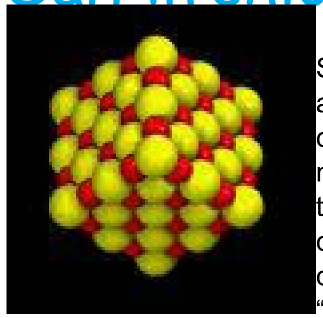
Chemistry & You

A Brief History of Chemistry - Modern Chemistry

Modern Chemistry (20th Century Chemistry)-Mid 19th Century to Present

This is the era chemistry flourished. Lavoisier's thesis gave chemists the first sound understanding of the nature of chemical reactions. Lavoisier's work led an English schoolteacher by the name of John Dalton to formulate his atomic theory. Around the same time an Italian chemist, Amedeo Avogadro formulated his own theory Avogadro's Law concerning molecules and their relation to temperature and pressure. By the middle of the 19th century, there were approximately 60 known elements. John A.R. Newlands, Stanislao Cannizzaro and A.E.B. de Chancourtois first noticed that all of these elements were very much alike in structure. Their work led Dmitri Mendeleev to publish the first periodic table. Mendeleev's work set the foundation of theoretical chemistry. In 1896 Henri Becquerel and the Curies discovered the phenomenon known as radioactivity. This laid the foundation for nuclear chemistry. In 1919, Ernest Rutherford became discovered that elements could be transmitted. Rutherford's work laid the basis for interpreting the structure of the atom. Soon after, another chemist, Niels Bohr finalized the atomic theory. These and other major advanced in chemistry have led to many distinct branches of chemistry. These branches include, but are not limited to: biochemistry, nuclear chemistry, chemical engineering, organic chemistry.

Salt in chlorine chemistry



Salt is the feedstock of the chlor-alkali industry which produces chlorine, caustic soda and the myriad other products formed from these basic chemicals. The chemical industry well-describes the chemical genealogy of salt with its "Chlorine Tree." Globally, chlorine chemistry is the single largest market for salt, although in the U.S., where there are numerous areas with exploitable salt deposits, the salt produced for chemical production is often extracted directly by chemical companies and not by salt producers. In Europe and Japan, the chlor-alkali industry is more likely to buy its salt from a salt company.

Chemical companies pass an electrical current through saturated salt brine in a salt bridge, producing a oxidation-reduction (redox) chemical reaction. This electrolysis separates the gaseous chlorine, (Cl2), from the sodium hydroxide (caustic soda). Chlorine is an effective disinfectant and bleach. We use it to keep drinking water safe. And swimming pools. Downstream, vinyl chloride and polyvinyl chloride (PVC) and their derivatives are produced from chlorine. Caustic soda is used in pulp processing, and to make cellulose chemicals and their derivatives. Sodium chlorite is used in the textile industry. Other chemicals manufactured from salt are metallic sodium and sodium chlorate. Until 1986, salt was used to produce synthetic soda ash (NaCO3) in the U.S. by the Solvay process. Soda ash is now obtained naturally from trona mines.

Salt-based chemicals are used

- To cool nuclear reactors (liquid sodium)
- To make brass and bronze (metallic sodium)
- To make case-hardened steel, fumigating materials, and are used to make the dye, indigo (sodium cyanide)
- To produce polymers used to make plastics, synthetic fibers, and synthetic rubber (chlorine)
- In crude oil refining and for making pesticides (chlorine)
- To make bleach and to disinfect public drinking water supplies and treat municipal sewage (chlorine)
- To make glass, rayon, polyester and other synthetic fibers, plastics, soaps and detergents (caustic soda) Extensively in the manufacture of pulp and paper, dyes and ceramic glazes (sodium sulfate)
- In manufacturing glass, pulp and paper, and rayon (sodium carbonate)
- In making synthetic rubber and in cleaning gas and oil wells (HCl)
- In textile manufacturing, processing leather, making glass and neutralizing acids (sodium bicarbonate)
- As an ingredient in fertilizers and explosives (sodium nitrate)

Learn more about how other industries use these products of chlorine chemistry.

Due to security concerns with the transportation of chlorine in tanker trucks and rail cars, including chemical terrorism (aka "toxic trains"), some chlorine users are using on-site chlorinators for "saltwater" swimming pools, drinking water purification and wastewater disinfection.

Air Pollution Chemistry

Some air pollutants that are released into the atmosphere by man-made activities pose environmental and health risks directly. These primary pollutants include carbon monoxide, particulate matter, nitrogen oxides and lead, emitted from exhausts of road vehicles. Additional impacts, however, result from the conversion of primary pollutants by a complex series of chemical reactions in the atmosphere, to secondary pollutants, many of which are potentially more harmful than their precursors. Since much of the pollutant chemistry is driven by the presence of sunlight, the secondary products are commonly referred to as photochemical pollutants.

A well-known secondary photochemical pollutant is ozone (O_3). Its formation results from the sunlight-initiated oxidation (reaction with oxygen) of volatile organic compounds (VOCs) such as benzene in the presence of nitrogen oxides (NO_x), mostly nitric oxide (NO) and nitrogen dioxide (NO_2).

Once formed, ozone is scavenged by NO, and in the absence of other competing reactions, a "photostationary state" is formed where concentrations of NO, NO_2 and O_3 are all inter-related. In rural areas away from major sources of NO, such as urban road transport, ozone scavenging by NO is lower, and consequently ozone concentrations in the atmosphere are higher.

The primary pollutants sulphur dioxide and nitrogen oxides also undergo chemical transformation as they are dispersed in the atmosphere, forming sulphuric acid and nitric acid respectively, which may be deposited downwind as acid rain.

Everyday Science: The Chemistry Behind Recycling

by: Amanda Romaniello
Thursday, 02 July 2009

Every day I drink a Diet Coke, and then I make sure I recycle that can either in a marked can or in our family's blue recycling bin. And once a week, we drag our bin out to the end of the driveway where a truck picks up the contents of the bin, but I never know what happened after that.

