The kinetics of a reaction

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Introduction

In this research project, a kinetic model was established using UV-Vis spectroscopy to study the rate at which a chemical reaction occurs. The purpose of this study is to identify a suitable reaction to be studied using UV/Vis spectrophotometry, and to investigate the influence of different reductants, oxidizers, and acids on the rate of the reaction. The research was inspired by the oxidation of tartrazine dye by sodium hypochlorite, but this reaction was not suitable for study using UV/Vis spectroscopy. Alternative reductants and oxidizers, such as ethanol, glucose, ascorbic acid, sodium thiosulfate, iron(III) chloride, and potassium permanganate, were considered in the study. The addition of an acid was also explored as a way to influence the rate of the reaction.

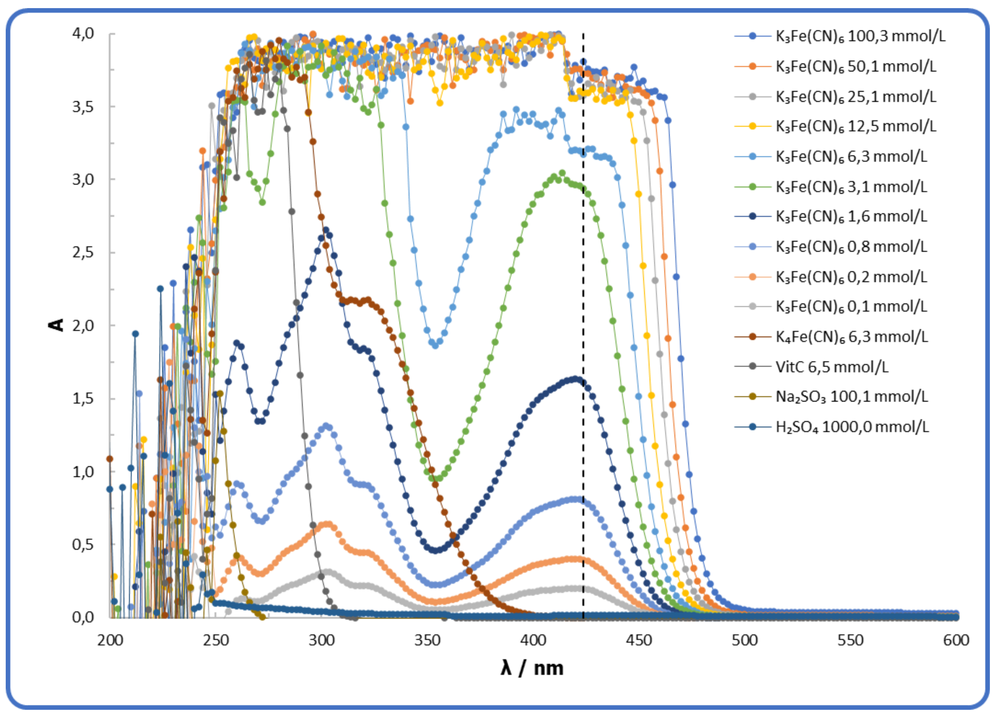
Materials and methods

First of al a dilution series for the oxidisers was made. This is for finding the right concentration of the oxidisers to be around an absorbance of 2. The starting concentration was 0,1 molar and the dilution factor was always 2. There were 10 dilutions made for each oxidiser. After the right concentration of oxidiser was found the reaction could be observed.

For the analysis of the reactions a Shimadzu spectrophotometer UV-1900 was used. The spectra of the different molecules were taken with this spectrophotometer. After the spectra were taken the time courses of the different reactions were taken.

