Chapter 14 Chemical Hair Relaxers and Soft Curl Permanents

Key Terms

Base cream
Guanidine hydroxide relaxers
Hydroxide neutralizers
Hydroxide relaxers
Lanthionine bonds
Lanthionization
Lithium hydroxide and potassium hydroxide relaxers
Metal hydroxide relaxers
Sodium hydroxide relaxers
Soft curl permanents
Thio neutralizers
Thio relaxers

Learning Objectives

After completing this chapter, you should be able to:

- Understand the role that reduction reactions play in relaxers.
- Realize the importance of proper neutralization.
- Define lanthionization and how it relates to other chemical services.
- Effectively use prerelaxing evaluation tests to determine hair condition.
- Understand the difference between thio and hydroxide relaxers.
- Understand the difference between thio and hydroxide neutralizers.

CHEMICAL HAIR RELAXING

Chemical hair relaxing straightens overly curly hair. Permanent waving curls straight hair. Other than the objectives being so different, chemical hair relaxing is similar to permanent waving. The chemistry of thio relaxers and permanent waving is the same. Even though the chemistry of hydroxide relaxers and permanent waving is different, all relaxers and all permanents change the shape of the hair by breaking disulfide bonds.

These techniques require great care and attention. Errors may cause irreparable damage.

The concepts discussed in this chapter assume a basic understanding of hair structure and reduction/oxidation (redox) reactions.

A detailed guide to proper application and neutralization of relaxers is found in *Milady's Standard Textbook of Cosmetology*. This chapter will focus on the theory involved in those techniques.

HAIR RELAXING CHEMISTRY

Hair "remembers" its shape and will resist attempts to refashion it. Hair contains millions of disulfide cross-linked, polypeptide chains. The cross-link bonds work with peptide bonds, salt bonds, and hydrogen bonds to create amazingly strong structures. Curl removal is accomplished by breaking apart the cross-link side bonds.

Hair Types and Textures

A thorough understanding of the kind of hair to be straightened is necessary to minimize possible damage to the client's hair or scalp. It is important to detect the differences between the different types of hair and the action to be expected of the chemical hair relaxer.

Excessively Curly Hair

Excessively curly hair exists in all races. That means anyone of any race, or mixed race, can have excessively curly hair. It's also true that within races, individuals have hair with different degrees of curliness. African-Americans have hair of varying degrees of curliness, from nearly straight to excessively curly.

Excessively curly hair grows in long twisted spirals. Cross sections are highly elliptical and vary in shape and thickness along their length. Compared to straight or wavy hair, which tends to possess a fairly regular and uniform diameter along a single strand, excessively curly hair is fairly irregular, exhibiting varying diameters along a single strand.

The thinnest and weakest sections of the hair strand are located at the twists. These sections are also bent at a sharp angle and will be stretched the most during relaxing. A chain is only as strong as its weakest link and hair is only as

strong as its weakest section. Hair breaks at its weakest point. Excessively curly hair usually breaks at the twists because of the weakness in that section and the extra physical force that is required to straighten it.

Fine Hair

The part of the hair that is to be straightened is the cortex. If the hair is fine and, therefore, has a smaller diameter than normal or average hair, the amount of cortex will be less. If the cuticle of the hair is not overly resistant, penetration of the relaxer will be quicker and processing time shorter.

Porous Hair

Porous hair, because of rather widely spaced cuticle scales, absorbs solutions more rapidly than normal hair and is naturally quicker to process. Less processing time should be allowed.

Coarse or Strong Hair

This type of hair usually has a larger diameter than normal hair and this results in a greater area of cortex. So more disulfide bonds need to be broken and processing time will be longer. If the cuticle is of the resistant type, processing time will be lengthened still more.

Dense Hair

This kind of hair thickly covers the scalp. As the follicles are numerous and closely clustered together, there are more hairs to be straightened. The hairstylist must use great care in applying sufficient amounts of chemical to ensure that all hairs are exposed equally to the relaxer.

