# A Novel Method for Pollutant Removal Using Thermo-Responsive Hydrogels in Dynamic Water Systems

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Thermo-responsive hydrogels represent a promising advancement in sustainable water purification, as this research investigates PNIPAM-based hydrogels enhanced with silica, cellulose, and activated carbon to selectively capture and release contaminants such as pharmaceuticals, microplastics, and synthetic dyes by adsorbing them at lower temperatures and releasing them upon heating above 32°C for regeneration and reuse, with laboratory testing showing activated carbon composites achieving removal efficiencies up to 73.5% for methylene blue, 66% for acetaminophen, and 50% for microplastics across at least three heating–cooling cycles, demonstrating advantages over traditional methods like activated carbon filtration and reverse osmosis due to reusability, lower resource demands, and effectiveness against emerging pollutants, while still requiring further optimization for broader applicability and long-term durability, ultimately highlighting their potential as a cost-effective and sustainable solution for dynamic water treatment and global water quality challenges.

**Awards Won:**