

Using Polysaccharide Aerogels to Filter Drinking Water Polluted by Industrial and Agricultural Waste

435

Million people take water from unprotected wells and springs.

200k

Americans died from lead poisoning in water in 2020.

LACK OF CLEAN WATER

The lack of clean drinking water is a huge problem that plagues every country, world-wide. Even in developed countries, like the United States and Canada, pockets of communities and minorities remain without drinking water. In underdeveloped countries, the circumstances are worse. They are forced to drink water contaminated by industrial and agricultural waste for *survival*.

AFFORDABLE, ACCESSIBLE, CLEAN WATER

1

Fill

Fill your reusable mesh bag with one packet of cellulose aerogel beads and one packet of alginate aerogel beads.

2

Soak

Place your AeroPure in the unfiltered water for 1 to 2 hours to allow the contaminants to be uptaken by the beads.

3

Squeeze

Squeeze your AeroPure to remove the organic compounds, and wash it in a vinegar solution to remove the metals and prevent biofouling.

4

Reuse

Using the same beads, your AeroPure can be reused 10 to 30 times with a < 1% decrease in absorption capacity before repeating this process.

Cellulose

Cellulose is covered in hydroxyl (-OH) groups which are **amphiphilic**, meaning they are attracted to both water and organic compounds such as oils. By coating the aerogel with a silane coupling agent (such as MTES), it can be turned hydrophobic and oleophilic, such that it selectively **absorbs 99.4% of organic compounds** including oils, dyes, organic solvents, pharmaceuticals, and pesticides, without absorbing water. With a density of 0.04 g/cm³, 97.3% porosity, and a specific surface area of 26 m²/g, the cellulose aerogel has an absorption capacity of 59 g/g for crude oil and 212.7 mg/g for dyes.

Alginate

Alginate is covered in both hydroxyl (-OH) and carboxylate (-COO⁻) groups, and is typically obtained from brown seaweed. Apart from it being an anionic polymer, the addition of the carboxylate group gives the aerogel a **high affinity for heavy metal ions** such as lead (Pb²⁺), copper (Cu²⁺), and cadmium (Cd²⁺). With a density of 2.15 g/cm³ and a specific surface area of 419 m²/g, the alginate aerogel is able to **remove up to 99% of the ions** with an adsorption capacity of 415 mg/g for Pb²⁺, 126.82 mg/g for Cu²⁺, and 244.55 mg/g for Cd²⁺.

77x

COST REDUCTION

With one pack of alginate beads costing \$2.63 and one pack of cellulose beads costing \$1.41, this equates to a 77x cost reduction for the average person living in Africa, compared to the price they would have to pay if they were forced to live off bottled water, in order to have clean water.

- ✓ Biodegradable
- ✓ Low Maintenance
- ✓ Inexpensive