
# A temperature-assisted cyclic process with tailor-made carbon microtubes for the removal of antibiotics from water

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**Abstract:**

In this presentation, we introduce a new microtubular porous carbon as an efficient adsorbent for the removal of the frequently detected antibiotic sulfamethoxazole (SMX) from water. In this adsorbent, the carbon nanotube (CNT), besides providing mesopores, fundamentally acts as a binder while powdered activated carbon (PAC) embedded in the CNT network supplies micropores which are known as high-energy centers for adsorption. In this regard, carbon microtubes (CMTs) with different PAC content were fabricated, characterized and tested in adsorption processes. In addition, the versatility of the fabrication method in tailoring the porosity and designing the inner structure has been demonstrated. Moreover, the best fabricated CMT with respect to both adsorption kinetics and capacity could be regenerated through Fenton chemistry and reused up to 12 times in a so-called cyclic process. A moderate increase of temperature (T=50°C) shows to enhance the regeneration capacity of the adsorbent up to 50% compared to ambient conditions.

**Keywords**: Antibiotics removal; Cyclic process; Tailor-made carbon

The occurrence of antibiotics in water bodies is of great concerns due to their negative impact on the environment, especially developing antibiotic resistant genes and bacteria [1]. Since these kinds of pharmaceuticals are chemically designed to supress or hinder the growth of infection made by bacterial community, one cannot consider biological treatment as an effective removal method. Thus, physiochemical treatment methods have been regaining considerable attention regarding antibiotics removal.

Among different approaches, adsorption on powdered activated carbon (PAC) is a safe option as it does not encounter any secondary pollution like oxidation by-products which forms during oxidation process. Utilizing PAC as adsorbent, however, requires an additional separation step as well as extra efforts for carbon sludge handling and disposal. This means that fresh PAC must be continuously supplied to the system which is not only unsustainable but also energy-intensive. In addition, the degradation of antibiotics through Fenton chemistry is a viable alternative due to formation of extremely strong oxidant called OH radical. Yet, the acidic pH of Fenton (pH=3) does not allow its direct application in wastewater treatment due to high demand of chemicals. Therefore, to avoid the pH adjustment of wastewater, Fenton process can be indirectly employed in a so-called cyclic process to regenerate the spent adsorbent (Figure 1.1).

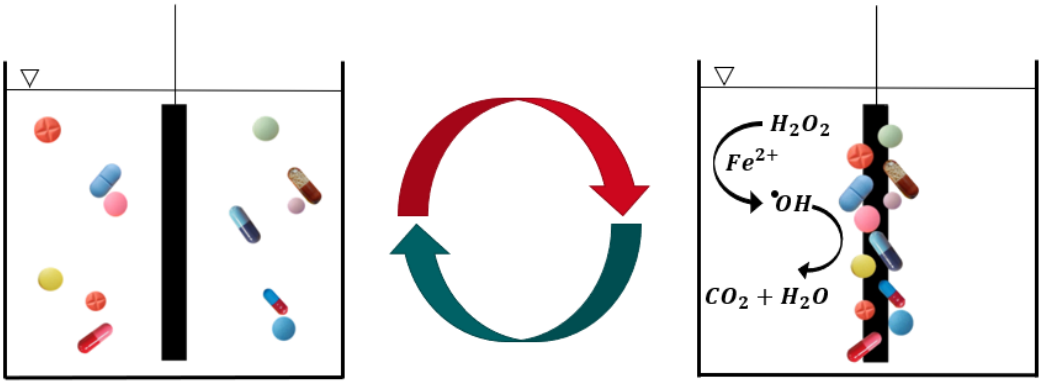


**Figure 1.1:** This is the schematic of cyclic process used in this study

The essential prerequisite for the cyclic process is to have an adsorbent that is easily removable from water phase. In this regard, carbon nanotube (CNT) has been chosen given their intrinsic features in fabrication of freestanding geometries like buckypapers [2] and microtubes [3]. Although the functionality of CNT-made microtubes has been illustrated as a gas diffusion electrode through cyclic process to remove Acid Red 14[4], CNT is considered as expensive materials especially in the field of water and wastewater treatment while it contents much less specific surface area in comparison to PAC. Moreover, Acid Red 14 is not an eligible representative for persistent antibiotics.

## REFERENCES

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