So what does happen when our recycled goods are collected and then separated by material at a recycling center? Well, it all depends on the material. Today let's find out what happens to that can...

After the cans are separated from the other recycled goods, they are chopped up into lots of little pieces. Then, the pieces are heated to remove the paint coating that shows us which drink we have chosen. The pieces are put into a vortex furnace that melts and mixes them all up. The final stop for the cans, after they are filtered and treated, is pouring the molten aluminum into ingots, which are then rolled out into sheets of aluminum which are ready to be used for new cans.

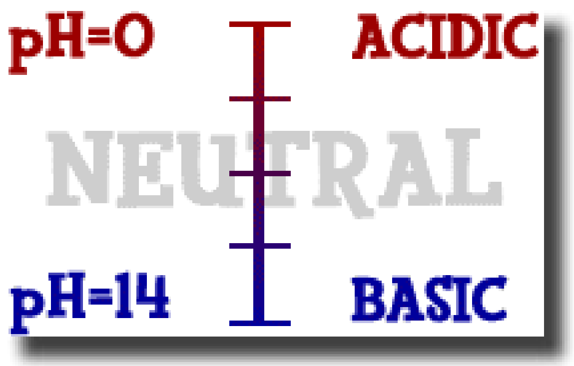
It's great that the aluminum can be used again, but what don't we know about recycling? According to DoSomething.org, "recycling one aluminum can saves enough energy to run a TV for three hours. In spite of this, Americans throw away enough aluminum to rebuild our entire commercial fleet of airplanes every three months!" By choosing to recycle, you can do your part in reusing and helping the environment. For more fun facts on what Americans are doing with recycling, check this out.

In researching about aluminum can recycling, I have come across a bunch of websites that are extremely helpful. An interesting note on aluminum cans is that one can takes 500 years to decay. The aluminum can was not used as a beverage container until 1965, even though the "can" was originally invented in the early 1800s, according to Earth911.com.

If you're wondering about how to start recycling in your home, look at Waste Management's website to find out how you can get started.

ACIDS AND BASES ARE EVERYWHERE

Every liquid you see will probably have either acidic or basic traits. One exception might be distilled water. Distilled water is just water. That's it. The positive and negative ions in distilled water are in equal amounts and cancel each other out. Most water you drink has ions in it. Those ions in solution make something acidic or basic. In your body there are small compounds called amino acids. Those are acids. In fruits there is something called citric acid. That's an acid, too. But what about baking soda? When you put that in water, it creates a basic solution. Vinegar? Acid.



Scientists use something called the pH scale to measure how acidic or basic a liquid is. Although there may be many types of ions in a solution, pH focuses on concentrations of hydrogen ions (H^+) and hydroxide ions (OH-). The scale goes from values very close to 0 through 14. Distilled water is 7 (right in the middle). Acids are found between a number very close to 0 and 7. Bases are from 7 to 14. Most of the liquids you find every day have a pH near 7. They are either a little below or a little above that mark. When you start looking at the pH of chemicals, the numbers go to the extremes. If you ever go into a chemistry lab, you could find solutions with a pH of 1 and others with a pH of 14. There are also very stong acids with pH values below one such as battery acid. Bases with pH values near 14 include drain cleaner and sodium hydroxide (NaOH). Those chemicals are very dangerous.

NAMES TO KNOW

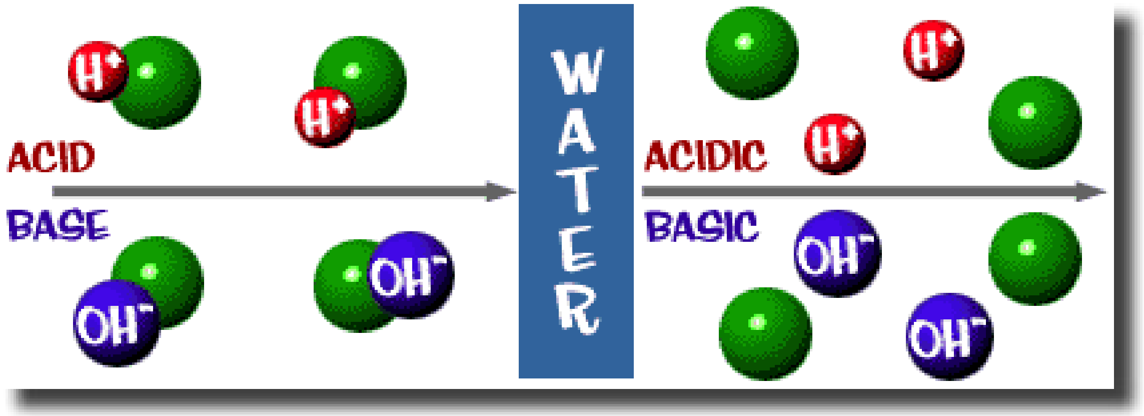
Here are a couple of definitions you should know:

Acid	A solution that has an excess of H^+ ions. It comes from the Latin word acidus that means "sharp" or "sour".
Base	A solution that has an excess of OH^- ions. Another word for base is alkali.
Aqueous	A solution that is mainly water. Think about the word aquarium. AQUA means water.
Strong Acid	An acid that has a very low pH (0-4).
Strong Base	A base that has a very high pH (10-14).
Weak Acid	An acid that only partially ionizes in an aqueous solution. That means not every molecule breaks apart. They usually have a pH close to 7 (3-6).
Weak Base	A base that only partially ionizes in an aqueous solution. That means not every molecule breaks apart. They usually have a pH close to 7 (8-10)
Neutral	A solution that has a pH of 7. It is neither acidic nor basic.

