



THE IMPACT OF TEMPERATURE ON A VARIETY OF CHEMICAL PROCESSES

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Abstract

The discussions about “Thermal effect of chemical reactions” is elaborately described in this paper. The increase of the rate of reaction due to the presence of heat is discussed below. The produced and required heats for the chemical reaction are referred to be in this topic. Two different thermochemical reaction and their comparison is mentioned in this paper. The effects of temperature, the methodology, ethical issues and hazards followed by the heat reactors are well discussed in this topic. Few recommendations to avoid the risk associated have been described here.

Keywords: Rate of Reaction, Enthalpy, Equilibrium Conversion, Course of Reaction, Pathway, thermal effects, Chemical Bonds etc.

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1. Introduction

Different chemical reactions are being catalysed in the presence of heat. Generally, the temperature above 100degree Celsius is being classified in the grouping for the high temperature situation. This high temperature effect is referred to as the thermal effect for which a chemical reaction happens. Here thermal is considered as an energy form which can transfer from one body to other body as a result of the differentiation in the temperature of two bodies. If there are two different bodies whose temperature is different and the two bodies are brought together then the heat flows from the hotter temperature to the respective cooler temperature bodies. At the high temperature the chemical reactions happen in a very quick process. Due to the increase in temperature the average kinetic power energy of the chemical particle increases, the particles having high thermal temperature start moving faster and can have a collision with each other which is per unit time as a frequently.

Objectives

- To analyse various types of chemical reactions

- To highlight the thermal effects for different types of chemical reactions
- To determine the effect of sequence mechanism for the chemical reactions
- To examine different challenges faced during investigating thermal effect for a reaction

2. Methodology

The methodology for studying the thermal effects is used here as the "rate of reaction". It is the speed at a point when a chemical reaction is happening. In general, the rate of reaction gives the description about the changes of some variables over a certain period of time. One of the common ways for the measurement of the rate is to measure the concentration of the reactants and the produced molecules change over a particular time duration [1]. The molecules of a particle have different kinetic energy and thus they have various effect when the molecular reactants are heated. When the particle is heated, the mean kinetic energy of the molecules in the matter increases and they can start moving with a high speed and hit each other with more energy.

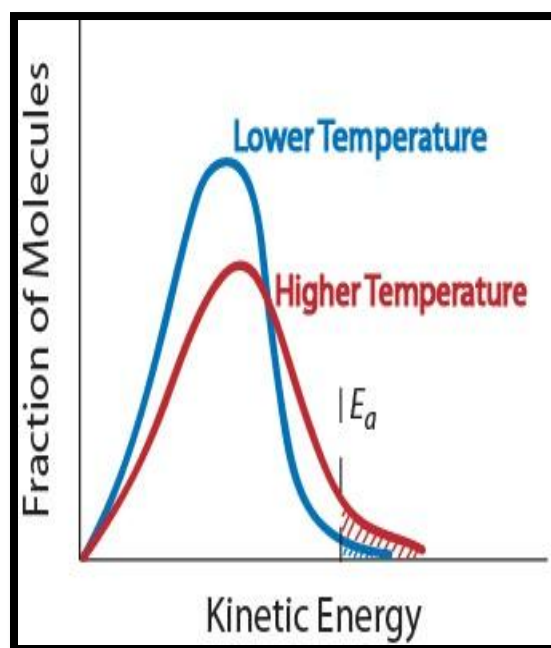


Figure 1: "Temperature and Reaction Rate."

Analysis of different types of chemical reactions

Various types of chemical reactions are found in this chemical world. Particularly, the 2 types of chemical reactions regarding the thermal effects are-

A. Exothermic Reaction- The chemical reactions which evolve heat or some sort of energy during the

process of the reactions [1]. Here the Enthalpy changes to negative and if there is higher evolved heat then the produced particle is more stable. Examples of such heat producing chemical reactions are- fermentation, respiration, combustion reaction, neutralization reaction etc.

