REMOVAL OF CIPROFLOXACIN FROM WATER USING MODIFIED NATURAL POROUS MATERIAL

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INTRODUCTION

Many types of common antibiotics find their way into water, in both natural and municipal settings. Sources of this contamination include human waste and flushing unused medication down the toilet. Ciprofloxacin is one such common antibiotic, prescribed for treating a wide range of bacterial infections. Due to the nature of antibiotics, low concentrations can still have adverse environmental impacts. Ciprofloxacin can remain active in water and soil. Antibiotic pollution is known to have consequences ranging from developing antibiotic resistant bacteria, to harming soil microorganisms. Natural porous material was modified with a carbon-based coating and doped. The purpose of this research was to understand how temperature, pH, and salt content affect the modified natural porous material's adsorption of Ciprofloxacin.

OBJECTIVES

To calculate the adsorption capacities of Ciprofloxacin to the modified natural porous material in multiple environments, as well as model kinetics and isotherms.

To draw conclusions on how changing environmental factors affects the adsorption of Ciprofloxacin to the modified natural porous material

HYPOTHESES

Regarding temperature, it was hypothesized that warmer environments would increase Ciprofloxacin adsorption capacity, and cooler environments would lower it.

Regarding presence of NaCl, it was hypothesized that this additional species in water would interfere with Ciprofloxacin adsorption, and increased NaCl content would lower the adsorption capacity of Ciprofloxacin.

Regarding pH modification, it was hypothesized that acidic pH environments would improve adsorption behavior, and basic pH environments would hinder Ciprofloxacin adsorption.

METHODOLOGY

For fabrication, natural porous material, sorted by size, was cleaned by sonication and microwaving. Material was etched and doped, dried, then coated with doped carbon-based coating. The excess coating was rinsed, then the carbon-coated modified material was dried.

-Isotherms were conducted with 1,3,5,7,10, and 15 mg/L Ciprofloxacin adjusted to pH 5.5, conducted at 4, 25, and 40 Celsius, sampled after 24 hours.
-Kinetics were sampled at room temperature across 96 hours with 10mg/L Ciprofloxacin adjusted to pH 5.5.
-NaCl content of 0, 0.03, 0.05, 0.1, 0.2, 0.3, and 0.5 mol/L was tested with 10mg/L Ciprofloxacin adjusted to pH 5.5 and sampled after 96 hours.
-pH of 2-10 in 1.00 increments was tested at room temperature with 10 mg/L Ciprofloxacin and sampled after 96 hours.

Samples were analyzed with a UV Spectrophotometer.