WHAT REALLY HAPPENS

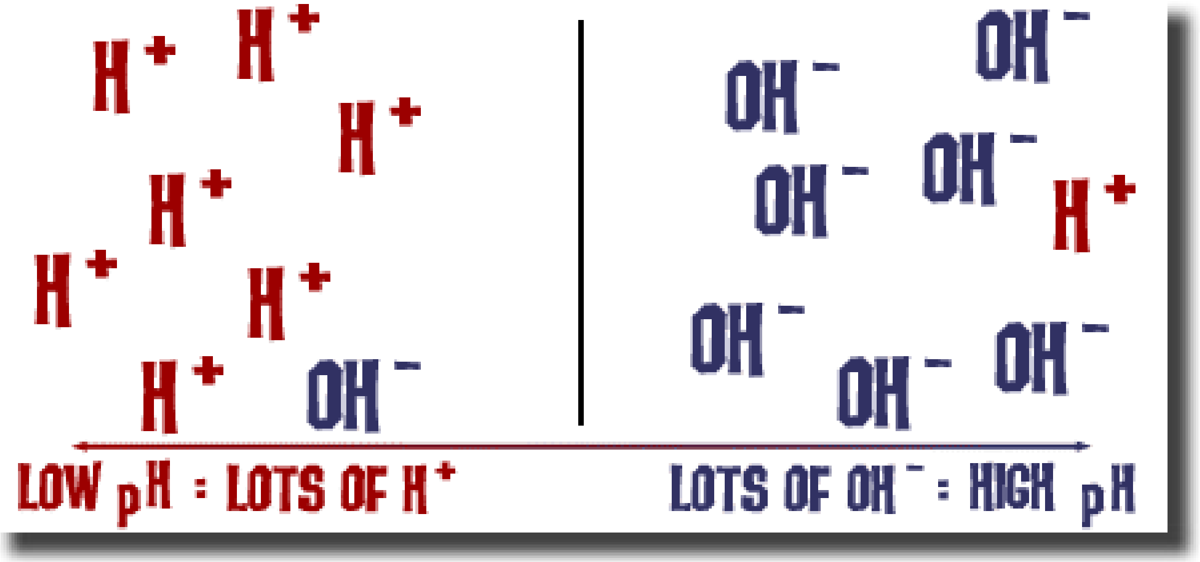
What really happens in those solutions? It gets a little tricky here. We'll give you the straight answer. Acids are compounds that break into hydrogen (H^+) ions and another compound when placed in an aqueous solution. Bases are compounds that break up into hydroxide (OH^-) ions and another compound when placed in an aqueous solution.

Let's change the wording a bit. If you have an ionic compound and you put it in water, it will break apart into two ions. If one of those ions is H^+, the solution is acidic. If one of the ions is OH^-, the solution is basic. There are other ions that make acidic and basic solutions, but we won't be talking about them here.



That pH scale we talked about is actually a measure of the number of H^+ ions in a solution. If there are a lot of H^+ ions, the pH is very low. If there are a lot of OH^- ions, that means the number of H^+ ions is very low, so the pH is high.

Think about it for a second. Why would a liquid with high levels of $NaOH$ be dangerous and very basic? The Na-OH bond breaks in solution and you have sodium ions (+) and hydroxide ions (-). The sodium ions don't really pose a danger in solution, but there are a huge number of hydroxide ions in solution compared to the hydrogen ions. All of those excess OH^- ions make the pH super-high and the solution will readily react with many compounds. The same thing happens on a less dangerous scale when you add baking soda to water. OH^- ions are released in the solution. The numbers of OH^- are greater than the H^+ and the pH decreases.



That's basically it. (Ha Ha, get it?)

Solution Chemistry

The majority of chemical processes are reactions that occur in solution. Important industrial processes often utilize solution chemistry. "Life" is the sum of a series of complex processes occurring in solution. Air, tap water, tincture of iodine, beverages, and household ammonia are common examples of solutions.

A solution is a homogenous mixture of substances with variable composition. The substance present in the major proportion is called the solvent, whereas the substance present in the minor proportion is called the solute. It is possible to have solutions composed of several solutes. The process of a solute dissolving in a solute is called dissolution.

Many common mixtures (like concrete) are heterogeneous "the components and properties of such mixtures are not distributed uniformly throughout their structures. Conversely, solutions are said to be *homogeneous * because they have uniform composition and properties. Solutions are intimate and random homogeneous mixtures of atomic-size chemical species, ions, or molecules.

In addition to their observed homogeneity, true solutions also have certain other characteristics. For example, components of a solution never separate spontaneously, even when a significant density difference exists between the components. Solutions also pass through the finest filters unchanged.

Droplets of a solution of water and oil, exposed to polarized light and magnified.

The components of a solution distribute themselves in a completely random manner, given sufficient time. For example, a lump of sugar dropped into a glass of water dissolves, and eventually molecules of sugar can be found randomly distributed throughout the water, even though no mechanical stirring has been employed. This phenomenon, called diffusion, is similar to the process of diffusion that occurs with gases. The molecules of sugar (as well as those of water) must be in constant motion in the solution. In the case of liquid solutions, the sugar molecules do not move very far before they encounter other molecules; diffusion in a liquid is therefore less rapid than diffusion in a gas.

Kinds of Solutions

Many commonly encountered solutions are those involving a solid that has been dissolved in a liquid, but there are as many types of solutions as there are different combinations of solids, liquids, and gases. Solutions in which the solvent is a liquid and the solute is a gas, liquid, or solid are very common. The atmosphere is a good example of a solution in which a gaseous solvent (nitrogen) dissolves other gases (such as oxygen, carbon dioxide, water vapor, and neon). Solutions of solids in solids are another example, and these are encountered most often among the various metal alloys.

Of all the liquid solvents used in the laboratory, in industry, and in the home, water is the most commonly employed and is the best of the inorganic solvents. The alcohols and numerous other types of compounds are classified as organic solvents; many of these are used in dry cleaning chemicals, nail polish removers, paint thinners, and many other similar purposes.

Concentration

The concentration of a solution is defined as the amount of * solute * present in a given quantity of solvent. Very often scientists speak of concentrated solutions, dilute solutions, or very dilute solutions, but these designations give only a rough relative qualitative idea of concentration. For example, a "concentrated solution" contains a considerable quantity of solute as compared with a "dilute solution." Although such designations are only qualitatively useful, they are nevertheless widely used.

