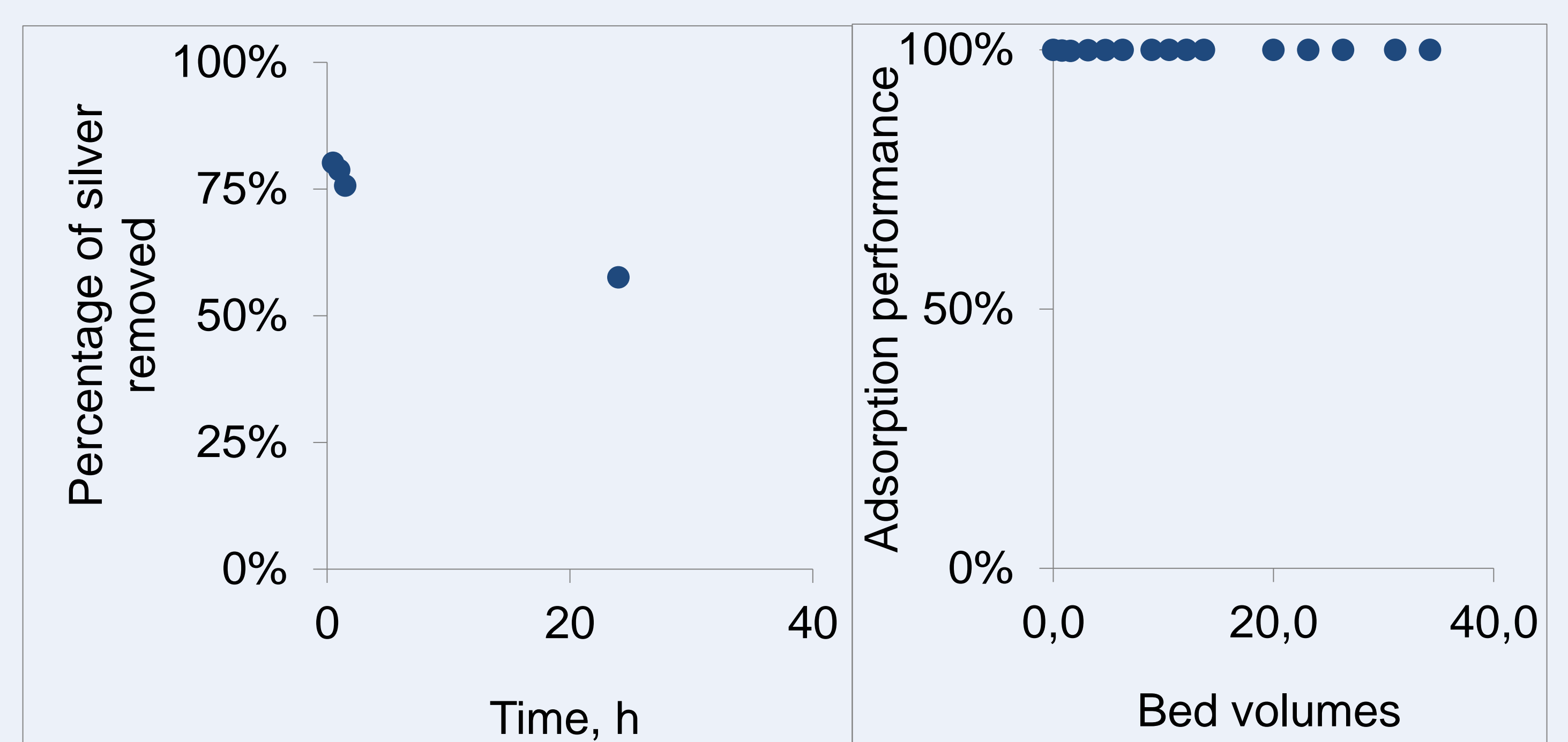


Fig. 5. Batch test for silver removal

Fig. 6. Column test for lead removal

Conclusion

- Possible to combine wastewater treatment with EPS production
- Able to use EPS (a waste in wastewater treatment plants) to remove heavy metals.

Future

- Possibility to recover the metals from EPS. In principle, this is possible by treating with an acid.