Remediation of per- and polyfluorinated substances (PFAS) from contaminated water by sorption to pine and spruce bark

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Highlights

- The bark sorbent showed potential to remove PFAS under realistic conditions.
- There were no changes of electrical conductivity and pH in the outgoing water.

Introduction

Adsorption is considered an efficient treatment technique for per- and polyfluoroalkyl substances (PFAS) in contaminated water [1].

Association of PFAS to surfaces are mainly hydrophobic interactions (see Figure 1, A) for long-chain PFAS and electrostatic interactions (B) for short-chain PFAS. Other relevant binding mechanisms are absorption (C) and anion or ligand exchange (D). The interactions between PFAS and surfaces are dependent on both the sorbent and physiochemical environment e.g., the presence of organic matter, pH, electrical conductivity and other competitive binding ions [2, 3].

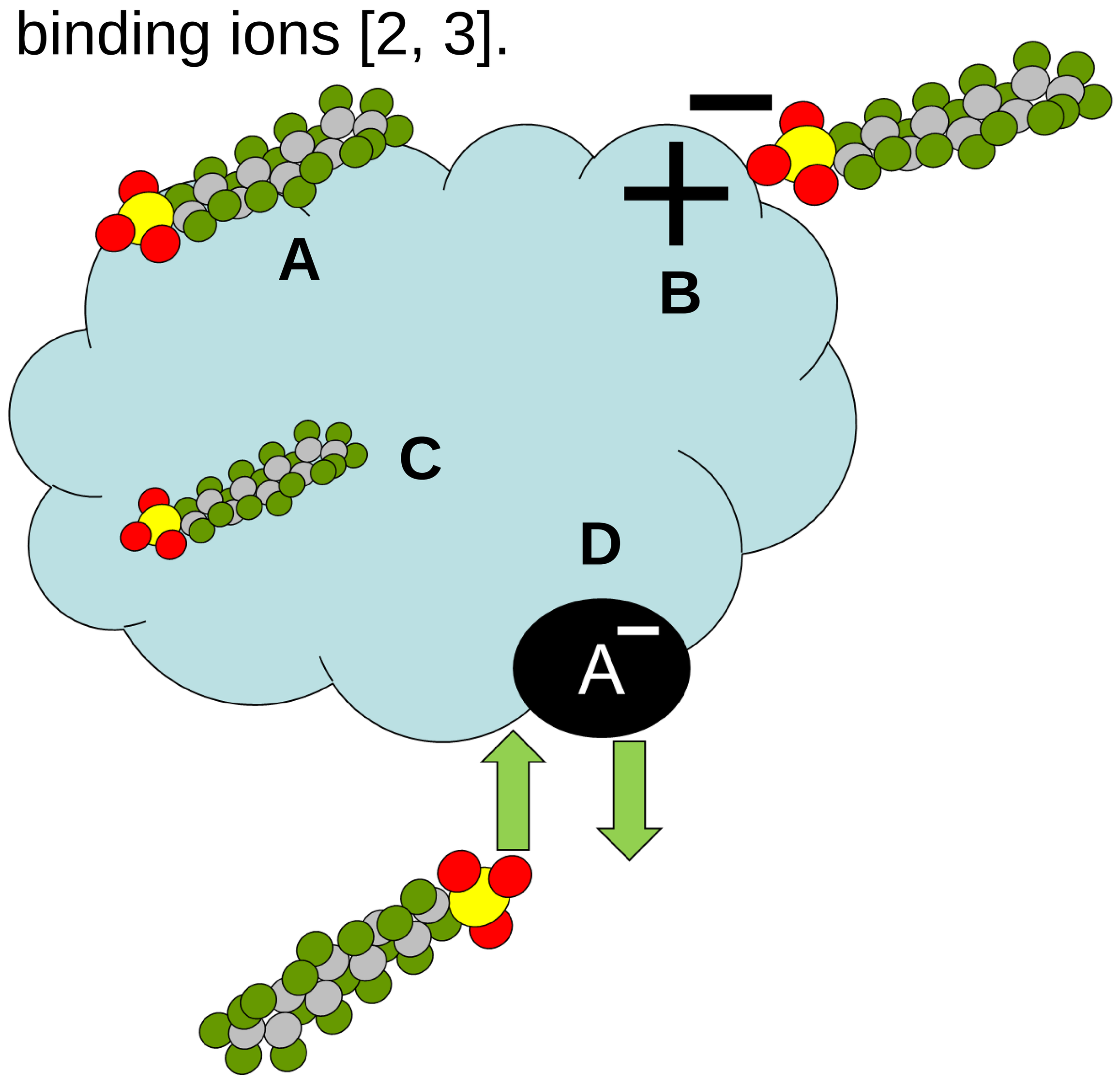

Figure 1 Illustration of PFAS relevant ab- and adsorption mechanisms to surfaces.