The most common way to express concentration is on the basis of the weight of solute per unit weight of solvent. For example, a salt solution may be prepared by dissolving 1.64 grams of sodium chloride in 100 grams of water. The concentration of this solution could also be expressed as 0.0164 grams of NaCl per 1 gram of water, or as 16.4 grams of NaCl per 1,000 grams of water. Thus, a statement of the concentration of a solution does not imply anything concerning the amount of solute or the amount of solvent present, but rather gives the ratio of solute to solvent in terms of some convenient (and arbitrary) units. Because the weight of a sample of a liquid is usually more difficult to determine experimentally than its volume, a practical unit of concentration is the weight of solute in a given volume of the solution; for example, a sugar solution may contain 50 grams of sugar per 100 milliliters of solvent.

Solubility

Solubility is a measure of the maximum amount of solute that can be dissolved in a given amount of solvent to form a stable solution. The composition of many solutions cannot be varied continuously because there are certain fixed limits imposed by the nature of the substances involved. Solid salt and sugar can be mixed in any desired proportions, but unlimited quantities of sugar (or salt) cannot be dissolved in a given amount of water; however, up to the solubility limit, solutions can be produced in any desired proportion.

When the solvent contains a maximum quantity of solute, the resulting solution is said to be saturated. The saturation point varies according to the solute. For example, 100 grams of pure water at 25°C (77°F) can dissolve no more than 35.92 grams of NaCl to form a stable saturated solution, but this same amount of water at 25°C dissolves only 0.0013 grams of calcium carbonate. The solubility in these examples is expressed in grams of solute per 100 grams of water, but any suitable units could be used. Water can dissolve any amount of a solute less than that required for a saturated solution. Tables of the solubilities of many substances can be found in various chemistry texts.

In some cases there is no upper limit to the amount of a solute that a given quantity of solvent can dissolve, and these substances are said to be miscible in all proportions. Completely miscible substances give homogeneous mixtures (solutions); for example, a mixture of any two gaseous substances is homogeneous. Often, liquids such as alcohol and water can be mixed in all proportions to give homogeneous mixtures.

When a saturated solution has been achieved, a dynamic equilibrium exists between the solute in solution and any undissolved solute. Molecules of the solute (or atoms or ions, depending upon the nature of the solute) are continuously going into solution, but since the solution is already saturated, an equal number of molecules of the solute leave the solution and redeposit on the excess solid solute. A state of equilibrium exists when these two processes occur at the same rate, the net result being a constant amount of solute in solution. A saturated solution can therefore be defined more precisely as a solution that is in equilibrium with an excess of the solute at a given temperature.

In some instances it is possible to prepare a true solution that contains an excess of the equilibrium amount of solute; this condition is called supersaturation. Supersaturated solutions are unstable. If left undisturbed, they may remain in this state for an indefinite period of time. However, the excess solute can be brought out of solution by a slight agitation or by the addition of any solid particle (dust, a small crystal of solute, etc.) that can act as a center for crystal growth, returning the solution to its normal saturated state.

Conditions That Affect Solubility

In general, three major factors ”pressure, temperature, and the nature of the solute and solvent ”influence the solubility of a solute in a solvent. Not all these factors are equally important in a specific instance.

Pressure Changes in pressure have little effect on the solubility of solid or liquid solutes in a liquid solvent, but pressure has a much greater influence on the solubility of a gaseous solute. A commonly observed phenomenon that supports this is the effervescence that occurs when the cap of a bottle of ordinary soda water is removed. Soda water contains carbon dioxide gas dissolved in water under pressure; when the cap is removed, the pressure of the gas on the liquid is decreased to atmospheric pressure. Since carbon dioxide gas leaves the solution at this lower pressure, it follows that the solubility of carbon dioxide in water is dependent upon the pressure of the carbon dioxide above the liquid. The results of this simple observation are summarized in Henry's Law, which states that at any specified temperature, the extent to which a gas dissolves in a liquid is directly dependent upon the pressure of the gas.

Temperature

In general, a change in temperature affects the solubility of gaseous solutes differently than it does the solubility of solid solutes, because the solubility of a gas in a liquid solvent decreases with increasing temperature. With relatively few exceptions, the solubility of solids in liquids increases with an increase in temperature. In some instances, the increase in solubility is very large; for example, the solubility of potassium nitrate in water at 25°C is about 31 grams of KNO_3 per 100 grams of water and about 83 grams of KNO_3 per 100 grams of water at 50°C (122°F). On the other hand, the solubility of some solutes, such as ordinary table salt, shows very little dependence on temperature. Often this difference in solubility can be used as an advantage in the preparation, isolation, or purification of substances by the process of crystallization. In general, it is not possible to arrive at any reliable generalization concerning the influence of temperature upon the solubility of liquids in liquids. In some cases the solubility increases with an increase in temperature, in some cases it decreases, and in others there is very little effect.

The nature of solute and solvent Crystalline substances consist of a regular arrangement of atoms, molecules, or ions; in the latter case, the forces that hold the crystal together are electrostatic in nature. For an ionic crystal to dissolve in water, the water molecules must be able to shield the charges of the positive and negative ions from each other. The attractive forces between the ions in solution are less than those in the solid state because of the solvent molecules; hence, the ions behave more or less independently in solution. In general, the relative solubilities of ionic substances are a measure of the magnitude of the electrostatic forces that hold the crystals together.

Properties of Solutions

Pure liquids have a set of characteristic physical properties (melting point, vapor pressure at a given temperature, etc.). Solutions in a solvent exhibit these same properties, but the values differ from those of the pure solvent because of the presence of the solute. Moreover, the change observed in these properties in going from the pure solvent to a solution is dependent only upon the number of solute molecules; these properties are called colligative properties. The properties of a solvent that show a predictable change upon the addition of a solute are melting point, boiling point, vapor pressure, and osmotic pressure.

