

The chemistry of perming & rebonding

Some of us have naturally curly hair but want it straightened; others have it naturally straight but want it curly. But whatever the style you like to wear, there's chemistry involved in it!

The structure of hair

Hair is made mostly of a protein called keratin, which is also present in nails. In hair, keratin molecules are arranged in straight bundles. These bundles are held together by disulphide bonds (-S-S-), which give strength to the hair.

Disulphide bonds are made by the amino acid called cysteine. The cysteine of one keratin molecule forms a disulphide bond with the cysteine of the neighbouring keratin molecule. The more disulphide bonds there are in a strand of hair, the straighter it is.

Ammonium thioglycolate: the perm salt

Ammonium thioglycolate (**HSCH₂CO₂NH₄**) is a compound that can break disulphide bonds. This is because it contains a thiol group (-SH). The thiol group replaces one of the sulphur atoms in the disulphide bond, like this:



When the disulphide bond is broken, the keratin bundles come apart, and hair is weakened. Ammonium thioglycolate is therefore used widely in beauty parlours when customers want their hair re-styled. However, if you use too much of it, or if the reaction is left for too long, you could end up going bald. So do not, *ever*, try it at home!

If you have watched the film *Legally Blonde*, you'll have seen Reese Witherspoon (acting as a law student) win her first case by her knowledge of the chemistry of perms!

How to get your hair re-styled

If you'd like your hair curled, it's called a perm. If you like it straightened, that's rebonding. In both cases, the steps are very similar.

First, the beautician will wash your hair thoroughly to clean it. Then she applies perm salt (ammonium thioglycolate solution) to it for a short while. It releases ammonia, which loosens the hair and allows the glycolate to seep through. If you want a perm, your hair will be tied around curlers to get the curls you want. If you want it rebounded, it is pressed firmly among flat irons till it becomes straight.

When the hair is shaped to your satisfaction, it needs to be strengthened again so that the style becomes permanent. For this, an oxidation lotion is applied. This contains hydrogen peroxide (H_2O_2), which reconstitutes the disulphide bonds.



Another way to get your hair rebounded is to use lye soap or lye cream. This contains 5-10% of sodium hydroxide, which breaks the disulphide bonds. The hair loosens up, causing the curls to disappear. After treatment with lye soap, the hair is washed with water and conditioner to remove the sodium hydroxide, which can otherwise corrode the scalp.

How does a perm work?

JONATHAN LIANG APRIL 24, 2010 0

The year 2009 marked the 100th anniversary of the permanent wave, also known as the “perm.” In 1909, Charles Nessler submitted a patent to the U.K. Patent Office for “A New or Improved Process of Waving Natural Hair on the Head.” Since then, the perm has become a staple of hairstylists around the world.

Yet the perm is not just an art. Rather, it relies on the fundamental chemical structure of hair for all of its effects. So how do a few chemicals and some heat produce those glorious curls?

To answer that question, we must first understand what holds hair together. About 95% of hair is a single protein, keratin, which has a long, helical shape. Individual keratin molecules aggregate into larger helices called protofibrils, which in turn compose microfibrils and macrofibrils, forming the superstructure of an individual hair.

Keratin molecules are rich in the amino acid cysteine, which contains reactive sulfur atoms. Two cysteine residues on two molecules of keratin can form a disulfide bond, a strong connection that links the keratin molecules, preventing them from slipping past each other.

This connection is permanent until acted upon by strong external forces. The disulfide bonds are key players for the curls that a perm produces. Though it is a strong bond, the disulfide bond is still weaker than the bonds within each keratin molecule; it can be broken quite easily by reducing agents, whose electrons attack the bond.

In a standard “cold” perm, hair is put into curlers and the reducing agent ammonium thioglycolate is added. The disulfide bonds break and keratin molecules are now free to move around and adjust to the shape of the curl. Then a “neutralizer,” such as hydrogen peroxide, is added to reverse the effect of the reducing agent. New disulfide bonds form so the keratin molecules are locked into the shape of the curls.

In the last 30 years, variations on the perm have entered the market. For example, the “acid perm” uses a different reducing agent in combination with heating, resulting in better curling and less damage to the hair. Recently, companies in Asia have taken the acid perm even further and created the “digital perm,” in which the temperature of the hair is controlled by a computer.

