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Theory

Evaporation is the process whereby atoms or molecules in a liquid state (or solid state if the substance sublimes) gain sufficient energy to enter the gaseous state.

The thermal motion of a molecule must be sufficient to overcome the surface tension of the liquid in order for it to evaporate, that is, its kinetic energy must exceed the work function of cohesion at the surface. Evaporation therefore proceeds more quickly at higher temperature and in liquids with lower surface tension. Since only a small proportion of the molecules are located near the surface and are moving in the proper *evaporation is limited. Also, as the faster-moving molecules escape, the remaining molecules have lower average kinetic energy, and the temperature of the liquid thus decreases.*

If the evaporation takes place in a closed vessel, the escaping molecules accumulate as a vapor above the liquid. Many of the molecules return to the liquid, with returning molecules becoming more frequent as the density and pressure of the vapor increases. When the process of escape and return reaches equilibrium, the vapor is said to be "saturated," and no further change in either vapor pressure and density or liquid temperature will occur.

Factors influencing rate of evaporation:-

1. Concentration of the substance evaporating in the air. If the air already has a high concentration of the substance evaporating, then the given substance will evaporate more slowly.
2. Concentration of other substances in the air. If the air is already saturated with other substances, it can have a lower capacity for the substance evaporating.
3. Temperature of the substance. If the substance is hotter, then evaporation will be faster.
4. Flow rate of air. This is in part related to the concentration points above. If fresh air is moving over the substance all the time, then the

likely to go up with time, thus encouraging faster evaporation. In addition, molecules in motion have more energy than those at rest, and so the stronger the flow of air, the greater the evaporating power of the air molecules.

5. *Inter-molecular forces. The stronger the forces keeping the molecules together in the liquid or solid state the more energy that must be input in order to evaporate them.*

6. ***Surface area and temperature: -***

Because molecules or atoms evaporate from a liquid'S surface, a larger surface area allows more molecules or atoms to leave the liquid, and evaporation occurs more quickly. For example, the same amount of water will evaporate faster if spilled on a table than if it is left in a cup.

evaporation. At higher temperatures, molecules or atoms have a higher average speed, and more particles are able to break free of the liquid'S surface. For example, a wet street will dry faster in the hot sun than in the shade.

Intermolecular forces: -

Most liquids are made up of molecules, and the levels *explain why some liquids evaporate faster than others. Attractions between molecules arise because molecules typically have regions that carry a slight negative charge, and other regions that carry a slight positive charge. These regions of electric charge are created because some atoms in the molecule are often more electronegative (electron-attracting) than others. The oxygen atom in a water (H2O) molecule is more electronegative than the hydrogen atoms, for example, enabling the oxygen atom to pull electrons away from both hydrogen atoms. As a result, the oxygen atom in the water molecule carries a partial negative charge, while the hydrogen atoms carry a partial positive charge. Water molecules share a mutual attraction—positively charged hydrogen atoms in one water molecule attract negatively charged oxygen atoms in nearby water molecules.*

Intermolecular attractions affect the rate of *attractions hold the molecules in a liquid together more tightly. As a result, liquids with strong intermolecular attractions evaporate more slowly than liquids with weak intermolecular attractions. For example, because water molecules have stronger mutual attractions than gasoline molecules (the electric charges are more evenly distributed in gasoline molecules), gasoline evaporates more quickly than water.*

Objective of project

In this project,we shall investigate various factors that have already been discussed such as nature of liquid ,surface of liquid and temperature and find their correlation with the rate of evaporation of different liquids.

Experiment no.1

Aim:

To compare the rate of evaporation of water, acetone and diethyl ether.

Materials required:

China dish, Pipette, Beaker, Weighing balance Measuring flask, Acetone, Distilled water, Diethyl ether, Watch

PROCEDURE:

1. Take three china dishes.

2. Pipette out 10 ml of each sample.

Dish B-Water

Dish C-Diethyl ether

4. Record the weights before beginning the experiment.

5. Leave the three dishes undisturbed for ½ an hr and wait patiently.

6. Record the weights of the samples after the given time.

7. Compare the prior and present observations.

OBSERVATION:

	Water (gm)	Acetone (gm)	Diethyl Ether (gm)
Weight of dish	50	50	50
Weight of (dish + substance) before evaporation	60	57.85	57
Weight of (dish + substance) after evaporation	59.8	55.55	54.33
Weight of substance	0.2	2.30	2.67

evaporated			

Inference and conclusion: -

The rate of evaporation of the given three liquids is in order :-

Diethyl Ether>Acetone>Water

Reason: -

Water has extensive hydrogen bonding in between oxygen atom of one molecule and hydrogen atom of another molecule. But this is absent in the case of

Experiment no.2

Aim:- To study the effect of surface area on the rate of evaporation of Diethyl ether.

Requirements

Three Petridishes of diameter 2.5 cm,5 cm, and 10 cm with covers ,10 ml pipette and stopwatch.

Procedure

1. Clean and dry the petridishes and mark them as A,B,C.

2. Pipette out 10 ml of Diethyl ether in each of the petridishes a,band C cover them immediately.

3. Uncover all the three petridishes simultaneously

4. Note the time when diethyl ether evaporates completely from each petridish.

Observation Table

Petridish Mark	Diameter of petridish	Time taken for complete evaporation
A	2.5 cm	11min 45sec
B	5.0 cm	8min 45sec
C	7.5 cm	6min 30sec

Result

It will be observed that maximum evaporation occurs in petridish with largest diameter followed by smaller and the smallest petridish. It is therefore , concluded that rate of evaporation increases with increase in surface area.