Melting and boiling points

Solutions exhibit higher boiling points and lower melting points than the parent solvent. The increase in boiling point and decrease in melting point is dependent upon the number of solute particles in the solution. The greater the number of solute particles (i.e., the concentration), the greater the boiling point elevation and melting point depression. A common application of this effect in some parts of the world is in the use of antifreeze solutions in the cooling systems of automobiles in cold climates. "Antifreeze" compounds are usually organic liquids that are miscible with water so that large freezing point effects can be attained.

Vapor pressure

All liquids exhibit a vapor pressure, the magnitude of which depends on the temperature of the liquid. For example, water boils at 100°C, which means that at 100°C the vapor pressure of water is equal to the atmospheric pressure allowing bubbles of gaseous water (steam) to escape from the liquid state. However, the vapor pressure of a solution (at any temperature) is less than that of the solvent. Thus, boiling water ceases to boil upon the addition of salt because the salt solution has a lower vapor pressure than pure water. The salt solution will eventually boil when the temperature of the solution increases bringing about an increase in vapor pressure sufficient to again form bubbles. Note in this example that the boiling point of water increases with the addition of salt; thus, the boiling point elevation and the vapor pressure depression are related.

Osmosis

This property of solutions is perhaps the least familiar of the colligative properties, but in a sense it is more important than those already mentioned. In 1748 French clergyman and physicist Jean-Antoine Nollet observed that certain animal membranes are selectively permeable to different molecules. Since then, many examples of semipermeable membranes have been discovered, including animal bladder or gut tissues, eggshell lining, and certain vegetable tissues. A semipermeable membrane may be defined as a material that allows molecules of one kind to pass through it but prevents the passage of other kinds of molecules or allows the passage of different kinds of molecules at different rates. Membranes often permit the passage of solvent molecules and prevent the passage of solute molecules. The phenomenon of osmosis is of far-reaching importance in biology, medicine, and related areas. Many animal and vegetable membranes are semi- permeable, and the process of osmosis plays an important role in the transfer of molecules through cell walls in biological processes. Osmosis is responsible in part for the germination of seeds and for the rising of sap into the branches and leaves of trees. The preservative action of sugar solutions (e.g., preserves, jellies) is believed to depend upon osmotic processes; bacteria are literally dehydrated.

History of Plastics and Polymers

Plastics are polymers. What is a polymer? The most simple definition of a polymer is something made of many units. Think of a polymer as a chain. Each link of the chain is the "mer" or basic unit that is made of carbon, hydrogen, oxygen, and/or silicon. To make the chain, many links or "mers" are hooked or polymerized together. Polymerization can be demonstrated by linking strips of construction paper together to make paper garlands or hooking together hundreds of paper clips to form chains.

Polymers have been with us since the beginning of time. Natural polymers include such things as tar and shellac, tortoise shell and horns, as well as tree saps that produce amber and latex. These polymers were processed with heat and pressure into useful articles like hair ornaments and jewelry. Natural polymers began to be chemically modified during the 1800s to produce many materials. The most famous of these were vulcanized rubber, gun cotton, and celluloid. The first semi-synthetic polymer produced was Bakelite in 1909 and was soon followed by the first synthetic fiber, rayon, which was developed in 1911.

Did you know?...

Polyethylene (there are two types--high density polyethylene or HDPE, and low density polyethylene or LDPE) played a key supporting role during World War II as a critical material which insulated radar electronics.

Even with these developments, it was not until World War II that significant changes took place in the polymer industry. Prior to World War II, natural substances were generally available; therefore, synthetics that were being developed were not a necessity. Once the world went to war, our natural sources of latex, wool, silk, and other materials were cut off, making the use of synthetics critical. During this time period, we saw the use of nylon, acrylic, neoprene, SBR, polyethylene, and many more polymers take the place of natural materials that were no longer available. Since then, the polymer industry has continued to grow and has evolved into one of the fastest growing industries in the U.S. and in the world.

The Structure of Polymers

Many common classes of polymers are composed of hydrocarbons. These polymers are specifically made of small units bonded into long chains. Carbon makes up the backbone of the molecule and hydrogen atoms are bonded along the backbone. Below is a diagram of polyethylene, the simplest polymer structure.

There are polymers that contain only carbon and hydrogen. Polypropylene, polybutylene, polystyrene, and polymethylpentene are examples of these. Even though the basic makeup of many polymers is carbon and hydrogen, other elements can also be involved. Oxygen, chlorine, fluorine, nitrogen, silicon, phosphorous, and sulfur are other elements that are found in the molecular makeup of polymers. Polyvinyl chloride (PVC) contains chlorine. Nylon contains nitrogen and oxygen. Teflon contains fluorine. Polyester and polycarbonates contain oxygen. Vulcanized rubber and thiokol contain sulfur. There are also some polymers that, instead of having a carbon backbone, have a silicon or silicon-oxygen backbone. These are considered inorganic polymers. One of the most famous silicon-based polymers is Silly PuttyTM.

Molecular Arrangement of Polymers

How spaghetti noodles look on a plate is similar to how polymers can be arranged if they are amorphous

Think of how spaghetti noodles look on a plate. This is similar to how polymers can be arranged if they are amorphous. An amorphous arrangement of molecules has no long-range order or form in which the polymer chains arrange themselves. Amorphous polymers are generally transparent. This is an important characteristic for many applications such as food wrap, PlexiglasTM, headlights, and contact lenses. Controlling and quenching the polymerization process can result in amorphous organization.

Obviously, not all polymers are transparent. The polymer chains in objects that are translucent and opaque are in a more crystalline arrangement. By definition a crystalline arrangement has atoms, ions, or in this case, molecules in a distinct pattern. You generally think of crystalline structures in salt and gemstones, but not in plastics. Just as quenching can produce amorphous arrangements, processing can control the degree of crystallinity. The higher the degree of crystallinity, the less light can pass through the polymer. Therefore, the degree of translucence or opaqueness of the polymer is directly affected by its crystallinity.