Tree bark is a residue produced in high quantities within the forestry industry, with current main use as fuel in heat plants. Within this study, the focus was to investigate if this waste product could be used as a sorbent for PFAS.

Aim and objective

To evaluate if pine and spruce bark holds a PFAS sorption ability when used at an industrial site.

- To investigate the reduction of PFAS after passing through the sorbent.
- Evaluate if the sorbent changes three physiochemical parameters (electrical conductivity, pH and metals) in the outgoing water.

Materials and methods

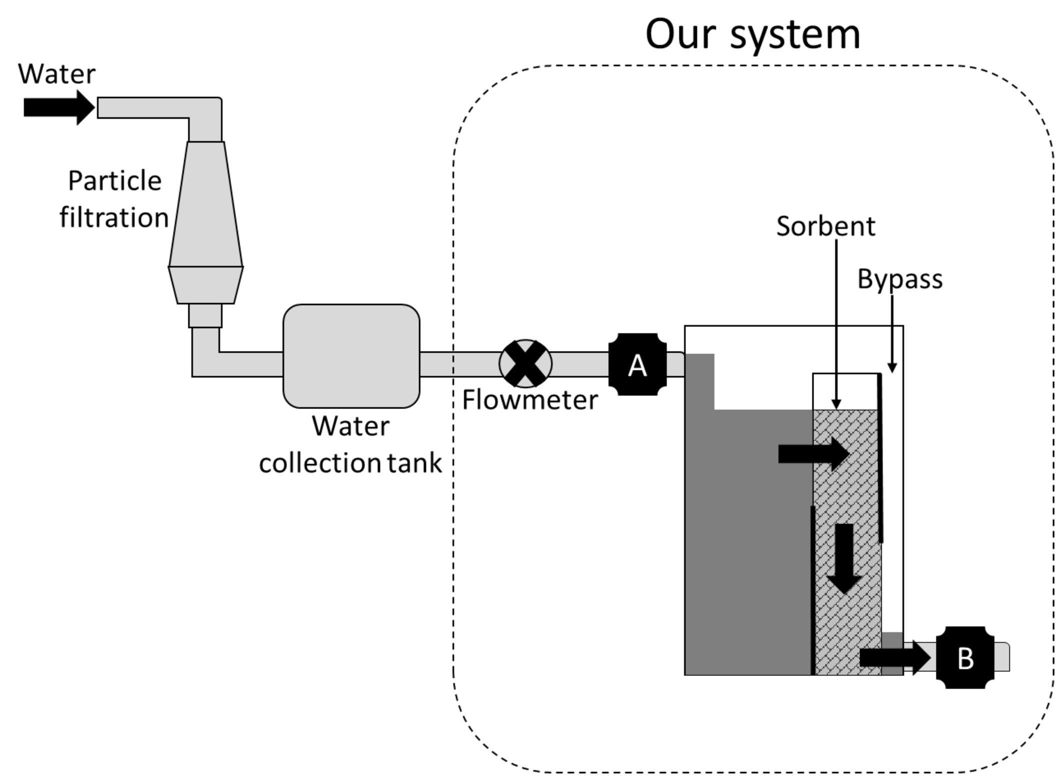

Figure 2 Illustration of the sorption unit, average water flow of 500 L/hour and sampling points (A, ingoing; B, outgoing).

Results and discussion

No significant changes were seen in the outgoing water for electrical conductivity or pH. The sorbent did not show a potential to decrease in the metal concentrations. However, some metals e.g., the aluminum concentrations increased after passing through pine bark.

Some short-chain PFAS (PFBA and PFHxA) were initially released from the sorbents (see Figures 3 and 4). The bark was not pretreated before use, and plants have the capacity to bioaccumulate particularly short-chain PFAS from nearby water and soil [4].

The hydrophobic long-chain PFAS were sorbed more than the corresponding more hydrophilic short-chain homologue [3].

