EXPERIMENT E4

Introduction to Kinetics: Factors that Affect the Rate of Reaction

Pan Chong Dan 潘崇聃

ID:516370910121

Section 5

Group 4

Yan Li Hao 闫李豪

Pan Chong Dan 潘崇聃

Zhou Meng Tian 周梦恬

Liu Ni Yi Qiu 刘倪逸秋

Date:2017/3/20

Telephone:13621631412

E-mail: panddddda@sjtu.edu.cn

UM-SJTU JI

**Objectives**

* Learn to list and rationalize the factors affecting the rate of reaction
* Explain various scenarios
* Learn how to balance theory with practice

**Introduction**

 Chemical reactions occur at various rates. We can make reactions run faster or slower by being familiar with the factors affecting the rate. Chemical kinetics is the study of rates of chemical processes. If we double the concentration of reactants, the rate may double too. Scientists will be able to gain insight into reaction mechanisms through an understanding of the relationship between the concentration of reactants and the rate of the reaction

**Background & Theory**

1. **The Rate Law**

For an equation: aA+bBcC+dD the rate=k[A]m[B]n and the rate constant k is specified for each reaction and temperature independent. The unit of k depends on the reaction order. We must do experiments to determine the values of m and n.

1. **The Iodination of Acetone**

We will study the kinetics of the reaction between acetone and iodine to form iodoacetone and iodide in the experiment.

CH3COOH3(aq)+I2(aq)(yellow)CH3COCH2I(aq)+H+(aq)+I-(aq)(colorless)

The rate law will be determined by the varying concentration of acetone and iodine. We must measure the concentration of reactants as a function of time to study the rate of the reaction. In this particular reaction, the rate will remain relatively constant because the amount of acetone will be kept in vast excess with respect to the amount of iodine. As a result, we can calculate the rate by measuring the change in iodine concentration divided by the time measured.

Rate=([Iinitial]-[Ifinal])/t

The study of the reaction for the iodination of acetone is also made easy due to the color ranges of the solution. Iodine (I2) is a pale yellow whereas the iodide ion (I-) colorless. Acid is also colorless catalyst introduced in the reaction. Therefore, changes in iodine concentration can easily be visualized. The time at which the pale yellow color of the initial solution turns clear indicates that the reaction is completed and that [I2]initial =0 M.

**Data Processing**

Equation:*CH3COCH3(aq)+I(aq)(yellow)**CH3COC2I(aq)+H+(aq)+I(aq)(colorless)*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Solution | Vacetone | VHCl | Viodine | Timerxn1 | Timerxn2 | Timeave | [acetone]initial | [iodine]initial | Rateinitial |
| #1 | 10ml | 10ml | 10ml | 89’00s | 89’31s | 89’155s | 0.8M | 2.36\*10-4M | 2.65\*10-6M/S |
| #2 | 10ml | 10ml | 20ml | 189’13s | 193’75s | 191’44s | 0.8M | 4.72\*10-4M | 2.47\*10-6M/S |
| #3 | 20ml | 10ml | 10ml | 43’56s | 44’46s | 44’01s | 1.6M | 2.36\*10-4M | 5.36 \*10-6M/S |
| #4 | 5ml | 10ml | 5ml | 87’99s | 67’32s | 77’655s | 0.4M | 1.18\*10-4M | 1.52\*10-6M/S |

[acetone]initial= Vacetone\*4/50

[iodine]initial= Viodine\*0.00118/50

Rate=k[acetone]initialm\*[iodine]initialn

Rate1/Rate2=([acetone]1\*[iodine]1)/ ([acetone]2\*[iodine]2)

Rate3/Rate4=([acetone]3\*[iodine]3)/ ([acetone]4\*[iodine]4)

Rate1/Rate2≈1=[acetone]1/[acetone]2

Rate3/Rate4≈4=[acetone]3/[acetone]4

n=0 m=1

k=Rate1/[acetone]1=2.65\*10-6/0.8=3.3125\*10-6 M-1\*S-1

**Discussion**

There is only one part in this experiment but it requires a lot of calculation and lab work since we need many data to calculate the reaction order. According the manual, the percent difference between two measured time should be less than 5%, but ours are much bigger. In our experiment, we used de-ionized water as the control group, so when the solution looked like the de-ionized water which is totally transparent. I think there might be some wrong with our observation because we can’t precisely distinguish the color of the solution. In addition, in the process of preparing the solution, we used 4 100mL beakers, which were so big that the molarity of the reactants might not be so accurate.

After our experiment, we calculated that the rate order was one and the rate of the reaction has nothing to do with the concentration of iodine. We’re very curiously about the reason behind this because since there are two reactants, why the order isn’t two.

**Conclusion**

The experiment report includes some basic concepts about reaction order and how to measure it by conducting an experiment. In our experiment, we used different amount of acetone and iodine to react and measured how long it took. After four times of reaction, we gathered many data and calculated the rate order of the reaction between acetone and iodine. The data collection was very important in this experiment, but I think we did a good job and we had a deeper understanding of rate order.

**References**

Prof. T. Hamade,” Determining the Rate Law: A Kinetics Study of Iodination of Acetone”, UM-SJTU JI & SJTU Chemistry Department