Engineers are always producing better materials by manipulating the molecular structure that affects the final polymer produced. Manufacturers and processors introduce various fillers, reinforcements, and additives into the base polymers to expand product possibilities.

Characteristics of Polymers

Polymers are divided into two distinct groups: thermoplastics and thermosets. The majority of polymers are thermoplastic, meaning that once the polymer is formed it can be heated and reformed over and over again. This property allows for easy processing and recycling. The other group, the thermosets, can not be remelted. Once these polymers are formed, reheating will cause the material to scorch. Every polymer has very distinct characteristics, but most polymers have the following general attributes.

1. Polymers can be very resistant to chemicals. Consider all the cleaning fluids in your home that are packaged in plastic. Reading the warning labels that describe what happens when the chemical comes in contact with skin or eyes or is ingested will emphasize the chemical resistance of these materials.
2. Polymers can be both thermal and electrical insulators. A walk through your house will reinforce this concept, as you consider all the appliances, cords, electrical outlets, and wiring, that are made or covered with polymeric materials. Thermal resistance is evident in the kitchen with pot and pan handles made of polymers, the coffee pot handle, the foam core of refrigerators and freezers, insulated cups, coolers, and microwave cookware. The thermal underwear that many skiers wear is made of polypropylene and the fiberfill in winter jackets is acrylic.
3. Generally, polymers are very light in mass with varying degrees of strength. Consider the range of applications, from dime store toys to the frame structure of space stations, or from delicate nylon fiber in pantyhose to KevlarTM, which is used in bulletproof vests.
4. Polymers can be processed in various ways to produce thin fibers or very intricate parts. Plastics can be molded into bottles or the body of a car or be mixed with solvents to become an adhesive or a paint. Elastomers and some plastics stretch and are very flexible. Other polymers can be foamed like polystyrene (StyrofoamTM) and urethane, to name just two example.
5. Polymers are materials with a seemingly limitless range of characteristics and colors. Polymers have many inherent properties that can be further enhanced by a wide range of additives to broaden their uses and applications.

Did you know?...

The plastics we all know as Silly Putty were invented by an engineer in the 1940s--he originally called it Nutty Putty because of its ability to stretch to many times its original size

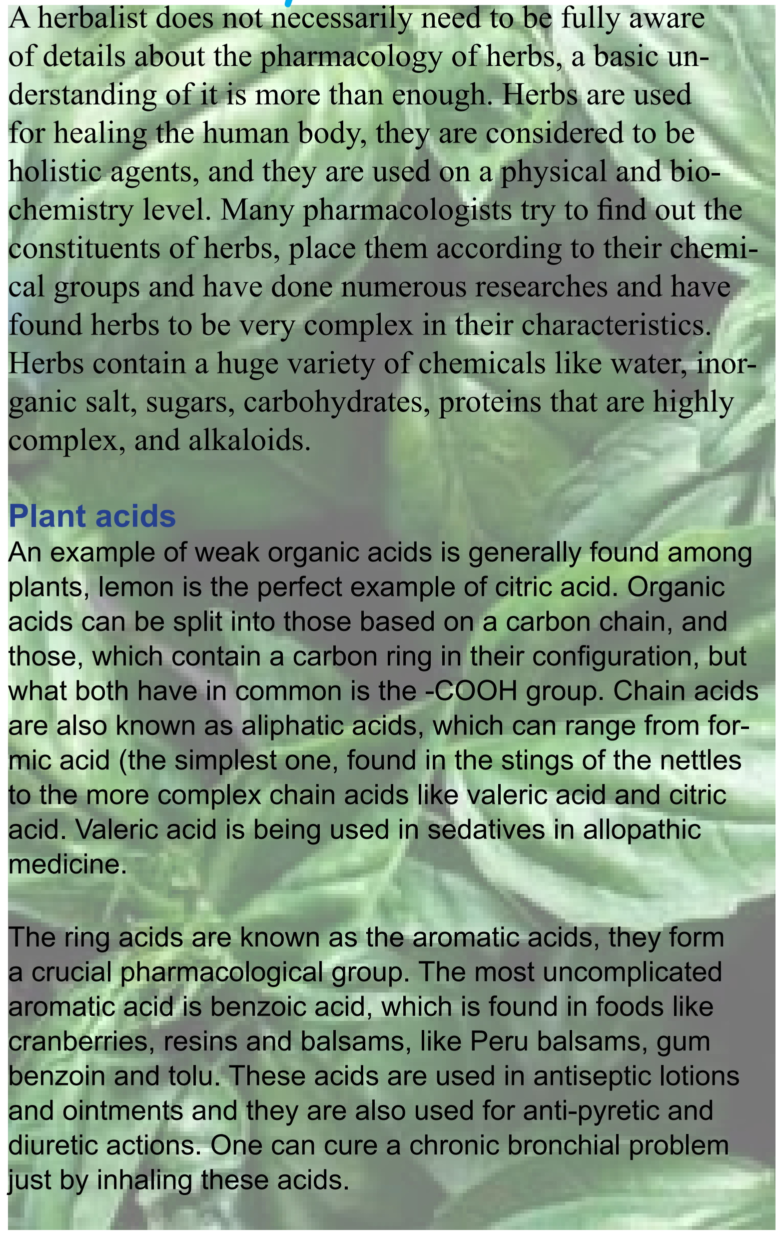
In addressing all the superior attributes of polymers, it is equally important to discuss some of the difficulties associated with the material. Plastics deteriorate but never decompose completely, but neither does glass, paper, or aluminum. Plastics make up 9.9 percent of our trash by weight compared to paper, which constitutes 39 percent. Glass and metals make up 13 percent by weight. In 1997, Americans produced 217 million tons of trash.

Applications for recycled plastics are growing every day. Plastics can be blended with virgin plastic (plastic that has not been processed before) to reduce cost without sacrificing properties. Recycled plastics are used to make polymeric timbers for use in picnic tables, fences, and outdoor toys, thus saving natural lumber. Plastic from 2-liter bottles is even being spun into fiber for the production of carpet.

