

Solutions

Homogeneous mixtures are also referred to as **solutions**. In a solution, one substance is usually considered to be dissolved in another. The substance that is dissolved is called the **solute**. The substance that does the dissolving is called the **solvent**.

The most common example of a solution involves a substance dissolved in water. This is known as an **aqueous solution**. For example, salt is the solute and water is the solvent in a solution of saltwater.

A substance that will dissolve in another substance is said to be **soluble** in that substance. Salt and sugar are both soluble in water. A substance that will not dissolve in another substance is said to be **insoluble**. Mercury and oil are both insoluble in water.

When two liquids dissolve in each other (in any amount), they are said to be **miscible**. If two liquids do not dissolve in each other (at all), they are said to be **immiscible**.

Most solutions share the following properties:

- they are stable, meaning the solute will not settle out if left standing
- they are clear or transparent (not cloudy), but can have color
- the particles of the solute are indistinguishable from the particles of the solvent
- the solute and solvent cannot be separated by filtering

Types of Solutions

Most of the solutions we are familiar with have a liquid solvent (water). There are, however, several different possible combinations of solute and solvent according to physical state, as shown below:

| Solution | Example |
|------------------|---|
| gas in gas | <ul style="list-style-type: none">• air (oxygen in nitrogen) |
| liquid in gas | <ul style="list-style-type: none">• water vapor in air |
| solid in gas | <ul style="list-style-type: none">• dust in air• mothball particles in air |
| gas in liquid | <ul style="list-style-type: none">• carbonated drinks (carbon dioxide in water)• oxygen in water |
| liquid in liquid | <ul style="list-style-type: none">• antifreeze (alcohol in water) |
| solid in liquid | <ul style="list-style-type: none">• seawater (salt in water)• tincture (iodine in alcohol) |
| gas in solid | <ul style="list-style-type: none">• hydrogen in palladium• charcoal filter (poisonous gases in carbon) |
| liquid in solid | <ul style="list-style-type: none">• dental fillings (mercury in silver) |
| solid in solid | <ul style="list-style-type: none">• sterling silver (copper in silver)• brass (zinc in copper) |

It is useful to categorize solutions according to the state of the solvent.

Solid Solutions

The most common solid solutions contain two or more metals and are called **alloys**. Alloys are formed by melting the component metals, mixing them, and then allowing them to cool.

Alloys are extremely useful because the properties of an alloy are often quite different from the properties of the component metals. By properly choosing the proportions of each metal in the alloy, many desirable properties can be obtained.

| Types of Alloys | | |
|------------------------|-----------------------------------|-------------------|
| Alloy | Components | Uses |
| Babbitt | tin, antimony, copper | bearings |
| bell metal | copper, tin | bells |
| coinage bronze | copper, tin, zinc | coins |
| 16 karat gold | gold, copper, silver | jewelry |
| sterling silver | silver, copper | jewelry, flatware |
| nichrome | nickel, iron, chromium, manganese | heating elements |

Gaseous Solutions

The air we breathe is an example of a solution in the gaseous state. If gases placed in the same container do not react with each other, they will mix to form a solution. Thus, all mixtures of gases are solutions.

The properties of a gaseous solution depend on the properties of its components. For example, air has the properties of both nitrogen and oxygen.

Liquid Solutions

Most common examples of solutions are liquid solutions. In liquid solutions, the solvent is a liquid – the most common solvent being water. The solute may be a solid, liquid, or gas.