Chemical Reactions- Sodium Hydroxide

A chemical reaction is a change where two or more substances are changed into a new substance. You can identify a chemical reaction by colour change, effervescence (bubbles), when light or heat given off, and the change is usually irreversible. There are 6 main types of chemical reactions- combustion (often called burning), synthesis, decomposition, neutralization, single replacement and double replacement. A combustion reaction is a reaction with oxygen, and heat is evolved (given off). A common example of combustion is

Hydrogen +Oxygen= Water

Synthesis is a reaction where two or more substances combine to make a compound. An example of a synthesis reaction is
Iron + Oxygen = Iron Oxide

Decomposition is the opposite of synthesis. It is the breakdown of a compound, usually through electrolysis. Electrolysis is a method of separating bonded elements or compounds by passing an electric current through them . An example of a decomposition reaction is

Calcium carbonate calcium oxide+ carbon dioxide

Single displacement is the replacement of one element with another in a compound. One of the elements is one of the reactants, and a metal replaces a metal or a non-metal replaces a non-metal. Eg.

Magnesium + zinc sulphate = magnesium sulphate + zinc

Double displacement is the swapping of elements, usually forming a solid. Eg.

Lead nitrate + sodium chloride = sodium nitrate + lead chloride

Neutralization is the reaction between an acid and alkali/base/carbonate . One example of neutralization is

Sulphuric acid + magnesium oxide = magnesium sulphate + water

Sodium hydroxide is a corrosive metallic base, and it is also called caustic soda. Nowadays, it is made along with hydrogen and chlorine, using the chloralkali process (any process that produces chlorine or a related oxidizer) Electrolysis of a solution of sodium chloride (common salt) makes chlorine and sodium hydroxide.

$2NaCl + 2H_2O$ --electric current = $2NaOH + H_2 + Cl_2$

This is a double displacement reaction, because both substances ‘swap’. To stop the sodium hydroxide from reacting with the chlorine, three processes can be used. The first one is called the Mercury cell process, where sodium metal forms an amalgam at the bottom of a mercury cathode . This sodium then reacts with water to produce NaOH. Another process is called the Diaphragm Cell process, where it uses a steel cathode and a porous diaphragm. The third is the most cost-effective and environmentally friendly process. It is called the Membrane Cell process, and it is similar to the Diaphragm Cell process, just that it produces a higher quality of sodium hydroxide.

An older process used to make sodium hydroxide is the LeBlanc process, which is a process that heats sodium chloride with sulphuric acid to make hydrochloric acid and sodium sulphate. The sodium sulphate is mixed with crushed limestone (calcium carbonate) and coal (carbon) then fired . The coal oxidizes, and the chemical reaction leaves behind a solid mixture of sodium carbonate and calcium sulphide. The sodium carbonate is fired to make sodium oxide and carbon dioxide. The sodium oxide is then mixed with water to produce sodium hydroxide.
$Na2O + H2O = 2NaOH$

Nicolas LeBlanc, who found out a way to produce an alkali from sea salt, discovered the LeBlanc process. Another way to make sodium hydroxide is by adding lime (general term for various minerals where carbonates, oxides and hydroxides of calcium predominate) to natron (a mineral salt mainly with the mixture of sodium bicarbonate, sodium chloride, sodium carbonate and sodium sulphate) . This is also a synthesis reaction, as it combines 2 simple substances and makes one complex substance.

Lime + natron = sodium hydroxide

Sodium hydroxide is very important in the industrial, commercial and biological world. In the industrial world, it is used for the textile industry, making paper, making soap and making detergent. In the textile industry, sodium hydroxide is used for scouring the material before weaving. In the paper industry, sodium hydroxide breaks down the lignin in wood, to free the fibres that can be turned into paper. The soap and detergent industries use sodium hydroxide to make soap by the saponification (the reaction of a metallic alkali base with fat or oil to make soap) process. Saponification is a traditional process used by the Arabs in the 7th century, and it is still used today. In the commercial world, sodium hydroxide is used to prepare food. For example, German pretzels are dipped in a sodium hydroxide solution before they are baked to give a unique crispiness to them, and sodium hydroxide is also the chemical that causes the gelling of egg white in century eggs. Sodium hydroxide also helps in chocolate processing. Cocoa powder contains sodium hydroxide and other alkalis to balance out the acids in the powder, to help it dissolve in hot water. In the biological world, sodium hydroxide is used to break the bonds keeping an animals body intact. To do this, the carcass of the animal must be put in a container with a solution of sodium hydroxide and water. The body then turns into a coffee like liquid, with only the bone hulls left. Sodium hydroxide is also used to decompose animals killed on the road dumped in the landfills by animal disposal contractors. Sodium hydroxide is also used at home to unblock drains and oven cleaners by converting grease into soap. The

soap is then flushed away by water. These types of drain cleaners are very corrosive and can cause blindness if it goes into eyes.