A solution for plastics that are not recycled, especially those that are soiled, such as used microwave food wrap or diapers, can be a waste-to-energy system (WTE). Incineration of polymers produces heat energy. The heat energy produced by the burning plastics not only can be converted to electrical energy but helps burn the wet trash that is present. Paper also produces heat when burned, but not as much as plastics. On the other hand, glass, aluminum and other metals do not release any energy when burned.

Polymers affect every day of our life. These materials have so many varied characteristics and applications that their usefulness can only be measured by our imagination. Polymers are the materials of past, present, and future generations.

Chemistry Of Herbs



A herbalist does not necessarily need to be fully aware of details about the pharmacology of herbs, a basic understanding of it is more than enough. Herbs are used for healing the human body, they are considered to be holistic agents, and they are used on a physical and biochemistry level. Many pharmacologists try to find out the constituents of herbs, place them according to their chemical groups and have done numerous researches and have found herbs to be very complex in their characteristics. Herbs contain a huge variety of chemicals like water, inorganic salt, sugars, carbohydrates, proteins that are highly complex, and alkaloids.

Plant acids

An example of weak organic acids is generally found among plants, lemon is the perfect example of citric acid. Organic acids can be split into those based on a carbon chain, and those, which contain a carbon ring in their configuration, but what both have in common is the -COOH group. Chain acids are also known as aliphatic acids, which can range from formic acid (the simplest one, found in the stings of the nettles to the more complex chain acids like valeric acid and citric acid. Valeric acid is being used in sedatives in allopathic medicine.

The ring acids are known as the aromatic acids, they form a crucial pharmacological group. The most uncomplicated aromatic acid is benzoic acid, which is found in foods like cranberries, resins and balsams, like Peru balsams, gum benzoin and tolu. These acids are used in antiseptic lotions and ointments and they are also used for anti-pyretic and diuretic actions. One can cure a chronic bronchial problem just by inhaling these acids.

Alcohols

Alcohols are found in a variety of forms in the plant kingdom, they are mostly a component of volatile oils or sterols, for example geraniol in attar of rose and the menthol in peppermint oil. Waxes too are also a common form of alcohol. Mixtures of alcohols and fatty acids are generally found on leaves and other parts of the plants. Carnauba wax is acquired from the palm Copernicia cerifera.

Volatile oils

Volatile oils are a combination of simple molecules like isoprene or isopentane, which can mix in various ways to produce terpenes. It is a basic mix of 5 carbon molecules, sometimes with slight differences here and there. All this combines to make the volatile oils.

Volatile oils are mostly found in aromatic plants, herbs like peppermint and thyme are the perfect example of volatile oils. The combination of the oils and the smell can be in variations, even if they belong to the same types of the plant, basically it all depends on the concentration of the oils. When these oils are extracted from the plants, the aromatic oils are produced, which are used for many therapeutic treatments, and the major part of the production is used to manufacture perfumes.

There is a wide range of aromatic oils and they each have specific qualities, though most of these oils have some common characteristics, which are worth learning about.

Most aromatic oils are antiseptics; oils like eucalyptus oil, garlic oil and thyme oil fall under this category. These oils are absorbed with ease inside the body and they are effective for both internally and externally on the whole body system. When they are consumed internally or applied externally they land up finally in the urinary system, lungs, bronchial, sweat glands, saliva, tears or vaginal fluids. They can even occur in breast milk and during pregnancy can go to the placenta inside the fetus. Apart from having antiseptic functions, it can also encourage the creation of white blood cells, therefore increasing the immune system of the body. Volatile oils have the quality of arousing the tissues they come in touch with, some oils like the mustard oils irritates the skin slightly, while oils like menthol and camphor leave a numb feeling. Both these oils help in digestion arousing the lining of the colon which gives reflex reaction thus increasing the gastric juices to flow, which also makes the person feel hungry. People, who suffer from acute pain, can benefit from these oils by calming the peristalsis in the lower part of the intestines.

Volatile oils are also beneficial for the central nervous system. Oils like for example chamomile oil, are known to calm and sedate, while peppermint oil helps in stimulation, both these oils have the quality so easing out any tension in the body system thus reducing conditions like depression or tension. When there is an external application of aromatic oils on the body, the aroma is easily transferred through the nose to the brain, triggering an instant reaction. Herbs, which contain volatile oils, have to be retained by storing them carefully in sealed bottles or containers, as volatile oils can evaporate with ease.

Carbohydrates

There is a huge variety of carbohydrates in the plant kingdom, they are found in foods like sugar: fructose and glucose, they are also found in starches, which is the storage of the main energy and they can also be in the form of cellulose which is much more complex or elaborate, which helps in supporting the structure of the plants.

Large cellulose known as polysaccharides combines with other chemicals and produce molecules known as pectins, which are generally found in fruits like apples or even in seaweeds like algin, agar or even carragum, which are found in Irish moss. They are very effective and have the power to cure and are used in producing gels, which are further used in medicines and foods. Gums and mucilage are carbohydrates, which are complex in nature and are retained in soothing and healing herbs like coltsfoot, plantain and marshmallow. Once applied it relaxes the lining of the gut, arousing a reflex reaction that goes to the spinal nerves to areas like the lungs and the urinary tract. The mucilage not only reduces irritation, it even reduces inflammation of the alimentary canal, it also decreases the sensitivity of the gastric acids, can cure diarrhea and reduce peristalsis, it also cures the respiratory system, lessens coughing and tension, and increases the secretion of watery mucus.

Phenolic compounds

Phenol is a bulging block of many components of plants. The compounds of phenol could be simple in structure or could be a composite of a variety of basic molecule. One of the simplest phenolic compounds is salicylic acid, which is generally found in the combination of sugar, it forms glycoside found in willow, cramp bark, meadowsweet and wintergreen. It functions as an antiseptic, painkiller and has anti-inflammatory functions too. It is utilized in most allopathic medicines like aspirin, acetylsalicylic acid is the main component if this medicine. Eugenol oil is found in cloves and it functions like a painkiller, even thymol from thyme oil also cures pains, and both oils contain salicylic acid. Bearberry acts like an antiseptic on the urinary system of the body because it contains phenol hydroquinone.