Resistant Hair

This type of hair is less likely to be damaged by overprocessing with the relaxing chemical because the cuticle scales, being closer together, slow the rate of its penetration.

Sulfur Content

Some hair, usually red and black, has a higher sulfur content. This means that there are more disulfide bonds to be broken during the straightening process, lengthening the time required.

Prerelaxing Evaluations

Before relaxing the hair, three tests should be performed: an elasticity test, a strand test, and a porosity test. These tests, combined with careful observations allow the hairstylist to evaluate the hair's condition.

Elasticity is the hair's ability to withstand stretching or pulling. Normally, hair should have a great deal of elasticity. A loss of elasticity is a sign of damage. A strand of dry hair should stretch slightly without breaking.

To test for elasticity, stretch a single strand of dry hair between your fingers. Repeat this test in several locations. Hair that breaks under a slight strain has lost its elasticity. If the hair shows a large elasticity loss, examine it closely before proceeding. It requires special attention and several conditioning treatments before relaxing.

Strand testing gives warning of potential problems. Such tests show how the product works on the client's hair. Strand testing predicts what final results can be expected. Many factors affect the way hair responds to chemical treatments (e.g., porosity, texture, temperature, previous chemical services). Strand testing lessens the chance for unpleasant surprises. Proper testing takes these factors into account.

Apply the relaxer to a small section of hair, following the manufacturer's recommendations. If a section is more damaged, perform a second strand test on the damaged hair. Check the strands every three or four minutes until relaxation is complete. Rinse, neutralize, shampoo, and dry; then redo the elasticity test. Do not relax the hair if the test strands are very brittle or break easily.

To evaluate porosity properly, check different parts of the head, (i.e., the front hair line, behind the ear, and in the crown area). Gently slide a single strand of hair between your fingers, from the tip toward the scalp. Normal to resistant hair will feel smooth and silky. Roughness indicates a raised cuticle. Damaged hair will have a rough texture. Using a few dozen strands, repeat the test several times.

Each of these important tests helps evaluate the condition of the client's hair before relaxing. Prerelaxing evaluations are an important way to avoid overprocessing or causing excessive damage. They should be done before each service.

Overprocessing can be remedied with proper care and conditioning. However, hair in this condition cannot stand further damage. If these three tests indicate excessive hair damage, strongly encourage the client to delay the service. Suggest a conditioning program to correct the existing damage.

Thio Reduction Reactions

Thio relaxing solutions use reduction reactions to split disulfide bonds. While the relaxer cream is in contact with the cortex, the strong alkali softens and swells the hair. The thio breaks apart the disulfide bonds and the hair is in a *reduced state*.

The polypeptide chains of the cortex are unlinked by the bond breaking action of the chemical relaxer. This action will then permit the removal of excess curl from the hair. Bonds are rearranged into a straight position by *physical action*.

There are two forms of physical action—combing the chemical through the hair or using hands to pull the hair straight. Physically, the natural curl is removed by combing or pulling of the hair.

Gently pulling the hair with either a comb or hands shifts the broken disulfide bonds to new locations.

Caution: Hair in a reduced state is fragile and lacks strength. Be careful not to pull too hard. The peptide bonds can easily be broken. Rough handling can cause extensive hair damage.

There is a great similarity between the actions in permanent waving and in chemical hair straightening. In both cases, the disulfide bonds of the keratin are broken down in the softening process. In permanent waving, the hair is wound on rods in order that the softened hair will take the shape of the rod. The goal of permanent waving is to curl naturally straight hair.

In relaxing, the objective is the opposite. The goal is to straighten naturally curly hair. The disulfide bonds are shifted into a straight position by mechanical actions.

One of the differences between permanent waves and relaxers is the *viscosity* (thickness) of the chemical product. Relaxer products are thicker, having a much higher viscosity. Having a high viscosity in relaxers is an advantage. A thick product holds the hair in a straight position while it is being straightened/processed. Fatty materials and other hair conditioners are blended into a thickened cream base. This allows the relaxer to stay on the hair and not run off.