The Scientific Processes During Perming & Relaxing

As we know, the hair is made up of protein chains held together by series of physical and chemical bonds which give the hair its shape and strength. The bonds we are most concerned with in styling the hair are the side bonds. Side bonds are found in two forms – physical side bonds and chemical side bonds. Breaking and reforming these side bonds allow us to rearrange the wave pattern of the hair. Physical side bonds can be broken using heat and water and reform when the hair dries and/or cools.

However, this article is about perming and relaxing and the scientific processes that occur. When the hair is permed (and sometimes when straightened) the disulfide bonds (the chemical side bonds) of the hair are broken through a chemical reaction called ‘reduction’. A reduction reaction involves either the removal of oxygen or the addition of hydrogen. In the case of permanent waving, the reduction is due to the addition of hydrogen.



The disulfide bonds join one sulfur atom on one polypeptide chain to another sulfur atom on different polypeptide chain. Perms use reducing agents called thiol compounds, which break the disulfide bonds by adding a hydrogen atom to each of the sulfur atoms in the disulfide bonds. With the disulfide bonds broken, the polypeptide chains are able to slip into their new shape.

The broken disulfide bonds are reformed through the neutralization of the thio compound used to break them. The most common neutralizer is hydrogen peroxide and the chemical process that removes the hydrogen atoms and reforms the disulfide bonds is called “oxidation”. Oxidation can result in the lightening of the hair color – especially if a strong thio compound was used – and this is why the hair should be rinsed carefully and blotted thoroughly before applying the neutralizer. The oxidation reaction combines the hydrogen and oxygen atoms in the peroxide molecules with the hydrogen atoms used to break the disulfide bonds to form two separate molecules of water.

(Peroxide {H₂O₂} + Hydrogen + Hydrogen {+ H + H} = Water {H₂O + H₂O})

The removal of the hydrogen atoms from the sulfur atoms forces them to reform their disulfide bonds in the new shape (around the perm rods). The process is the same for relaxers and straighteners that use thio compounds, except that these are removing curl rather than creating it.

Hydroxide relaxers break the disulfide bonds in the hair by removing one atom of sulfur from the disulfide bond and thereby converting it into a lanthionine bond. This process is called lanthionization. When a hydroxide relaxer breaks a disulfide bond the bond is permanently broken and can never be reformed.

Hydroxide relaxers leave the hair extremely alkaline even after rinsing. To restore the pH balance of the hair an acid-balanced shampoo or normalizing lotion neutralizes any remaining hydroxide ions to lower the pH of the hair and scalp. Some neutralizing shampoos intended for use after hydroxide relaxers have a built-in color-change indicator to show when the hair’s pH has returned to normal. The neutralization/normalizing process with hydroxide relaxers never uses any oxidation, in fact, oxidizing agents can seriously damage hydroxide relaxed

hair.

How Perms Work

From straight to curly, curly to straight, and everywhere in between, millions of people each year do something to change the texture and wave patterns of their hair. It's big business. There are many rules to remember, and some myths that need to be dispelled. So, let's talk about hair and perms.

Your hair is made up of proteins. Each strand has a cortex at the center. The cortex is made up of proteins in a chain down the length of the shaft. These proteins (called poly-peptide chains) are held together by peptide bonds which give the hair its strength.

Surrounding the cortex is the medulla, again made of protein fibers and containing the pigment of the hair, giving the hair its color. Here is where you'll also find the side bonds of the hair, which hold the wave pattern of the hair. There are three types of side bond: salt bonds, hydrogen bonds and disulfide bonds. The salt and hydrogen bonds are weaker than the disulfide bonds, but there are more of them, and overall, each of the bond types constitute about a third of the strength of the hair's curl. The disulfide bonds are what get changed in a permanent wave.



Finally, the cortex and medulla are encased in a protective sheath called the cuticle. The cuticle is made of tiny, overlapping scales of keratin (the same thing fingernails and toenails are made from). The cuticle is what protects the hair from damaging effects of the environment. Some people have hair with a tightly closed cuticle, and some have a cuticle whose normal state is slightly raised. The arrangement of the hair's cuticle determines how readily the hair absorbs moisture, and how "frizzy" the hair appears to be.