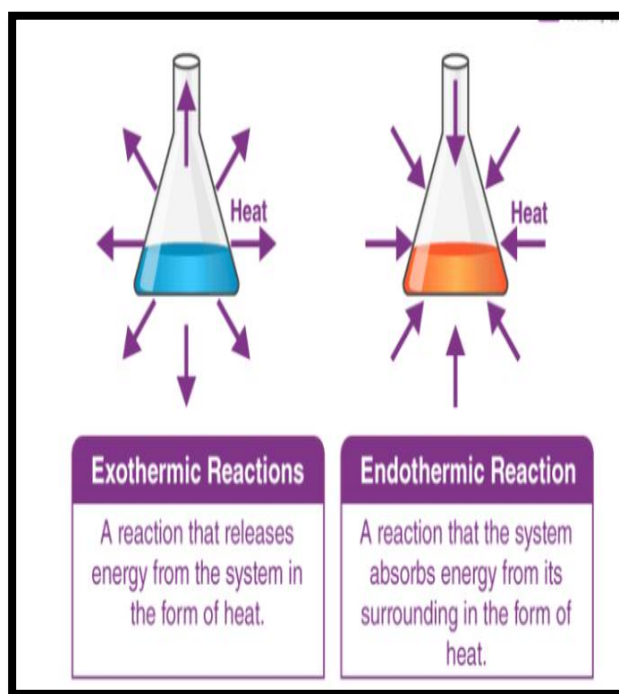


Figure 2: Exothermic Reaction

B. Endothermic Reactions- In these reactions, heats are absorbed during these chemical reactions. Here the change of Enthalpy is positive and if more heat is required then the product will be not much stable. Some examples of this type of reactions are- photosynthesis, decomposition reactions, sublimation reactions etc [2].

Endothermic Reaction	Exothermic Reaction
Endothermic reactions are chemical reactions in which the reactants absorb heat energy from the surroundings to form products.	An exothermic reaction is a reaction in which energy is released in the form of light or heat.
The energy is absorbed from the surrounding into the reaction.	The energy is released from the system to its environment.
Energy in the form of heat.	Energy is released as heat, electricity, light or sound.

The thermal effects for different chemical reactions

The reactions have different thermal effects like heat absorption or heat release which are the most important effect during a chemical reaction. In the

above two types of thermochemical reactions, heat is necessary for either initiating the process of chemical reaction or the production of energy [3]. For example, the boiling of milk can be considered.

