

## Factors Affecting the Rate of Reaction

The rate of reaction for a given chemical change is the speed with which the reactants disappear and the products form. It is measured by the amount of products produced or reactants consumed per unit time. Usually this is done by monitoring the concentration of the reactants or products over time as the reaction runs.

The factors that affect the rate of the reaction are

1. Nature of the reactants and products
2. Concentration of the reactants
3. Temperature of the system
4. Pressure of the reacting system
5. Nature of the catalyst if present
6. Surface area of reactants
7. Rate of heat and mass transfer

Chemists have identified many factors that affect the rate of a reaction. Some of these factors can be altered or controlled by chemists and some cannot.

### Nature of the Reactants

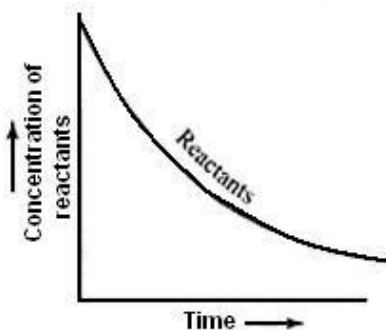
The nature of reactants includes not only the physical state of each reactant but also the particle size. The reaction rate is generally faster between liquid-state reactants than between solid-state reactants and is fastest between gaseous state reactants. Of the three states of matter the gaseous state is the one where there is the most freedom of movement and hence, collision between reactants are the most frequent in this state.

In the solid state, reactions occur at the boundary surface between reactants. The reaction rate increases as the amount of boundary surface area increases; subdividing a solid into smaller particles increases surface area and thus increases reaction rate.

When the particle size of a solid is extremely small, reaction rates can be so fast that an explosion results. Although a lump of coal is difficult to ignite, the spontaneous ignition of coal dust is a real threat to underground coal-mining operations.

### Change in Concentration of Reactants

According to law of mass action, the rate of a chemical reaction is directly proportional to the product of molar concentration of reactants. In a chemical reaction, the concentration of reactants decreases with time and simultaneously the concentration of products increases with time. Hence higher the initial concentration of reactants, higher will be the initial rate of reaction and the rate of the reaction decreases with time with decrease in concentration of reactants.



## Surface Area of the Reactants

The surface area of reactants influences the rate of heterogeneous chemical reactions. As particle size decreases, the total surface area for a given mass of reactants increases. Since such reactions occur by adsorption phenomenon the smaller molecules react faster than the larger particles.

Generally speaking, the greater the exposed surface area of the reactant, the greater the reaction rate. For example, a large piece of coal burns very slowly but coal dust burns rapidly, a consequence of which can lead to a disastrous coal mine explosion; solid potassium iodide reacts very slowly with solid lead nitrate, but when both are dissolved in solution the formation of lead iodide is instantaneous.

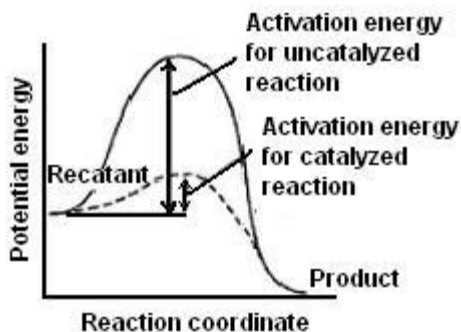
## Effect of Temperature

Since the number of activated molecules increases with the increase in temperature the number of effective collisions also increases with the rise in temperature and this increases the rate of reaction.

It is observed that the rate of majority of chemical reactions generally increases with rise in temperature.

## Presence of a Catalyst

A catalyst increases the rate of a chemical reaction without undergoing any net chemical change. Some catalysts increase the rate of only one specific chemical reaction without affecting similar reactions. Other catalysts are more general and affect an entire set of similar reactions. Catalysts generally reroute the pathway of a chemical reaction so that this "**alternate**" path although perhaps more circuitous, has a lower activation energy for reaction than the uncatalyzed reaction.



A catalyst is generally specific in its action. It may affect a particular reaction only and becomes ineffective

for some other reaction. A chemical reaction taking place with the help of a catalyst is called catalytic or catalyzed reaction. A catalyst does not alter the state of equilibrium and helps to attain the equilibrium faster. Overall, a catalyst is a substance which increases the rate of a chemical reaction and itself is not consumed in the overall reaction.