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FIGURES

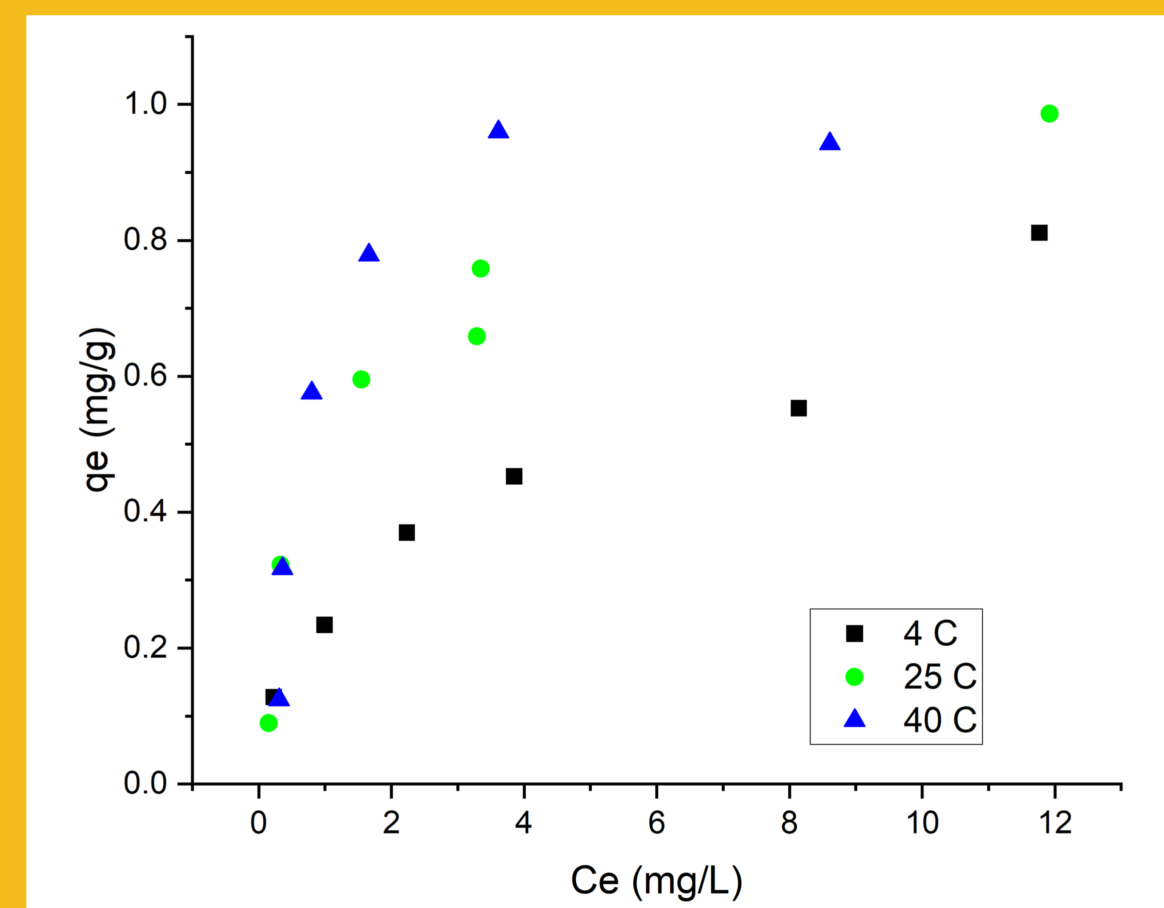

Figure 1: Ciprofloxacin isotherms at 4, 25, and 40 Celsius

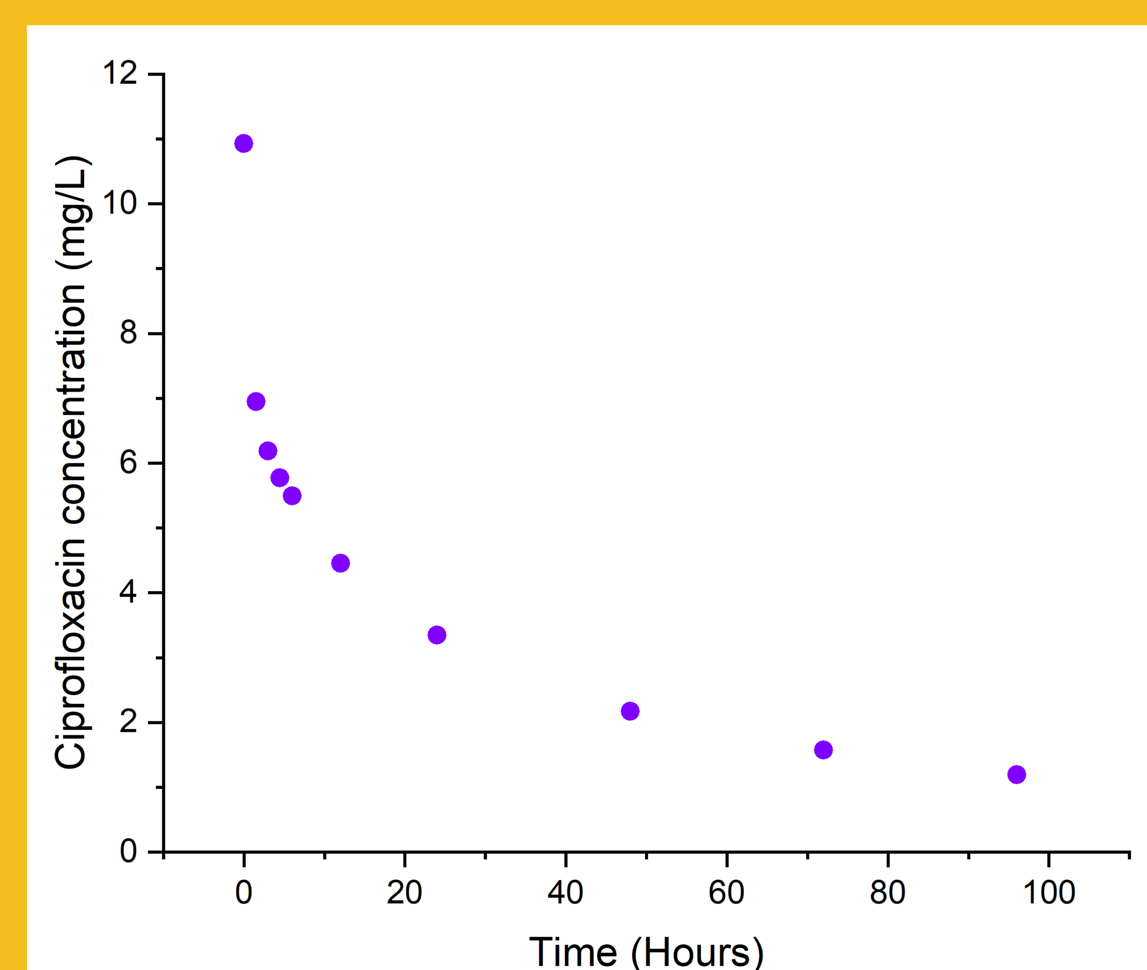

Figure 2: 96-hour kinetics of Ciprofloxacin adsorption

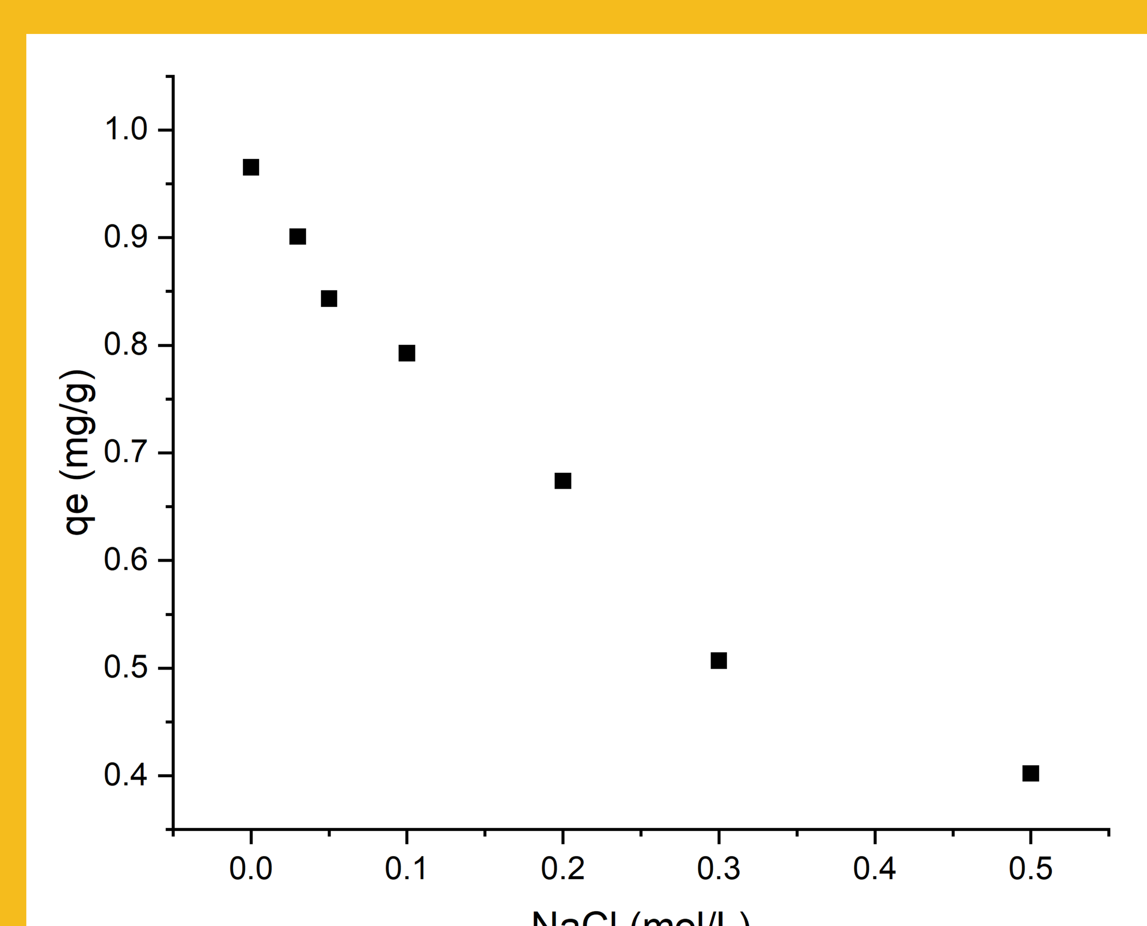

Figure 3: The effect of NaCl concentration on Ciprofloxacin adsorption capacity

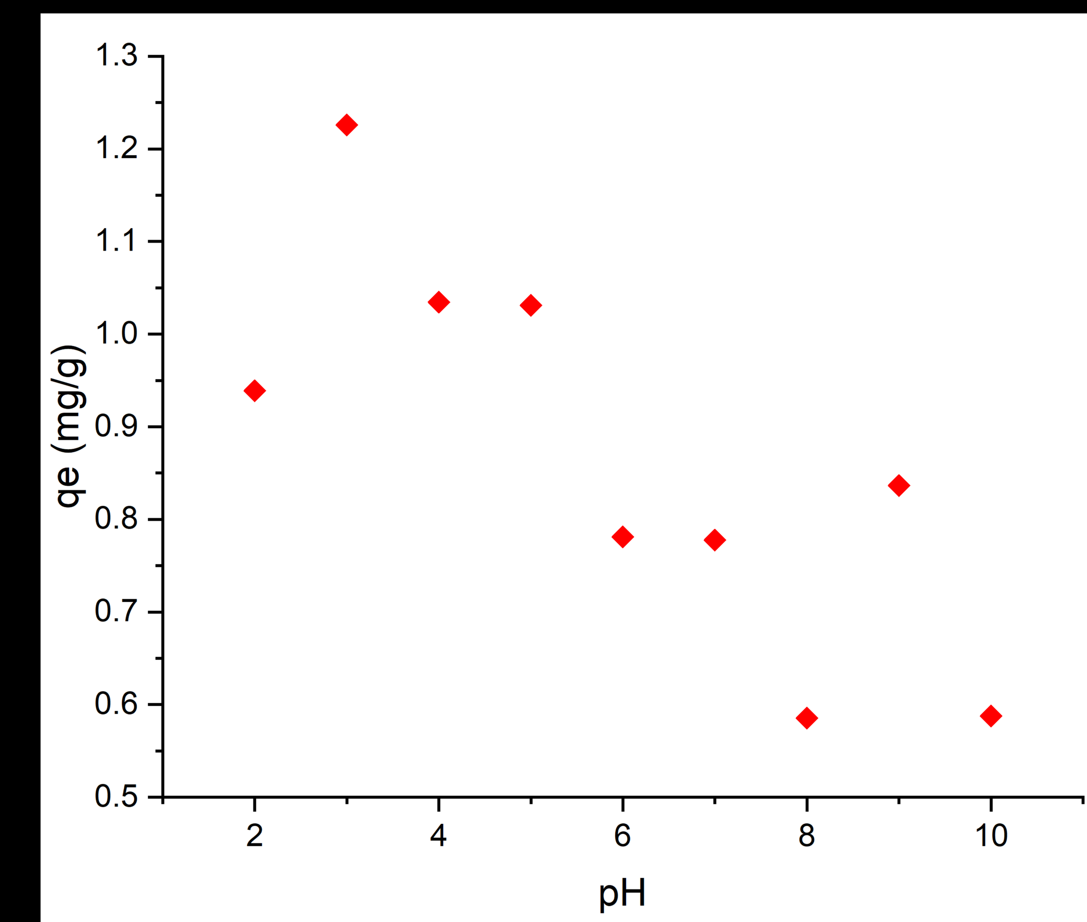

Figure 4: The effect of pH on Ciprofloxacin adsorption capacity

CONCLUSIONS

Figure 1 supports the hypothesis that increased temperature improved the material's adsorption properties.

Figure 3 supports the hypothesis that increased concentration of NaCl negatively affects the material's ability to adsorb Ciprofloxacin.

There is a general downward trend in adsorption capacity with increasing pH.

FUTURE WORK

Evaluation of the rate of adsorption of this engineered material will be compared to rate of adsorption of the base material. Kinetic models can be used to determine the adsorption rate of contaminants and the time needed for the process to reach equilibrium.

Develop experiments that will allow an even higher adsorption capacity for the modified natural porous material.

The effect on other species in water besides NaCl on the adsorption of Ciprofloxacin is another set of experiments which can yield useful information. Possible other species include chlorine and fluoride, as they are often present in municipal water supplies.

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