The reactions used to make sodium hydroxide are also important. The chloralkali process is used to make sodium hydroxide, and on the way it also makes hydrogen and chlorine. Both of those elements are very important to us. Chlorine is used for disinfectants, medicines, dyes, food and lots more. The chloralkali process has some environmental problems. The Mercury Cell process has problems with disposal of the mercury. Between 1930 and 1960, several few tonnes of mercury waste were dumped on Minamata bay in Japan, and thousands of people developed mercury poisoning through the consumption of contaminated fish. More than 900 people died. Nowadays, most chloralkali processed are done using the Diaphragm Call process or the Membrane Cell process. The chloralkali process uses electrolysis, and the English chemist William Nicholson was the first one to discover electrolysis and make a chemical change by electricity. He discovered electrolysis in 1812 after the electric battery was invented.

Sodium hydroxide is very important to us; because if we didn't have it, we would not have a lot of things we take for granted now. Even though its reactions cause some environmental and ethical problems, they help us a lot in our daily life. We should all learn to appreciate compounds, and we should try not to take them for granted.

Bibliography

Introduction:

Answers.com. (2006). chemical reaction: Definition.
Retrieved October 23, 2006,from
http://www.answers.com/topic/chemical-reaction

Turner, B. (2003). Paragraph 2. In Site Journal- Keystone Science Network.
Retrieved October 23, 2006, from
http://www.keystone.fi.edu/visits/billturnerchem.shtml

Thinkquest. (n.d.). Types of Reactions.
Retrieved October 23, 2006, from
http://library.thinkquest.org/2923/react.html

Body:

Wikipedia. (2006, October 23). Electrolysis.
Retrieved October 24, 2006, from
http://en.wikipedia.org/wiki/Electrolysis

Mr Wellington- Science class: types of reactions
Oct 24th 2006

Wikipedia. (2006, October 3). Chloralkali process.
Retrieved October 24, 2006,from
http://en.wikipedia.org/wiki/Chloralkali_process

Wikipedia. (2006, October 17). LeBlanc Process.
Retrieved October 24, 2006, from
http://en.wikipedia.org/wiki/LeBlanc_process

Wikipedia. (2006, October 12). Lime(mineral).
Retrieved October 24, 2006, from
http://en.wikipedia.org/wiki/Lime_%28mineral%29

Wikipedia. (2006, October 12). Natron.
Retrieved October 24, 2006, from
http://en.wikipedia.org/wiki/Natron

The Alchemy Web Site. Alchemical Substances.
Retrieved October 24, 2006,from
http://www.levity.com/alchemy/substanc.html

Chemical of the Week.
Retrieved October 24, 2006, from
http://scifun.chem.wisc.edu/CHEMWEEK/Cl2&NaOH/Cl2&NaOH.html

Uses. Retrieved October 25, 2006, from
http://web1.caryacademy.org/chemistry/rushin/StudentProjects/ElementWebSites/sodium/uses.htm

University of Geogia Research Magazine. (1997). A Natural Approach to Processing.
Retrieved October 25, 2006, from
http://www.ovpr.uga.edu/researchnews/9697fw/cotton.html

Wikipedia. (2006, October 20). Saponification.
Retrieved October 25, 2006, from
http://en.wikipedia.org/wiki/Saponification

Healthnotes. (2005). Chocolate.
Retrieved October 25, 2006, from
http://www.pccnaturalmarkets.com/health/Food_Guide/Chocolate.htm

Chloralkali.
Retrieved October 25, 2006, from
http://www.energymanagertraining.com/chloro_alkali/Chlor_Alkali_process_main.htm

HSC Online. Sodium hydroxide.
Retrieved October 26, 2006, from
http://hsc.csu.edu.au/chemistry/options/industrial/2763/Ch954.htm

Electrochemistry
Retrieved October 26, 2006, from
http://electrochem.cwru.edu/ed/encycl/art-b01-brine.htm

Nicholson. (2003, November 7).
Retrieved October 26, 2006, from
http://chem.ch.huji.ac.il/~eugeniik/history/nicholson.html