Curling The Hair:

We change the wave pattern of the hair by curling it, usually on rollers of some type. These changes occur because we alter the side bonds of the hair. The salt and hydrogen bonds mentioned above are easily broken through the application of water and heat, which is why simply wetting the hair, wrapping it in rollers, and allowing it to dry - or using a curling iron - allows you to add curl. When the heat cools and the hair dries, the salt and hydrogen bonds reform on their own. The curl you get this way only lasts until the next time the hair is wet. Hot combs and flat irons work on the same principles to relax curl and straighten the hair.

Perming The Hair:

The process we call permanent waving uses chemicals to break and reform the stronger disulfide bonds of the hair. When the hair is washed and wrapped on a perm rod (the rod size used determining the tightness of the curl), we place the hair in the physical shape we want it to take. Then, by applying a waving lotion with an alkaline base (ammonium thioglycolate is

most commonly used in today's perms), we raise the cuticle layer and break the disulfide bonds that hold the natural wave pattern.

After the waving lotion has had time to process and has been rinsed away and the rods have been blotted to remove excess water, and a neutralizer is applied. The neutralizer is actually what reforms the disulfide bonds of the hair and sets the new curl pattern. It is also the most potentially damaging stage of the perming process and should always be closely monitored.

Once allowed to take effect, the neutralizer is rinsed away, the rods are removed, and the hair is re-rinsed for good measure, it can be styled as desired.

Why To Perm:

Maybe your hair is board straight (or maybe you have really curly hair) and you want more body and movement (or more manageability). A perm can give you this. A perm can add volume and thickness to hair. In some cases, it can give the illusion of more hair. Or maybe, you just want versatility in styling. All of these are valid reasons to perm the hair. And perming the hair can be a satisfying experience as long as you know how to properly care for permed hair.

Caring for a Perm & Perming Myths:

Myth: Never wash freshly permed hair.

You'll hear varying advice on how long to wait to shampoo after a perm. Some stylists suggest you wait 24 hours before shampooing, while others swear it's at least 3 days. The truth is, it all depends on your hair. To counter the claim made by the movie "Legally Blonde", you won't 'risk deactivating the ammonium thioglycolate by getting your hair wet within 48 hours'. The waving lotion has done its job and been thoroughly neutralized if the process was performed correctly.



However, perming the hair is a strong process, and you have to pay attention to what your hair tells you. It's never a bad idea to give your hair a break after a strong process. Remember that the alkaline of the waving lotion has raised the cuticle of the hair and made it more porous, therefore it will feel drier and rougher, so use a good conditioner, and a milder shampoo. Acid balancing shampoos and conditioners are available from many makers, and you can always rely on your salon professional to suggest something suitable to your hair type.

Perms & Haircolor:

Also, do bear in mind (especially if your hair is color-treated) that perming the hair can result in lightening of the color. The most common ingredient in perm neutralizers is hydrogen peroxide, which is used as a developer for permanent haircolor formulas. With the cuticle already being raised in the process of waving, the peroxide readily penetrates the hair and will break up the color, though the peroxide solution is much weaker in the perm formula than in haircoloring.

This is also the reason that you want to have your hair permed before coloring it. Otherwise, you risk fading the color. As for how long to wait between perming and coloring, talk to your professional, and ask them when they think your hair is in the right condition for the subsequent color process.

Hopefully, this gives you enough information to understand how a perm works and lets you take better care of your hair. After all, you want to look your best, and beautiful hair is a major asset.

Natural pH Level for Hair

Q: My daughter is doing a project testing whether it is better to use professional expensive salon shampoos rather than the ones sold in a supermarket. We want to bring the pH levels of hair and why the professional shampoos (should) be better. We wanted to do a litmus paper test. Any ideas or help to the above question would be greatly appreciated.

A: Well, the main reason most salons claim that their products are better for the hair is a matter of pH levels. The pH (potential hydrogen) scale is a measure of the acidity or alkalinity of a substance. Here's a quick and simple explanation of pH and how it works.

You can't discuss pH without talking about water and ions (or ionization). Only aqueous (water-based) substances have a pH level. (Oils and Alcohols do not.) An ion is an atom or molecule that carries an electrical charge. Ionization is the separation of a substance into ions. These ions will have opposite electrical charges. Those ions that are positively charged are called cations (KAT-eye-uns) and those that are negatively charged are called anions (AN-eye-uns).

In pure water, some of the water molecules naturally ionize into hydrogen ions and hydroxide ions. The pH scale measures these ions. The hydrogen ion (H^+) is acidic, while the hydroxide ion (OH^-) is alkaline. pH is only possible because of the ionization of water. In pure water, every water molecule produces one hydrogen ion and one hydroxide ion. Pure water has a neutral pH because it has an even number of hydrogen and hydroxide ions.