High viscosity would be a disadvantage in permanent waving lotions. The thickness would make application, rinsing, and neutralization difficult.

The two most common types of chemical hair relaxers are thio (ammonium thioglycolate or ATG) and hydroxide (OH^-) (see Appendix E).

Thio Relaxers

Caution: A thioglycolate relaxer product is incompatible with sodium hydroxide. Never use a thio relaxer on hair that has previously been relaxed with a sodium hydroxide product, or hair breakage may occur!

Thio (**THY**-oh) (ammonium thioglycolate or ATG) is the same reducing agent that is used in permanent waving. Other than the strength of the solution, their chemistry is identical. **Thio relaxers** may have a pH above 10 and a higher concentration of ATG than used in permanent waving. Thio relaxers are also thicker and have a higher viscosity.

Although the procedures are different, thio relaxers break disulfide bonds and soften hair, just like permanents (Chapter 13, Permanent Waving). After enough bonds are broken, the hair is straightened into its new shape and the relaxer is rinsed from the hair. Blotting comes next, followed by a neutralizer. The chemical reactions are identical to those in permanent waving.

Thio Neutralization

The **thio neutralizer** used with thio relaxers is an oxidizing agent, usually hydrogen peroxide, just like permanents. The oxidation reaction caused by the neutralizer rebuilds the disulfide bonds that were broken by the thio relaxer. The chemical reaction of the neutralizer is identical to the neutralizer used in permanent waving (Fig. 14–1 and Chapter 13, Permanent Waving).

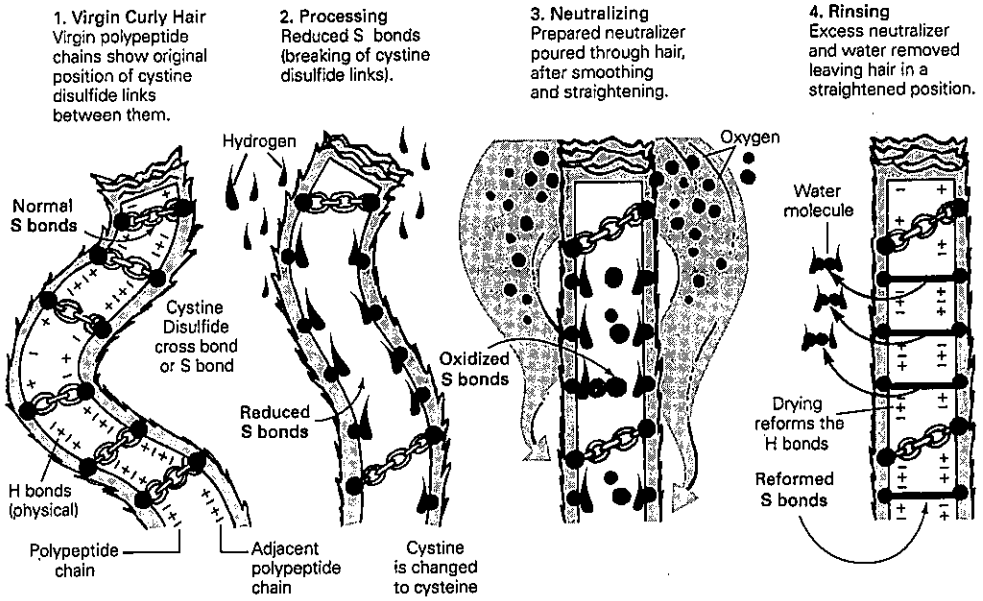

Figure 14-1 *Chemical hair straightening—ammonium thioglycolate.*

Soft Curl Permanents

A **soft curl permanent** is a combination of a thio relaxer, followed by a thio permanent wave that is wrapped on large rods. Soft curl permanents don't straighten the hair; they simply make the existing curl larger and looser. Soft curl permanents use ATG and oxidation neutralizers, just like thio permanent waves.

