

Removal of PFAS substances from water

Biokol Sverige

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Executive summary of the project

The overall objective was to synthesize and validate magnet activated carbon (MAC) as a potential adsorbent material and make a conceptual design of an industrial scale unit suitable for remediation of PFAS contaminated water in real applications.

Granulated activated carbon (GAC) is most common technology used today for remediation of chemical contaminated waters. There are however significant costs associated using GAC in these applications. PFAS is considered as a major risk for environment and health. High PFAS contamination is a problem in all countries. The costs for cleaning up PFAS contaminated soils and waters in Sweden alone is estimated to exceed 10 billion SEK. The authorities and drinking water providers are therefore looking for cost efficient solutions for PFAS remediation. Besides GAC other technologies are tested in the field such as ultrafiltration, ion exchange and foaming. MAC technology was proved by Biokol Sverige AB to have high capacity in removing pharmaceutical residues in water. Therefore Biokol suggested this project to validate MAC as a candidate for removal of PFAS in real and complex waters from landfills.

The project is divided in six work packages and three reports.

- Report 1: WP1 Synthesis and WP2 Characterization of Magnetic Activated Carbon.
- Report 2: WP3 Lab scale study and WP4 Recovery of PFAS and MAC regeneration.
- Report 3: WP5 Bench scale test and WP6 Industrial scale design.

The objective in WP1 is to synthesize magnetic activated carbon with high surface area, porosity, magnetism, small particle size. The up-scaling and industrial process should be simple and using biomass as raw material. The synthesized MAC material was subsequently characterized in WP2. Data, as reported, confirms a MAC product with equal or even better properties than the best commercial available activated carbons in the market currently used for water treatment.

WP3 objective is to optimize chemical and process parameters in laboratory format for uptake and recovery of PFAS and the subsequent WP4 objective is elution of PFAS from MAC and reuse of MAC. Synthetic water and real PFAS contaminated water from FWS/Norrköping landfill were used in the work. Resulting data shows an overall removal efficiency of PFAS higher than 90 %, whereas removal of long chain compounds is higher than 98% and for short chain the data is 88%. High desorption of PFAS from MAC was achieved using organic solvents like methanol and acetone. The result from tests shows almost 100% recovery of PFAS from MAC. After elution the MAC can be regenerated and used again.

The conclusions from WP3 and WP4 are that MAC is a promising candidate for remediation of PFAS from real and complex waters such as from landfills. The benefits compared with GAC are significant smaller inventory of carbon in contact tanks, lower consumption of carbon, easy to separate, non un-intended break-throughs of short-chain PFAS and no back-flushing.

WP5 objective is to elaborate process parameters in 30 liter bench test device and to define dosage of MAC, retention time of water in the contact tank and re-use of MAC. PFAS contaminated water from FWS/Norrköping landfill was used in the experiments. The bench unit was designed and manufactured according to the needs for testing. The objectives for WP5 was achieved. The bench unit worked well also for very low concentration of MAC. Cleaning of magnetic rods from MAC particles was done by short burst of pressurized water.

WP6 is design of industrial scale unit for treatment of a continuous flow of 15 m³/hour water. The experiences from design and assembly of the bench unit in WP5 became a very valuable know-how for the conceptual design of an industrial scale unit. The design work also benefitted from in- depth technical discussions with WS. The objective for design was to achieve a modular design that should be easy to assemble for specific project demands in container pre-installed format, remote control, low operational and maintenance costs, commercial available components.

The overall conclusion of the project is that all objectives in the WPs were fulfilled and for some even be better than expected. The project validated MAC is a promising candidate for remediation of PFAS and other complex contaminants in water. The results will hopefully be a good knowledge platform for next steps to bring the technology to the market.

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