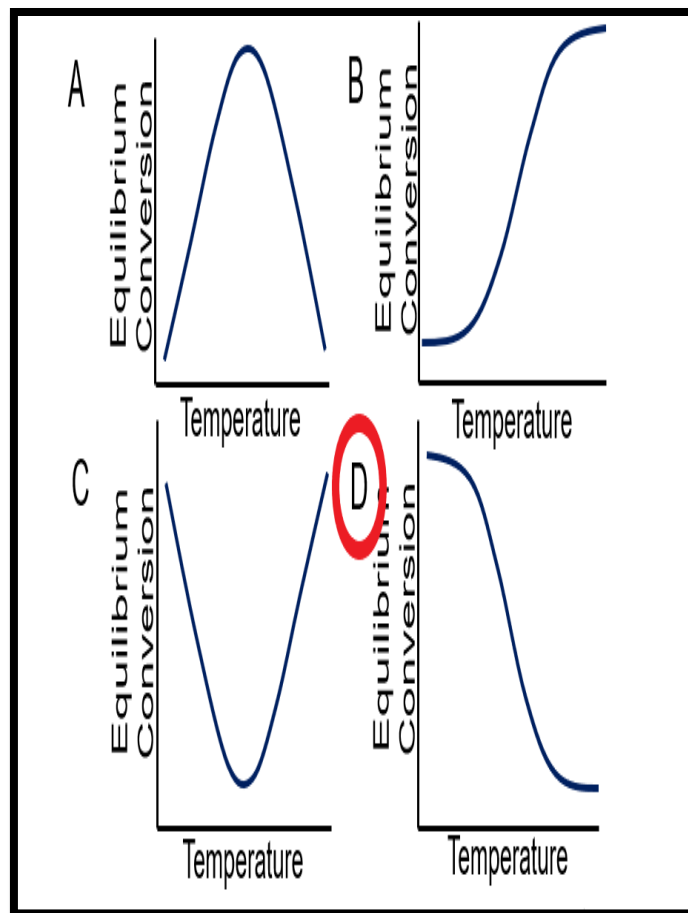


Figure 3: Thermal effects for different chemical reactions

One of the thermal effects is to get an inert affect to the adiabatic equilibrium temperature. For an exothermic reaction, this will lower the temperature and for endothermic reaction, it will increase the temperature [4].

In the case of equilibrium conversion, if temperature increases the conversion decreases for an exothermic and for the raise of temperature, there will be increase of equilibrium conversion for an endothermic reaction[5].

Elements	Chemical Reactions	Heats Entropy(kJ.kg-1)
C	$[C]+1/2O_2=CO_2$	34834
Si	$[Si]+O_2=SiO_2$	29202
P	$2[P]+5/2O_2=P_2O_5$	18980
Mn	$[Mn]+1/2O_2=MNO$	6594
Fe	$2[Fe]+3/2O_2=Fe_2O_3$	6460
SiO ₂	$4CaO+SiO_2=2CaO.SiO_2$	1620
P ₂ O ₅	$4CaO+P_2O_5=4CaO.P_2O_5$	4880

Determination of the thermal effect in reaction mechanism

The reactions can be interacting with the temperature, there and atoms and this mechanism can take place in every type of particles like liquids, solids and gasses or the interfaces in between these states. The mechanisms of these reactions are involving in breaking and forming of different type of chemical bonds between atoms [6]. Chemical reactions consist of the changes in the pattern of bonding of molecules

in the process of shifting electrons between their orbits or leaving electrons from their outer orbit in chemical bonds as a thermal effect of the reactions. As the thermal effect raises in a chemical reaction can results in the higher rate of reactions. The route by which the chemical changes is occurring is considered as the course of the reaction and the total change occurs in the full process that is referred to as the pathway or reaction path.

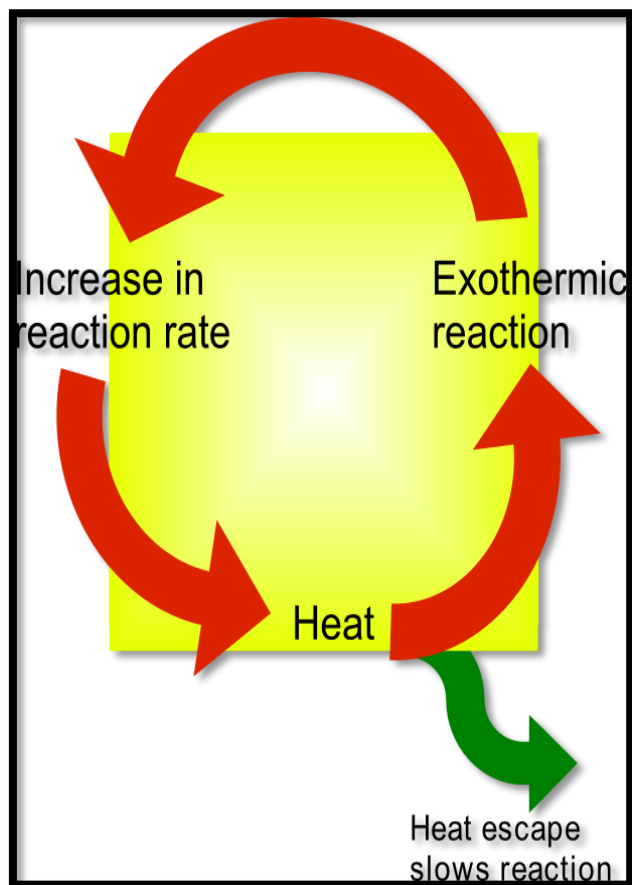


Figure 4: Thermal effects

Challenges faced during investigating thermal effect in a reaction

Raise in temperature during a chemical reaction can increase the rate of reaction typically, there are few exceptions. The increase in temperature will increase the mean kinetic energy of the reacting agents in the reaction. A huge type of molecules which will need the minimum thermal energy to collide with each other particles effectively. In the 19th century, there were

