Lecture 29

Properties of Water

Water Statistics:

About 71% of earth surface is covered with water out of which 97 is sea water and remaining 3% is fresh water. Out of this 3% the 2% is in the form of ice caps and glaciers remaining 1% is freshwater which is present in lakes, rivers, underground water and within atmosphere. Water makes up about 70% of the human body. Water makes about 92% of blood plasma, 80% of muscle tissues and 60% of red blood cells.

Structure of Water Molecule:

Water is a polar molecule. Polar molecules are that which have electrically charged ends. Water has partially positive charge due to presence of hydrogen atom and partially negative charge due presence of oxygen atom. Water is made up of two hydrogen and one oxygen atom. The chemical formula of water is H_2O.

Core Properties of water:

Some of the core properties of water include capillary action, cohesion, surface tension, universal solvent and specific heat capacity.

Capillary Action:

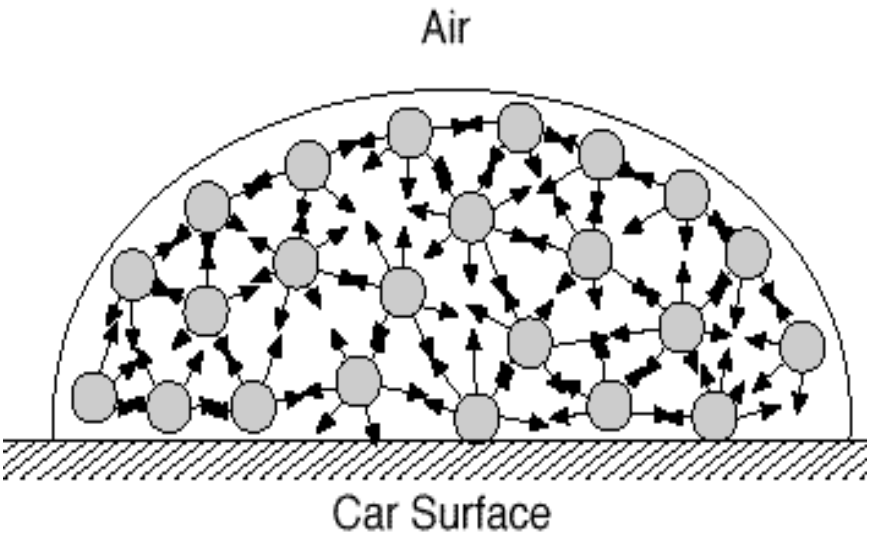
Capillary action is the ability of a liquid to flow in narrow spaces without the assistance of external force or even in opposition to, external forces like gravity. Examples of Capillary Action of Water are liquid rising inside a straw, paper towel absorbing water, plant roots absorbing water and sponge.

Cohesion:

Cohesion in water is the property that makes water molecules attracted to one another. Cohesion in water has to do with properties of water molecules that make them 'stick' together. To better understand water cohesion, we need to zoom in on a teaspoonful of water. In this teaspoon, there are more than a hundred drops of water. And in each individual drop, we can find millions of water molecules.

Surface Tension:

Surface tension is the tightness across the surface of water that is caused by the polar molecules pulling on one another. Examples of the surface tension of water: Raindrops forming beads on surface, Water strider, Paperclip Floating on Water, Drops of Water on a Penny, Skipping Rocks, Meniscus, and Belly Flops.



Molecules inside a water drop are attracted in all directions. Drops on the surface are attracted to the sides and inward.

Universal Solvent:

When a substance is dissolved in other substance a homogeneous mixture is formed which is called solution. There are two components of solution solvent and solute. The substance which is present in large amount in the solution and dissolves the other substance is called solvent and substance which is present in fewer amounts and is being dissolved by the solvent is called solute. Water is the universal solvent because of its high polarity. Water is capable of dissolving a variety of different substances that is why it is such a good solvent. In fact, water is called the "universal solvent" because it dissolves more substances than any other liquid. Water can dissolve substances such as salt and sugar but cannot dissolve non-polar oils like patrol, ether etc. Polar substances dissolves polar substances.

Specific Heat:

The specific heat is the amount of heat per unit mass required to raise the temperature by one degree Celsius. Water requires a lot of heat (gain or loss) to change its temperature. Water Specific heat is the amount of heat needed to increase the its temperature by 10C.Water's high specific heat is due to the strong attraction among water molecules. The oceans and lakes help regulate the temperature ranges that billions of people experience in their towns and cities. Water surrounding or near cities take longer to heat up and longer to cool down than do land masses, so cities near the oceans will tend to have less change and less extreme temperatures than inland cities

Physical States of Water:

Water occur in three physical states solid, liquid and gases. Solid water—ice is frozen water. When water freezes, its molecules move farther apart, making ice less dense than water. This means that ice will be lighter than the same volume of water, and so ice will float in water. Water freezes at 0° Celsius, 32° Fahrenheit. Liquid water is wet and fluid. This is the form of water with which we are most familiar. We use liquid water in many ways, including washing and drinking. Water as a gas—vapor is always present in the air around us. You cannot see it. When you boil water, the water changes from a liquid to a gas or water vapor. As some of the water vapor cools, we see it as a small cloud called steam. This cloud of steam is a miniversion of the clouds we see in the sky.

Molecular Movement:

Molecular movement is the slowest in solid state. Molecules of solid are very close to each other. In liquid form their movement is intermediate. Their movement is the fastest in a gas.Gas-molecules move freely and they are spread apart.

Phase changes:

Melting Point:

Water starts melting from a solid to a liquid at 0^{o}C. For example ice changes into water.

Freezing point:

Water changes from liquid to solid at 0^{o}C so its freezing point is 0^{o}C. for example water changes into ice.

Evaporation:

It is the Process by which molecules at the surface of a liquid absorb enough energy to change to the gaseous state. Examples of evaporation are boiling water, hair air-drying, wet clothes drying on a clothesline outside, puddle drying up.

Condensation:

It is the process by which gas changes into liquid. The common example of condensation is Water droplets on the outside of a glass fogging up a window.

References:

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