The pH scale is the measure of relative alkalinity (number of hydroxide ions) or acidity (number of hydrogen ions) in a substance. "pH" as a term originates from the French term 'pouvoir hydrogene' (or hydrogen power). The "p" is written lower case to represent a

quantity while the “H” is capitalized because it represents an element, therefore “pH” is the measure of the quantity of an element in a substance (in this case the amount of Hydrogen).

pH is measured on a scale of 0-14, with 7 being a neutral solution. Each step on the scale is a tenfold increase in alkalinity (moving up the scale) or in acidity (moving down the scale). For example: skin and hair have an average pH of 5, which means that pure water is 100 times more alkaline than skin or hair, and skin or hair is 100 times more acidic than pure water.

Any substance with a pH that is greater than 7.0 is considered an alkali, and any substance with a pH lower than 7.0 is considered an acid. Acids owe their chemical reactivity to the presence of Hydrogen ions (H⁺), taste sour, and will turn litmus paper from blue to red. Acids affect the hair by contracting and hardening it.

Alkalis owe their chemical reactivity to the hydroxide ion (OH⁻). The terms ‘alkali’ and ‘base’ are interchangeable. Alkalis have a bitter taste, turn litmus paper from red to blue, and feel soapy and slippery on the skin. They affect the hair by softening and swelling it.

When acids and alkalis are combined in equal portions, they neutralize one another.

When it comes to salon products and their pH levels, most salons claim that their products are better for the hair because they are gentler (more closely match the natural pH of hair). This could be tested by using litmus paper to gauge the pH level of these salon products, and comparing the pH levels with the established natural level of 5 for hair. (Hair and skin actually have a pH that ranges from 4.5 to 5.5, and is typically averaged to 5.0.) You could test a number of salon products (shampoos and conditioners) and a number of store brand versions.

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Note: All acid waves have three components: a waving solution, an activator, and a neutralizer. The activator contains the agent Glyceryl Monothioglycolate (GMTG) and should be considered carefully before deciding to use an Acid Wave since repeated exposure to GMTG is known to cause allergic sensitivity in both stylists and clients.

Acid-Balanced Waves

Because of the level of added effort and difficulty in processing a True Acid wave, the strength and pH of acid waves has been increased over the years to allow for easier, and simpler processing. Most acid waves found in salons today have a pH of between 7.8 and 8.2 which isn't truly acidic. These are now called Acid-Balanced Waves.

In addition to speeding up the processing and allowing for the wave to process at room temperature, and without the need for use of a hair dryer to provide added heat. Acid-balanced waves create firmer curl results than a true acid wave. They are great for use with hair that is porous and possibly damaged because they are gentler than most alkaline waves.

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Exothermic Waves

An exothermic wave is called thus because of the chemical reactions involved in the waving process. An exothermic chemical reaction produces heat, and an Exothermic Wave uses exothermic chemical reactions to produce heat as a way to speed up the processing time of the permanent wave. Exothermic waves have three components (like acid waves): waving

solution, activator and neutralizer. The waving solution contains thio just as in a cold wave and the activator contains an oxidizing agent (usually hydrogen peroxide). Combining the two creates a rapid release of heat and an increase in the temperature of the solution. The increased temperature increases the rate of the chemical reactions in the hair and shortens the required time to process the curl.

Exothermic waves are good for coarse, thick and/or resistant hair types, typically process faster than alkaline waves and create firm, strong curls. However, like an alkaline perm, exothermic waves can damage delicate hair and often has a strong, unpleasant ammonia odor.

Endothermic Waves

An Endothermic Wave is the counter-point to the Exothermic wave. Where the exothermic wave generates its own heat using a specific type of chemical reaction, the Endothermic Wave utilizes reactions that absorb the heat from its surroundings. This means that they are only activated by an outside heat source – typically a conventional hooded hair dryer.

As is obvious, most True-Acid waves are endothermic, but not all endothermic waves are “true” acid waves.

Ammonia-Free Waves

Ammonia-Free waves use an ingredient that does not evaporate as readily as ammonia, so there is very little odor associated with their use. One common substitute for ammonia is an alkanolamine, such as aminomethylpropanol and monoethanolamine. These ammonia-free waves generally process the same as standard alkaline waves but since the substitutes for the ammonia don't evaporate as readily as ammonia, there is typically very little odor associated with their use.