not any way and physical apparatus available for the measurement of the temperature for the rate of a reaction[7]. Later, Arrhenius's proposal was used related to the rate of reaction and temperature quantitatively. Now it had been noticed that the constant rate during the reaction procedure for a chemical reaction would get doubled for the rise of every 10 degree Celsius in temperature.

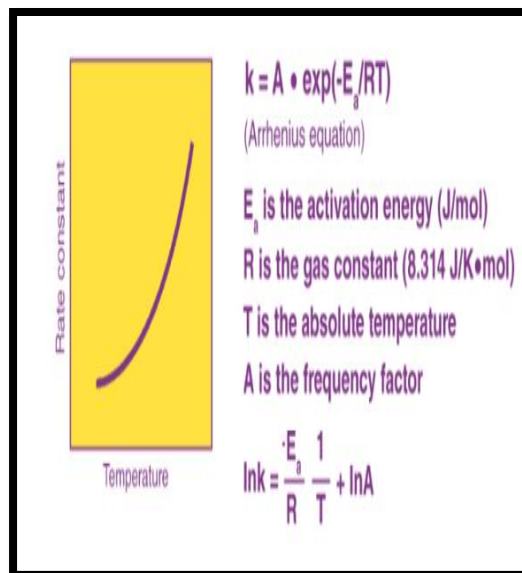


Figure 5: Arrhenius's proposal

Ethical Issues

For preventing and controlling the hazards faced during the process of conducting the reaction process, safety procedures should be followed for the reduction of risks associated with the experiments. Some of the major sources for the issues related to risks in the industrial chemical process includes risks of thermal runaway, scaling up process and explosions. When the produced heat in a reaction is exceeded the heat, it removed from the chimineas can result in thermal runaway in an accelerating reaction rate. One example of Scaling up process incident occurs when a MFG manufacturing chemical facility's 4000 gallons of "triallyl cyanurate" overheated in a reactor in Dalton, GA. This hazard had resulted an explosion causing the injuries of 154 people[8]. Such type of chemical incidents happened for the lack of understanding for the tragedy of these reactive hazards due to the inefficient hazard review and in effective designs. These would have resulted in the insufficiency in incapability of heat removal.

Recommendation

To speed up any reaction, there will be required for increasing the number of energetic particles at any particular situation and those particles having energies greater than or equal to the energy activation. For controlling the temperature in a reaction, direct injecting of water solvent process should be followed in case of errors in inlet conditions. As this injection will diminish the temperature until the desired temperature set points [9]. The thermal activity of a chemical reactive power plant should closely be monitored by proper experts and technicians.

Problem Statement

During studying the topic of thermal effect of various types of chemical reactions, there have some problem faced for determining the rate of reactions due to the effect of temperature in the reactions. The temperature can supply a sufficient energy for the occurrence of a chemical reaction and also a greater temperature can produce after the breaking and formation of different covalent bond within the molecules of the participating agents in a chemical reaction [10].

3. Conclusion

In the evaluation of this informational report, it can be concluded that the chemical reactions consisting of the breaking and producing new matters with the help of the formation of various chemical bonds. To break the chemical bond, an amount of energy is required which comes from the thermal effect of a molecule and thus the energy is released. If more amount of energy released than the required consumed energy, then the chemical reactions produce the thermal effect. There are different chemical reactions which have various type of thermal effects have been discussed above in this article.

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