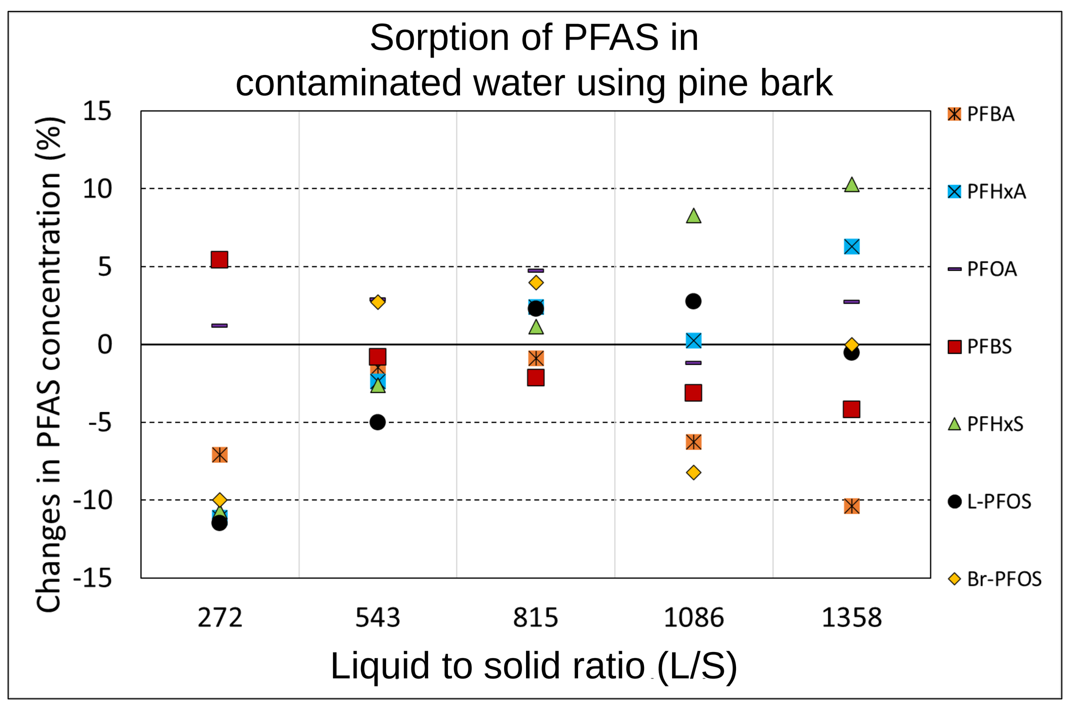

Figure 3 Sorption of PFAS using pine bark.

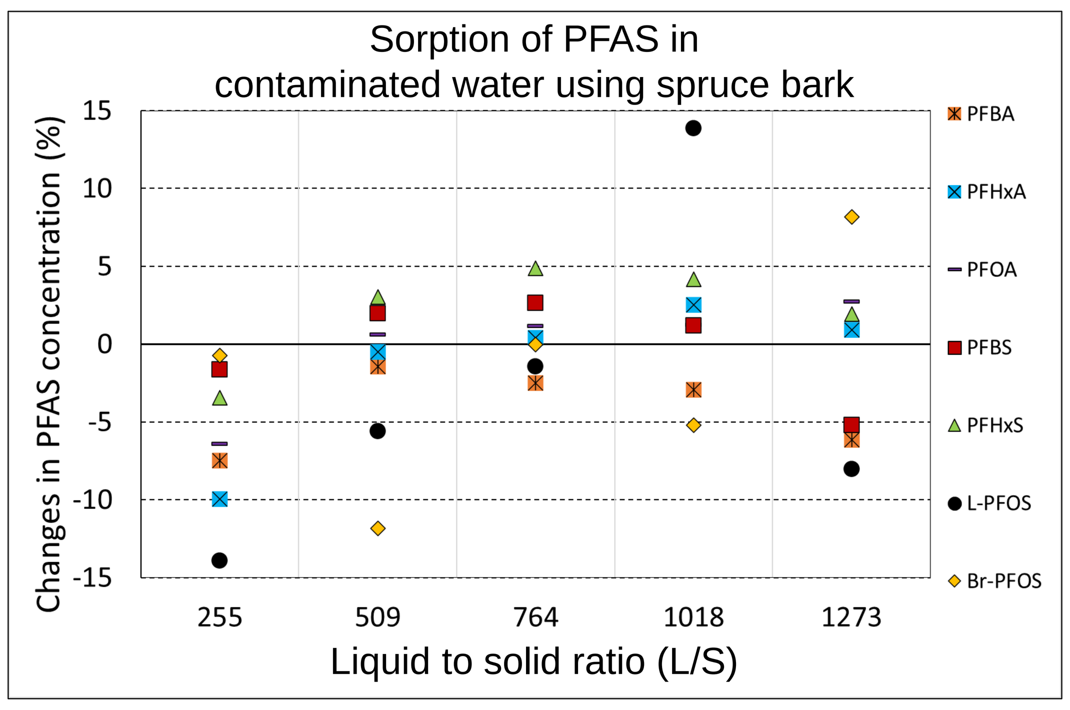

Figure 4 Sorption of PFAS using spruce bark.

Conclusions

- The sorbents contained leachable PFAS and might require washing as a pretreatment before use.
- During these conditions, the reduction potential of PFAS using pine or spruce sorbents was <15%.
- There was not any leaching of toxic metals from the sorbents.

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The authors would like to acknowledge KKS and Flexiclean AB

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