Ammonia-free waves are generally suited to use on hair that is porous to normal in resistance level, processes at room temperature, and typically generates medium to fine curls. While these waves may not smell as strongly as ammonia, they can still be every bit as alkaline and just as damaging. Remember that ammonia-free doesn't mean damage-free.

Thio-Free Waves

Thio-Free Waves use a substitute for Ammonium Thioglycolate (ATG) as the primary reducing agent in the waving formula. Commonly, the substitutes used are cysteamine or mercaptamine which while not technically being ATG are still thio compounds. Thio-Free Waves are marketed as being damage-free, but this isn't necessarily true. In high concentrations these can be as damaging as thio to the hair.

Thio-Free Waves have the benefits of processing at room temperature, and produce medium to fine curls. The Thio-Free Wave is suited for use on normal to porous hair types, and can be gentler on the hair depending on the individual formula used. Since the strength varies from manufacturer to manufacturer be sure to use caution in selecting and using a new formula.

Low-pH Waves

Low-pH waves use an alternative formula for their waving solutions. Instead of Ammonium Thioglycolate, low-pH waves use sulfates, sulfites and bisulfites as their primary ingredients. These formulations are very gentle since they work at a low pH, but while they have been in use for years, they are not very popular. The trouble is that the permanent waves based on sulfites are very weak and do not provide firm curls. Because of this they are often marketed for use in body wave services.

The weak formulation of Low-pH waves make them suited for use with fine and damaged hair or in cases where a gentle wave is desired as opposed to firm curl. Low-pH waves are endothermic waves and will need the heat of a hair dryer.

So, as you see, there are many options available when you start looking for a permanent wave formula. Knowing what the different terms mean and how they differ can help you select the right option for your hair, and help you know whether this is going to be something you can manage on your own. Just remember that if you are unsure, always ask a professional for guidance, or at the very least try to err on the side of caution.

Q: Can you tell me how I can get a perm without the awful smell?

A: That awful smell associated with permanent waves is caused by ammonia. The strong smell can usually be avoided by selecting low-ammonia formulations of permanent waves, or opting for an acid perm.

Acid perms typically use glycerol monothioglycolate instead of ammonium thioglycolate to break the disulfide bonds in the hair. They are generally much gentler to the hair and are slower acting, often requiring heat application to make the perm process work. It's important when using at-home perm kits of an acid perm that you read the instructions carefully in order to make sure you fully understand the differences in the procedures you must follow.

There are also low-ammonia waves that can be found on the market. These relatively-new formulas work in much the same way as their older counterparts, but do have a reduced level of odor. However, there may still be some caustic smell associated with the perm.

In order to deal with the smell after the perm, you can always look for anti-odor shampoos that will help remove the smell of perms as well as other chemical processes or environmental odors.

Q: Please explain the difference of an acid perm vs. an alkaline perm. When should you use what and on what type of hair?

A: The difference between acid waves and alkaline waves are basically this:

Acid waves usually have a pH rating between 4.5 and 7.0 and require heat to speed processing. The main ingredient in an acid perm is glyceryl monothioglycolate. Since hair has a pH of around 5.0 acid waves are less damaging to the hair, require the heat of a dryer usually and typically do not produce as firm a curl as an alkaline wave. You will want to use acid waves for those individuals with very fine textured hair or those whose hair is damaged or has been processed with other harsh chemical services again.

Alkaline waves are made using an alkaline ingredient, generally ammonium thioglycolate. They are also usually between 9.0 and 9.6 in pH. Alkaline waves are also called “cold waves” since they don’t need any extra heat source to process. These work best on hair that is coarse, thick or resistant to processing as well as “normal” virgin hair as they are much stronger when compared to Acid waves.

Perms and a Burnt Smell

Q: Is an acid perm or an alkaline perm more likely to smell burnt after processing? Are there certain perms that would cause the burnt smell a few days after a perm or is it the fact the perm may not have been rinsed properly?

A: Typically, an alkaline perm formula has a much stronger and more unpleasant odor than that of the acid perm. This is because of the use of ammonia (in ammonium thioglycolate) used to break the chemical bonds within the hair that allow the wave pattern to be reconfigured as you desire it to be. Most people seem to identify this odor as that of either rotting eggs or burnt hair. The burnt hair comparison is somewhat appropriate as part of the processing involves a chemical reaction within the hair that gives off its own heat as a by-product.