Tannins

Tannins in herbs have the quality to function as astringents. They act on proteins and other chemicals to protect the layer of the skin and the mucous membrane. It can even bind the tissue of the gut, decrease diarrhea and also stop any internal bleeding. They are also used for external application like treatment of burns, healing wounds and reducing inflammation. Tannins can cure eye infections like conjunctivitis or even infection in the mouth, vagina, cervix or rectum.

Bitter principles

Bitter principles stand for a group of chemicals that have an extremely bitter taste. They are diverse in structure and the bitterest ones are irridoids, terpenes and other groups.

Bitter principles are known to be very effective in most therapeutic treatments. Through the taste bud, they arouse the secretion of the digestive juices and also help the liver to be more active, helping in hepatic elimination.

Sedatives like hops and valerian, cough remedies such as white horehound, anti-inflammatory herbs bogbean and devil's claw, and the vulnerary marigold have all the properties of bitterness.

Alkaloids

Alkaloids are the most powerful group of plant constituents that act effectively on the human body and mind. Under the category of alkaloids you will find hallucinogen mescaline and the very poisonous brucine. These alkaloids can work on the liver, lungs, nerves and the digestive system of the body. You will find alkaloids in most of the herbs. Alkaloids inside the plants do not really have any specific function, apart from storing excessive nitrogen. Alkaloids as a group are very different in their structure and they are separated into 13 groups accordingly. Their structure is dominated by nitrogen and they have a distinguished physiological activity.

To encourage weight loss there is a supplement known as chitosan, which is basically a fat blocker. Chitosan is derived from chitin which is found in exoskeletons of shrimps and crabs, it is quite similar to plant fiber and cannot be digested easily. If chitosan is consumed orally it behaves like a big sponge absorbing the fat of the body up to four to six times than the body usually does while passing the digestive system. It helps flush out all the excessive fat of the body which could have been metabolized and settled inside the body. It is like you can eat as much as you want, if you are consuming chitosan.

The disadvantage of chitosan is that it does not cure chronic overeating at all. It should only be consumed for two weeks at a time to just get a weight loss diet started. Chitosan can be very good in absorbing fat, but at the same time it can be quite harmful in the sense that it can rob the body of essential vitamins like E, A, D and K. If chitosan is consumed, diet supplements like vitamins and essential fatty acids should also be included in the diet too. According to studies chitosan is considered quite safe for any weight loss program.
A test was conducted on two mice, one was administered chitosan while the other was not, the mice which had consumed chitosan and other supplement diets had few precancerous lesions than the one who did not have chitosan at all. It can also lower total blood cholesterol level in the body and raise the level of HDL, known as the good cholesterol, which in turn protects the body against any heart disease. Chitosan is a versatile supplement, it is a good antacid and helps prevent tooth decay.

Chemistry Of Cooking: A Biochemist Explains The Chemistry Of Cooking

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A biochemist and cook explains that cooking is all about chemistry and knowing some facts can help chefs understand why recipes go wrong. Because cooking is essentially a series of chemical reactions, it is helpful to know some basics. For example, plunging asparagus into boiling water causes the cells to pop and result in a brighter green. Longer cooking, however, causes the plant's cell walls to shrink and releases an acid. This turns the asparagus an unappetizing shade of grey.

You love to cook, but have you whipped up some disasters? Even the best recipes can sometimes go terribly wrong. A nationally recognized scientist and chef says knowing a little chemistry could help.

Long before she was a cook, Shirley Corriher was a biochemist. She says science is the key to understanding what goes right and wrong in the kitchen.

"Cooking is chemistry," said Corriher. "It's essentially chemical reactions."

This kind of chemistry happens when you put chopped red cabbage into a hot pan. Heat breaks down the red anthocyanine pigment, changing it from an acid to alkaline and causing the color change. Add some vinegar to increase the acidity, and the cabbage is red again. Baking soda will change it back to blue.

Cooking vegetables like asparagus causes a different kind of reaction when tiny air cells on the surface hit boiling water.

"If we plunge them into boiling water, we pop these cells, and they suddenly become much brighter green," Corriher said.

Longer cooking is not so good. It causes the plant's cell walls to shrink and release acid.

"So as it starts gushing out of the cells, and with acid in the water, it turns cooked green vegetables into [a] yucky army drab," Corriher said.

And that pretty fruit bowl on your counter? "Literally, overnight you can go from [a] nice green banana to an overripe banana," Corriher said.

The culprit here is ethylene gas. Given off by apples and even the bananas themselves, it can ruin your perfect fruit bowl -- but put an apple in a paper bag with an unripe avocado, and ethylene gas will work for you overnight.

"We use this as a quick way to ripen," Corriher said. Corriher says understanding a little chemistry can help any cook.

"You may still mess up, but you know why," she said. When it works, this kind of chemistry can be downright delicious.

WHAT ARE ACIDS AND BASES?

An acid is defined as a solution with more positive hydrogen ions than negative hydroxyl ions, which are made of one atom of oxygen and one of hydrogen. Acidity and basicity are measured on a scale called the pH scale. The value of freshly distilled water is seven, which indicates a neutral solution. A value of less than seven indicates an acid, and a value of more than seven indicates a base. Common acids include lemon juice and coffee, while common bases include ammonia and bleach.

WHY DOES FOOD SPOIL?

Processing and improper storage practices can expose food items to heat or oxygen, which causes deterioration. In ancient times, salt was used to cure meats and fish to preserve them longer, while sugar was added to fruits to prevent spoilage. Certain herbs, spices and vinegar can also be used as preservatives, along with anti-oxidants, most notably Vitamins C and E. In processed foods, certain FDA-approved chemical additives also help extend shelf life.