A soft curl permanent is actually two services. A soft curl permanent is a combination of a thio relaxer, followed by a thio permanent wave that is wrapped on large rods. Before excessively curly hair can be wrapped on rods (rodded), it must be relaxed with a thio relaxer. The process is the same as a thio relaxer, but the hair should not be neutralized before rodding. After the hair is relaxed it is wrapped on large rods and processed with a second thio solution. After processing, the hair is rinsed, blotted, and neutralized as with other permanents.

Hydroxide Relaxers (OH^-)

There are several different types of hydroxide relaxers. The hydroxide ion (OH^-) is the active ingredient in all **hydroxide relaxers**. Sodium hydroxide, potassium hydroxide, lithium hydroxide, and guanidine hydroxide are all hydroxide relaxers. All hydroxide relaxers are strong alkalis (bases), which can swell the hair up to twice its normal diameter.

Hydroxide relaxers are not compatible with thio relaxers because they use a different chemistry. Thio relaxers have a pH of about 10 and use thio to break the disulfide bonds. The high pH of a thio relaxer simply opens the hair. Thio breaks the disulfide bonds.

Most hydroxide relaxers have an extremely high concentration of hydroxide ions (OH^-), which means they have a high pH (Chapter 9, Advanced Chemistry). The average pH of the hair is 5.0 and many hydroxide relaxers have a pH over 13.0. Since each step in the pH scale represents a tenfold change in concentration, a pH of 13.0 is one hundred million (100,000,000) times more alkaline than a pH of 5.0.

The hydroxide ion (OH^-) is the active ingredient in all hydroxide relaxers. The strength of all hydroxide relaxers is determined by the concentration of hydroxide ions, which is the pH of the relaxer. At high concentrations, the hydroxide ion breaks disulfide bonds by removing acidic hydrogen atoms next to the sulfur atoms in the disulfide bond. This is different than the reduction reaction caused by thio relaxers. The disulfide bonds that are broken by hydroxide relaxers are broken permanently and can never be reformed. Hydroxide relaxers work by a process called **lanthionization** (lan-thy-oh-ny-**ZAY**-shun). The disulfide bonds that are broken by hydroxide relaxers are converted to **lanthionine** (lan-**THY**-oh-neen) **bonds** when the relaxer is rinsed and the hair is still at a high pH (Fig. 14–2)

Thio Neutralization

Neutralization of a thio permanent or relaxer is an oxidation reaction that rebuilds the disulfide bonds that were broken during processing. Thio breaks disulfide bonds by adding extra hydrogen atoms to the two sulfur atoms joined in the disulfide bond. Neutralization, with an oxidizing agent, rebuilds the disulfide bonds by adding oxygen to the extra hydrogen atoms to form water. The formation of water removes the extra hydrogen atoms and allows the disulfide bonds to reform (Fig. 14–1 and Chapter 13, Permanent Waving).

Hydroxide Neutralization

Unlike permanent waving neutralization, the neutralization of hydroxide relaxers does not involve an oxidation reaction. Hydroxide neutralizers neutralize the alkaline residues (OH^-) left in the hair by the relaxer. The pH of hydroxide relaxers is so high that the hair remains at a high pH, even after thorough rinsing. Since acids neutralize alkalis (Chapter 9, Advanced Chemistry), the application of an acid-balanced shampoo or a normalizing lotion neutralizes any remaining hydroxide ions and lowers the pH of the hair and scalp. Some neutralizing shampoos, intended for use after hydroxide relaxers, have pH indicators that will change color to indicate if the pH of the hair has returned to normal.

Since the disulfide bonds that have been broken by hydroxide relaxers cannot be reformed by oxidation, application of a neutralizer that contains an