Acid perms use no ammonia, and instead are formulated with glyceryl monothioglycolate which doesn’t produce its own heat, and has to be exposed to heat from an outside source (typically an hood dryer). It is a gentler formula but also produces curls that are not as firm (and in some cases not as long-lasting) as alkaline perms.

Unfortunately, it seems that the odor of an alkaline perm is present, regardless of how well it is rinsed afterward. The intensity of the odor also varies from manufacturer to manufacturer. However, it can be said that making sure to leave the neutralizing solution on the hair the proper length of time IS key to minimizing the odor of any perm.

If, however, your hair still has an odor after perming, neutralizing and rinsing the hair thoroughly, here's a handy at-home tip to help:

Take one cup of white vinegar and two cups of water and combine them. Use this on as a rinse after shampooing your hair. Allow the solution to remain on the hair. Blot the hair and scalp dry with a clean, soft towel, and then allow the hair to dry naturally, or use a hair dryer with low heat and a diffuser attachment on the airflow nozzle. The acid in the vinegar will not only help to cut through the odor, but will also help to contract the cuticle layer and leave the hair shinier.

If you want even more conditioning impact, combine $\frac{1}{2}$ cup of white vinegar with a cup of your favorite conditioner and apply it as normal after shampooing. It will help remove the odor, seal the cuticle and keep the hair super-hydrated.

Making waves: The chemistry of hair perms

By Christine Herman • Posted in [chemistry blog carnival](#), [cosmetic chemistry](#) • [1 Comment](#)

I hope my previous post about [cosmetic chemistry](#) whet your appetite to know more about the mechanisms underlying the chemical processes that take place in the salon.

If it did, then I have just the thing for you.

It's the International Year of Chemistry, and in honor of that, the chief of the CENtral Science bloggers, Rachel Pepling, has called all blogging chemists to write about their [favorite chemical reaction](#).

If this is news to you, it's not too late! You have until Monday, September 26th to submit your entry. Check out all the details [here](#).

A bit of background

If you were like me, you had no idea that all those silly looking blobs inside the cell were just really big molecules. Photo credit: flickr user aubsglamola

Before I dive into my reaction, I need to set the stage a little.

Organic chemistry was my first chemistry love. Oh, the mechanisms, the reactions, the... electron pushing!

But what really sealed the deal between me and chemistry was my first biochemistry class. I had an “Aha!” moment when my professor threw a transparency up that showed how proteins are just really stinking big molecules.

So, you mean all those colorful blobs with strange names like “Golgi apparatus” and “mitochondria” that I memorized in high school biology— those were just molecules all along?

Yup. I discovered that so many everyday occurrences all boiled down to chemistry. Everything is made of chemicals. That’s right, I said it. *There’s no such thing as chemical-free!*