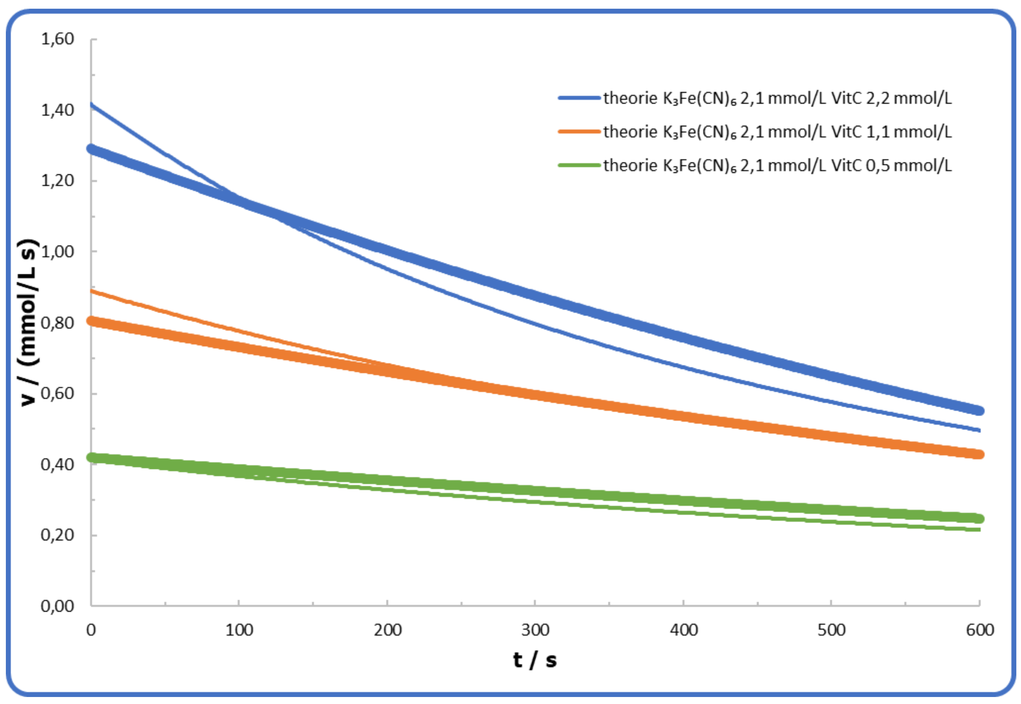
Results and discussion

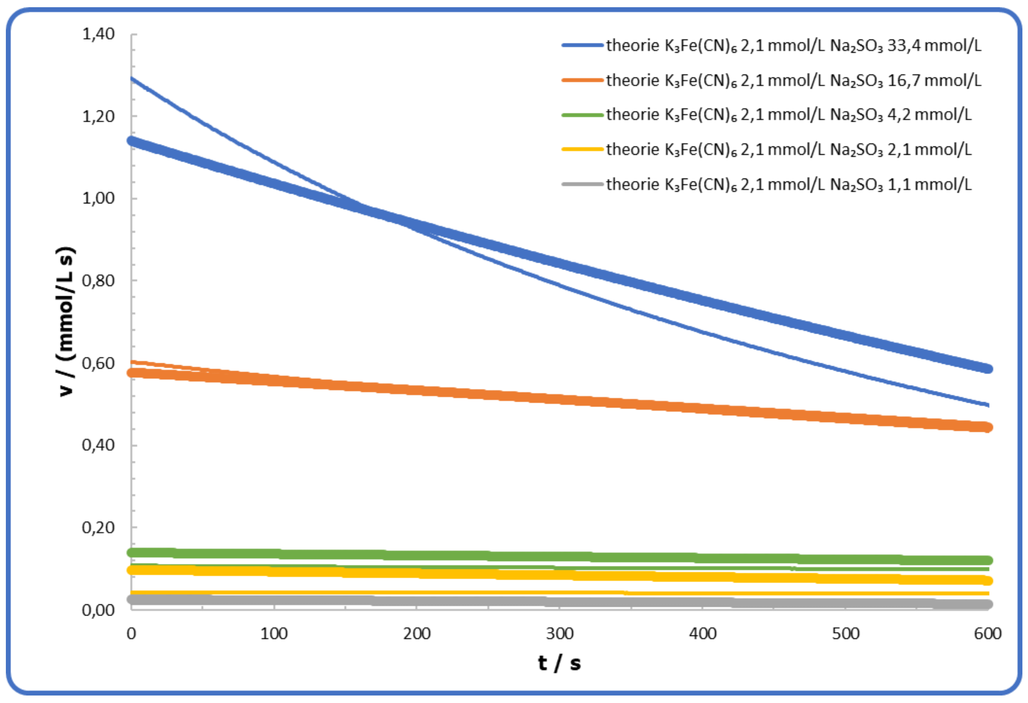
To know if there would be any interference in the spectrum of Fe^{3+} there had to be a spectrum taken of every product that was used and that would form during the reaction. Also the wavelength was to be chosen correctly to measure the absorbance of Fe^{3}.



When the correct wavelength was chosen (420 nm) the time course was taken with the spectrometer. After 30 min the absorbance was visible. With these data a reaction kinetic formula was produced out of the following general kinetic formula.

$$C_A(t) = a * t^3 + b * t^2 + c * t + d \rightarrow \frac{dC_A}{dt} = 3at^2 + 2bt + c$$





Conclusion

For the reaction with $K_3Fe(CN)_6$ two good reducing agents were eventually found, viz. vitamin C and $Na_2S_2O_3$. based on different time courses of $K_3Fe(CN)_6$ it is possible to determine the kinetic models at a certain concentration of Fe_3^+.

No good reducing agent has been found for the reaction with $KMnO_4$ to determine the kinetics of the reaction. The reaction always proceeded too fast or an intermediate was formed.

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