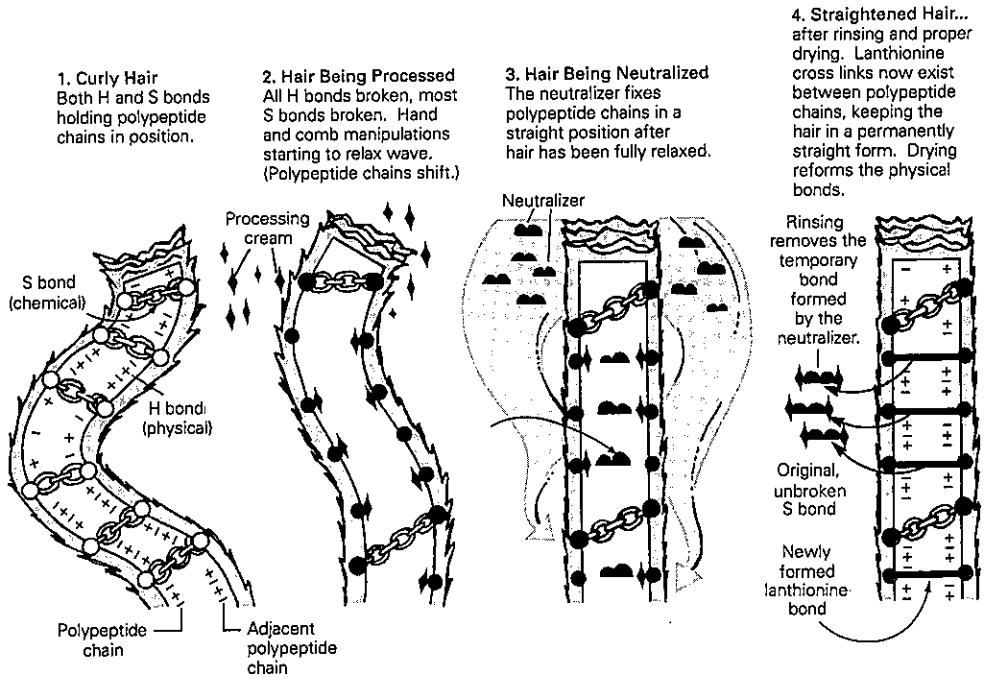

Figure 14–2 *Chemical hair straightening—sodium hydroxide.*

oxidizing agent will not rebuild the disulfide bonds and will only damage the hair. Disulfide bonds that have been broken by hydroxide relaxers cannot be reformed.

Hair that has been treated with hydroxide relaxers is unfit for thio relaxers or permanent waving. Disulfide bonds that are broken by hydroxide relaxers are converted to lanthionine bonds (Fig. 14–2). Unlike disulfide bonds, which are formed with two sulfur atoms, lanthionine bonds are formed with a single sulfur atom. Thio relaxers and thio permanents are designed to break disulfide bonds, not lanthionine bonds. The application of a thio relaxer or thio permanent on hair that has been treated with a hydroxide relaxer will not properly relax, or curl, the hair and may cause extreme damage. **Hair that has been treated with hydroxide relaxers is unfit for thio relaxers or permanent waving.**

Metal Hydroxide Relaxers

Metal hydroxide relaxers are ionic compounds formed by a metal, sodium (Na), potassium (K), or lithium (Li), which is combined with oxygen (O) and hydrogen (H). Metal hydroxide relaxers include sodium hydroxide (NaOH), potassium hydroxide (KOH), and lithium hydroxide (LiOH).

All metal hydroxide relaxers contain only one component and are used, without mixing, exactly as they are packaged in the container. The hydroxide ion (OH^-) is the active ingredient in all hydroxide relaxers. There is no significant difference in the straightening ability of these metal hydroxide relaxers.

Sodium Hydroxide

Caution: A sodium hydroxide relaxer is incompatible with thioglycolate. Never use a sodium hydroxide product on hair that has been previously relaxed with a thioglycolate product, or hair breakage may occur!

Sodium hydroxide is commonly used in chemical relaxing products and is an effective hair straightener. Sodium hydroxide is also known as lye or caustic soda. The pH level of this product often exceeds 13 and is sometimes above 13.5! As this high pH level suggests, this is a highly corrosive chemical. The hair can swell to more than twice its normal diameter. Use this relaxer with care and caution.

Sodium hydroxide is the same chemical used in drain cleaners and chemical hair depilatories.