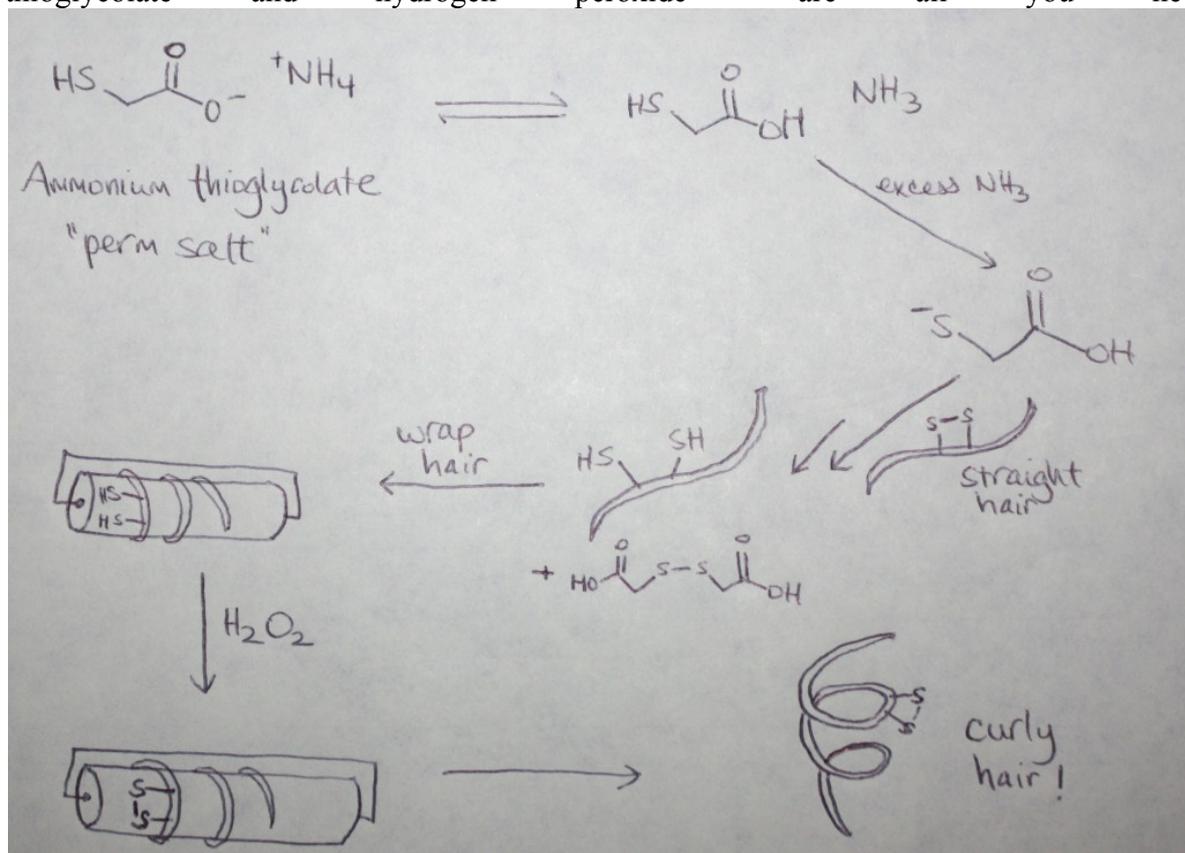
My biochem professor was great at building in examples of how science intersects with everyday life. One day we learned about the structure of hair. It’s made of keratin, a fibrous structural protein that is also found in skin and nails. Disulfide bonds between polypeptide chains in keratin molecules are what give your hair strength and rigidity.

The chemistry of perms

If you have straight hair, I know there are days when you’ve looked in the mirror and wished it was wavy. And vice-versa for the curly haired folks out there.

A century ago, you might have resorted to putting 24 pounds of heated brass rods in your hair and topped it off with a solution of cow urine and water to set the wave in place. That’s quite a price to pay for wavy hair.

But now, thanks to modern chemistry, a couple simple solutions— of ammonium thioglycolate and hydrogen peroxide— are all you need.



The chemistry of perms. Reference: J. Soc. Cosmet. Chem. **1996**, 47, 48-59.

A basic solution of ammonium thioglycolate, a.k.a. perm salt, is applied to the hair. The excess ammonia present in the solution helps the hair swell so that the reagents can work their way through each strand of hair, and also deprotonates the thioglycolate molecule, enabling it to break open disulfide bridges. At this point, the hair is wrapped around a curling rod and sprinkled with an oxidizing solution containing hydrogen peroxide. The disulfide bonds are reformed and the hair comes off the rod with a curl.

Anyone who has worked in a chemistry lab knows that yields are rarely ever one hundred percent. The same goes for the reactions on your hair. Not all the disulfide bonds that are broken by the thioglycolate will reform in the presence of hydrogen peroxide.

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This decrease in the total number of disulfide bonds is why people who perm their hair often likely notice a decrease in the strength and rigidity of their hair— also known as damage. But it varies from person to person.

It's funny because to this day, I still remember the sulfurous rotten-egg smell that would fill the bathroom whenever my mom permed her hair. I remember watching her use the solutions in sequence, wondering how it all worked.

Now I know why— it's all just chemistry on hair.

Chemical bonds broken, chemical bonds reformed, and *voilà!*— momma's got a brand new 'do.

What Chemicals Are Used in Perming Hair?

Answer

Chemicals commonly used to perm hair include glycerol monothioglycolate, which is acidic, and ammonium thioglycolate, which is alkaline. Alkaline perms are usually used for hair that is rough and strong, while acid perms are usually milder and are therefore used for more delicate, soft hair. Acid perms also usually require heat, while alkaline perms can typically be performed without the use of heat.