Reusable Magnetite-Activated Carbon for PFAS Removal and Destruction via Microwave Pyrolysis

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This experiment explores the regenerative properties of activated carbon as a filter for PFAS in water when combined with microwave-activated magnetite. PFAS refers to a family of over 14,000 distinct “forever chemical” compounds made up of carbon chains with fluorine appendages, making the bonds extremely strong and resilient. These chemicals are ubiquitous in everyday life as they are used in countless industrial and consumer applications, and they are well known to cause serious health issues, including infertility, birth defects, cancers, low immune system response, etc. In this experiment, magnetite was synthesized and added to activated carbon in a 1:3 mass mixture. One gram of this solids mixture was then added to 40 mL of 10 ppb PFAS solution and mixed continuously for an hour to fully capture the PFAS. Supernatants were removed and filtered for analysis while solids were used for repeated experimentation, up to 4 cycles of regeneration. Solids were microwaved in a kiln, reaching temperatures of >900 oC, sufficient to break down PFAS. This study found that 99.6% of PFAS was removed after cycle 1 and, after the fourth cycle, 93.4% of PFAS was removed from the water, a statistically insignificant difference (p-value = 0.3). Magnetite-activated carbon offers an economical and energy efficient method of PFAS removal and thermal destruction that can be regenerated for reuse

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