Lithium Hydroxide and Potassium Hydroxide

Lithium hydroxide (LiOH) and **potassium hydroxide** (KOH) are sometimes advertised and sold as "no mix–no lye" relaxers. Although, technically, they are not lye, the chemistry is identical, with little difference in their performance. The hydroxide ion (OH^-) is the active ingredient in all hydroxide relaxers. All metal hydroxide relaxers share the same chemistry, which makes them incompatible with thio permanents and relaxers.

Guanidine Hydroxide

Guanidine (GWAN-ih-deen) **hydroxide relaxers** are usually advertised and sold as "no lye" relaxers. Although, technically, they are not lye, the hydroxide ion (OH^-) is still the active ingredient. Guanidine hydroxide relaxers have the same basic chemistry as all other hydroxide relaxers, which make them incompatible with all thio permanents and relaxers.

Guanidine hydroxide relaxers contain two components that must be mixed immediately prior to use. Mixing a cream, containing calcium hydroxide, with a liquid activator, containing guanidine carbonate, causes a chemical reaction that produces guanidine hydroxide. Calcium hydroxide and guanidine carbonate will not straighten hair unless they are mixed correctly and in the exact proportions. Even though calcium hydroxide is often found in depilatories or added to metal hydroxide relaxers, calcium hydroxide, alone, will not straighten hair.

Guanidine hydroxide relaxers have the ability to straighten hair completely with significantly less scalp irritation than other hydroxide relaxers. Most guanidine hydroxide relaxers are recommended for sensitive scalp and sold over the counter for home use. Although guanidine hydroxide relaxers reduce scalp irritation, they don't reduce hair damage. Guanidine hydroxide relaxers swell the hair

slightly more than other hydroxide relaxers and are also more drying, especially after repeated applications.

Base and No-base Formulas

Hydroxide relaxers are usually sold in base and no-base formulas. **Base cream** is a petroleum cream that is applied to the skin and scalp to provide a barrier designed to protect the client's skin from irritation. For added protection, *base formulas* require the application of base cream to the entire scalp, prior to the application of the relaxer.

No-base relaxers already contain a base cream in the oil phase of the emulsion that is designed to melt at body temperature. As the relaxer is applied, body heat causes the base to melt and settle out on the scalp, in a thin, oily, protective coating. As added protection, base cream should always be applied to the entire hairline and around the ears, even with no-base relaxers.

Low pH Relaxers

Some reducing agents work fairly well at pH levels between 6.5 and 8.5. Sodium bisulfite is an example of a low pH value reducing agent. Low pH relaxers are less effective in straightening hair, especially resistant hair. However, they are milder on the scalp and hair. These relaxers are recommended for thin or overly brittle hair.

Use these relaxing agents with great care and caution. If used incorrectly, they cause serious scalp and skin burns. These same chemicals are used in depilatory creams and can dissolve hair.

These chemicals are highly corrosive to the skin and eyes. Always wear safety glasses and gloves when mixing, measuring, pouring, or dispensing the substances. Take precautions to protect clients, as well.

As discussed in previous chapters, the rate of a chemical reaction doubles with each 18°F/10°C rise in temperature. Therefore, using heat to speed up the relaxing process can be dangerous. The corrosive action on skin will speed up, as well. Never use heat unless specified in the manufacturer's instructions.

Use extreme caution with all types of relaxers. Always keep these products from contacting a client's skin, i.e., ears, forehead, and neck. Applying protective cream to these areas is advisable even with no-base products.

Relaxer Timing

Improper timing of hair relaxing services is a common and potentially serious error. This can be dangerous to the client. It is important to develop a foolproof system for timing hair relaxing services.

Always use a timer with an alarm. Check the client's hair periodically. This improves the quality of service and helps avoid overprocessing. Used improperly, relaxers with extremely high pH levels can rapidly destroy hair and skin.

Although they frequently occur, problems of this nature are unnecessary. Relaxers have been used safely for many years by thousands of clients. With care and attention, clients should never experience problems.

HAIR RELAXING SAFETY

Scalp irritation (irritant contact dermatitis) sometimes results from relaxer products. Shampooing before the relaxing service will increase the risk of irritation. The scalp has a protective barrier of sebum that is temporarily removed by shampooing.

