

## TECHNICAL INFO SHEET

### **Phosphates for the Removal of Heavy Metals in Water**

Kaylan Harmon

Prayon; EAS

As our world grows ever more industrialized, so too grows the amount of pollution in our water. Of particular concern is the presence of heavy metal contaminants in wastewater; if not managed properly, these heavy metals can leach into the environment and threaten the health of both humans and the surrounding ecosystem. Regulatory guidelines concerning pollutants in wastewater all around the world are becoming more strict as the environmental impact of heavy metal contamination becomes more clear, so efficient strategies to mitigate this risk and maintain legal compliance are critical for nearly every industry. While there are a few different methods for removing heavy metal contaminants, phosphate-based technologies offer one of the most efficacious and low-cost solutions for wastewater treatment operations.

#### **What are heavy metals and how do they get into wastewater?**

Heavy metals are metallic or semi-metallic elements that are toxic to living organisms. These metals are naturally present in the Earth's crust. While some of these metals like copper, selenium, and zinc are essential to life in trace amounts, they have the potential to accumulate and cause harm.<sup>1</sup> Other heavy metals include lead, mercury, iron, cadmium, and arsenic, which are commonly found in wastewater.<sup>2</sup> In humans, excessive heavy metal intake can cause headaches, nausea, respiratory issues, and abdominal pain. In the most severe cases, the liver, kidneys, reproductive system, and brain may suffer irreversible damage. Most heavy metals are also known carcinogens.<sup>1</sup>

Heavy metals are primarily introduced to wastewater by industrial processes like mining, oil refining, battery production, and pesticide synthesis. Metal contamination is also commonly found in aging metal piping systems that have suffered from corrosion. Water from agricultural sources may also pick up heavy metals which are naturally present in the environment, particularly in soil.<sup>3</sup>

#### **A solution for heavy metal pollution**

There are different methods for removing heavy metals during wastewater treatment.<sup>2</sup> Ion exchange resins are a classic treatment for wastewater effluents, however they are not easily adapted to the fluctuations in type and concentration of heavy metals that are often found in wastewater. Activated carbon and membrane filtration technologies offer more broad-spectrum control of metal removal, but both are susceptible to clogging and require frequent maintenance and replacement to maintain their efficacy, making them both inconvenient and costly. Other well-established technologies like flocculation or pH adjustment with caustic additives are unable to meet strict environmental impact limits in regulatory guidelines. Mineral adsorption-based methods, on the other hand,

can mitigate a wide variety of water pollutants at varying concentrations, maintain efficacy over a broad pH spectrum, are non-toxic, and require minimal operating costs.

Calcium phosphate (CaP) is an excellent example of the capabilities of mineral adsorbents. It can be specially synthesized with very high specific surface area, allowing the mineral to directly adsorb heavy metals and other pollutants onto its highly porous surface. This feature is what makes CaP effective against varying sizes and concentrations of pollutants, from mg/L to µg/L. CaP is not degradable and can be completely regenerated upon saturation with trapped pollutants, making it the optimal choice for sustainability and low-cost maintenance.

---

## References

1. Tchounwou PB, Yedjou CG, Patlolla AK, Sutton DJ (2012) Heavy metal toxicity and the environment. *Molecular, Clinical and Environmental Toxicology* 133–164. doi: 10.1007/978-3-7643-8340-4\_6
2. Qasem NA, Mohammed RH, Lawal DU (2021) Removal of heavy metal ions from wastewater: A comprehensive and critical review. *npj Clean Water*. doi: 10.1038/s41545-021-00127-0
3. Renu, Agarwal M, Singh K (2016) Heavy metal removal from wastewater using various adsorbents: A Review. *Journal of Water Reuse and Desalination* 7:387–419. doi: 10.2166/wrd.2016.104

