The performance in any chemical process

ASSIGN BUSTER

\n[toc title="Table of Contents"]\n

\n \t

\n[/toc]\n \n

Sodium hydroxide was reacted with ethyl acetate in a continuous stirred reaction. The two reactants were introduced in the mixing vessels. The conductivity was measured rather than measuring the values of concentration. Due to the fact that determining the value of concentration directly is very complicated. The conductivities of the reaction were recorded as time elapsed. Then, using certain calculations on the conductivity values, the reaction rate constants were obtained. Subsequently, the activation energy was found using Arrhenius equation and the resulted reaction rate constants. The activation energy was at about 107. 9 KJ / mol. This value differs than the actual value because of some errors in the experiment.

Summary:

This main purpose of this experiment is to calculate reaction rate constants and find out the activation energy for a reaction between sodium hydroxide and ethyl acetate by using continuous stirred tank reactor. These two reactants produce sodium acetate and ethyl alcohol. This reaction was

happened three times at different temperatures which were 293 K, 303 K and 313 K. The values of conductivity were recorded at these stages of the experiment. The values of the conductivity were decreased when the sodium hydroxide concentration decreased and the ethyl acetate concentration increased. As a result, there is an inverse proportional relationship between the sodium hydroxide and ethyl acetate concentrations and the values of the temperatures. On the other hand, after studying the relationship of the natural logarithm for the reaction rate constants and the inverse temperature of the reactants to get the value of the activation energy. It was found that the relationship is inversely proportional.

Introduction:

The aim of this experiment is to measure the reaction rate constants. By using the continuous stirred tank reactor for liquid phase, the activation energy for a reaction is measured. Furthermore, the other aim is to understand how the reaction rate constants of any reaction can be variable at different values of temperatures.

The report discuses the concept of homogenous reactions carried out in continuous stirred tank reactor which is very important to chemical engineers. However. This reaction was happened at three different values of temperatures to study the influence of the temperatures on the produced conductivity. This conductivity was considered as a function of time. According to Arrhenius equation, the values of activation energy at only two temperatures were measured by using the reaction rate constants. The values of the activation energy describes the required energy which makes the reaction happened.

Moreover, the negative values of the activation energy describe that the reactants which are sodium hydroxide and ethyl acetate have the required energy to react. Moreover, this report studies the concentration of the reactants, the concentration of the products and the impacts of reactants and products on the conductivity.

Literature Review:

A chemical reactor is really important for the performance in any chemical process. There are two types of chemical reactor: a tank reactor and a tubular reactor. The tank reactor is known, as an ideal type of reactors due to it is capable to make the temperature stable in the mixture and the concentration as well. Furthermore, a tubular reactor is used to describe a chemical reaction in continuous and flowing system. The purpose of the tubular tank model is to predict the behavior of chemical reactors.

Chemical reactions can play a major role in industrial processes. However, there are many types of reactors have been applied to the industrial purposes based on the quality and the quantity of the products. For instance, batch process and continuous process, which are essential in chemical processes. However, batch reactor is very efficient for small amount of production such as polymers while the continuous stirred tank reactor is suitable for large amount of production. The continuous stirred tank reactor is operated at steady state and it costs less than the batch reactors.

The continuous stirred tank reactor consists of baffle, cooling jacket, alligator, temperature controller and motor. These parts are connected to software to save and manage the values of the conductivities. The main

purpose of this type is to add more reactants in order to get different continuous products.

The speed of the reaction is known as the reaction rate. However, there are some slow reactions such as burning methane in oxygen which takes seconds while there are some fast reactions such as rusting of iron which takes several years.

The temperature can affect the reaction rate constant because at high temperature, the particles have very high kinetic energy. As a result, the collision between these particles is increased which lead to an increase in the reaction rate constant .

In any term of initial reaction, the first energy achieved before the reaction gets started is called the activation energy and the unit is (J mol-1). The activation energy is completely dependent on the reaction rate constants, which can measure the speed of the reaction. The molecules of the reaction must have equal or higher energy than the activation energy in order to start the reaction.

It is really important to minimize the activation energy in order to make the reaction fast than what it is by adding some substances. However, the added substances, which are called catalysts to the reaction, should reduce the activation energy while they increase the reaction rate constant. The main function of the catalysts is only to increase the speed of the reaction without any effect on the reactants or on the products.

Methodology:

At the beginning, five batches of 0. 1mol dm-3 sodium hydroxide and ethyl acetate were prepared for the experiment. However, this experiment was done at very secure way in order to avoid any damage or injury during the performance. Protective clothes, gloves and safety glasses must be worn. Then, when the covers had been removed, the two vessels were filled out from the top by the same amount, which was 50 mm. The first vessel was filled out with sodium hydroxide while the second vessel was filled out with ethyl acetate. After that, the set point of the temperature was set to be 293 K. Furthermore, by using the calibration graph, the flow was fed into the reactor at 40 cm-3 min-1 by adjusting the pump. After that, the agitator speed controller was set to be 7. 0.