Ask clients to refrain from shampooing their hair for twenty-four hours prior to a chemical relaxer application. You may wish to recommend the client use a buildup-removing shampoo for several shampoos before the appointment. Never shampoo a client's hair before applying a chemical relaxer. This is especially important for hydroxide relaxers.

Examine the scalp and hair carefully before beginning a chemical relaxer treatment. Look for signs of scalp irritation, redness, tender or puffy tissue, open sores, and excessive dryness or other skin problems. If a problem is observed, advise the client to see a dermatologist before proceeding with a chemical service.

In general, high-alkaline products are serious eye hazards. They may chemically react with eye protein and create a water-insoluble film. This film makes it difficult to flush and cleanse the eye properly.

Relaxers and neutralizers are potentially dangerous to the eyes. Should accidental contact occur, flush the eye immediately with warm, running water. Then call a physician! Some chemicals have delayed effects, causing damage hours later if not properly treated.

To avoid accidents, wear proper eye protection. Use protective creams to prevent contact with the client's face, ears, or neck.

A common mistake is made when retouching regrowth. Use every precaution to avoid overlapping. Overlapping previously relaxed hair can lead to hair breakage and excessive damage.

Proper shampooing and rinsing is an important final step. Relaxer residues are trapped beneath the cuticle layer. Failing to neutralize residues completely causes excessive and continuing damage.

Follow the manufacturer's directions when rinsing and neutralizing. After neutralizing, flush with an acid rinse, then shampoo with a mild, acid shampoo and apply a conditioner. Take care to massage the scalp gently. This prevents further irritation to sensitive tissue (Figs. 14–3 thru 14–9).

Figure 14-3 *Examining the scalp.*

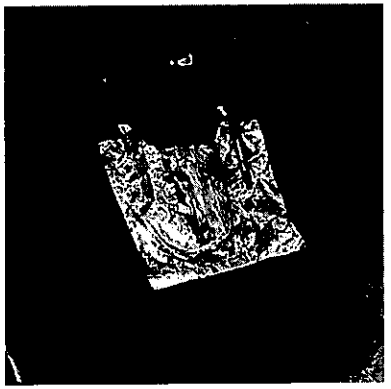

Figure 14-4 *Relaxer strand test.*

Figure 14-5 *Applying protective base.*

Figure 14-6 *Applying relaxer on top of strand.*

Figure 14-7 *Applying relaxer underneath strand.*

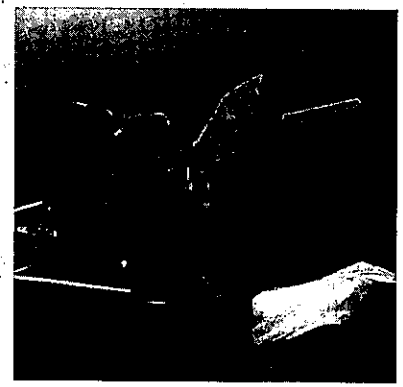

Figure 14–8 *Rinsing out relaxer.*

Figure 14–9 *Shampooing the hair.*

Review Questions

1. List the difference between permanent waving lotions and relaxers made with ammonium thioglycolate.
2. Why is hair in the reduced state more fragile?
3. How do thio neutralizers work?
4. What chemicals are used to dissolve hair?
5. Why do some relaxers use a base cream?
6. What is the difference between lanthionine and disulfide bonds?
7. In what three ways should hair be evaluated before relaxing the hair?
8. List safety procedures and precautions to be observed while using relaxers.

Discussion Questions

1. A client comes to you after doing a "home" permanent wave with poor results. The client wants the curls relaxed but the hair was severely over-processed by the perm lotion. You perform a strand test and an elasticity

test, and check the porosity. The results tell you the client's hair might not stand the process, but the client insists.

Discuss the various alternatives. For example:

a. You refuse and advise a hair-conditioning program.

b. You perform the service and badly burn the hair.

c. Can you think of other possibilities?