After that, the pump and the agitator motor were switched on connected to the data logger program. The data collection period was 45 minutes in order to allow the reaction reaches a steady state conversion. However, this experiment was done two more times at different temperatures. The values of the temperature were 303 K and 313 K.

Discussion:

As it is shown above, this experiment was divided into three parts. The first part was occurred when the temperature was 293 K and the type of the process was batch process occurs at a range of times (0s to 1320s). The second and the third parts were occurred when the temperatures were 303 K and 313 K respectively and the type of the process was continuous process occurred at a range of time (0s to 2160s). The measurements are obtained at these tow ranges of time as the provided equations applicable for the

continuous reaction. However, Table 1 proves that the values of Λao and Λ∞ are going up when the temperatures become higher. Form, Equation 5 and 6, it is clear that the temperature is a function of Λao and Λ∞. Furthermore, there is a direct proportional relationship between the values of Λao and Λ∞ and the temperatures.

Form Table 3 and 4, the values of the conductivity were increased when the values of the temperatures were increased. In other words, there is a direct proportional relationship between the conductivity and the values of the temperatures. The reason of that is there is a reduction in the sodium hydroxide concentration. To be more precise, the positive and negative ions that are called cations and anions respectively were decreased. However, the amount of dissociated ions is represented by the values of the conductivity. Moreover, when the amount of dissociated ions of the reactants and of the products is equal, the conductivity becomes more stable. This situation is called equilibrium that means the reaction rate of the reactants to produce products is equal to the reaction rate of the products to produce reactants.

The values of the conductivity were decreased as time was increasing. The reason is the sodium hydroxide concentration was increased. To be more precise, the decrease occurred where the positive and negative ions (cations and anions respectively). The presence of ions is responsible for the capability of the solution to conduct. However, the degree of the decrease in the values of the conductivity was reduced due to the presence of ions was decreased in the solution.

However, the conductivity will be decreased when the supplier of sodium hydroxide is stopped due to the reduction in the sodium hydroxide concentration in the tank. On the other hand, the conductivity will go up when the supplier of ethyl acetate is stopped. To be more precise, sodium hydroxide is considered as a strong base, which is ionized in water. Furthermore, a weak base will be made when these ions interact with more components. The ions from the weak base are not strong enough for conduction. However, when the supplier of ethyl acetate is stopped, the ions will be presented in the solution. In fact, the conductivity will be increased.

Table 3 and 4 show the values of the sodium hydroxide concentration is decreased, as time increases. The reason of that is sodium hydroxide reacts more in order to produce products. In addition, the sodium acetate concentration is increasing as time goes up due to sodium acetate was being produced. Moreover, when the values of temperatures were increased, the sodium hydroxide concentration was decreased because the values of temperatures lead to in increase in the sodium acetate concentration. The increases in temperatures affect the reaction rate of the reaction. Furthermore, the increases in temperatures lead to an increase in the rate of the conversion from the reactants to the products that the reaction is known as endothermic reaction.

Additionally, the sodium concentration was decreased when the values of the temperature were increased. However, the increase in the values of the temperature leads to an increase in the sodium acetate concentration. The change with respect to the values of the temperature is resulted in the effect on the rate of the reaction. Moreover, the increase in heat can increase the

rate of the conversion when the reaction is endothermic or when the reaction is exothermic. For the previous reaction, it seems that the reaction is endothermic due to increasing heat leads to a decrease in the products, which is sodium acetate, and an increase in the reactant, which is sodium hydroxide.

Figure 2 illustrates the relationship between the inverse temperature and ln (K). The relationship is clear that it fall into a straight line. However, this line has a gradient, which helps to get the activation energy. The value of the gradient is multiplied by the universal gas constant that is 8. 314 to get the activation energy.

However, there were some errors during the experiment such as a delay in time for taking the required measurements. In addition, the values of the conductivity were not accurate enough because these values were measured in very small area of the reactor.

Conclusion:

There is a direct relationship between the values of the temperature and the sodium hydroxide and the sodium acetate concentrations.

When the supplier of NaOH is stopped, the conductivity will decrease but when the supplier of CH3COONa is stopped, the conductivity will go up due to some reaction occurs between NaOH and CH3COONa. The reason of that is the strong ions lead to increases in the solution and in the conductivity.

It is clear that there is an inverse relationship between the values of the temperature and the sodium hydroxide concentration. In other words, due to

the fact that the reaction is endothermic, so increasing the values of the temperature lead to an increase in the sodium acetate concentration.

The conversion of sodium hydroxide and sodium acetate are equal at a specific time and temperature.

When the values of conductivity are constant that means the reaction become more stable. This situation is known as equilibrium.

The value of the activation energy is positive.