

HAIR COLORING PRODUCTS

- Hair colorants are widely used by both genders to alter their natural hair color **by removing some of the existing color and/or adding a new color.**
- While most consumers have their individual reasons, the main motivator for coloring the hair is to cover up gray hair.

- **Types and Definition of Hair Coloring Products**
- The size of the coloring molecule, swelling of the hair at the time of application, and alkalinity of the dye product determine whether the dye penetrates the cortex and colors the hair for a long period of time or precipitates on the cuticle and provides a temporary effect.

- **Hair dyes** add color to the hair, which can be lighter or darker depending on the type of hair coloring product used.
- **Hair bleaches** only lighten the hair without adding a new color to it. **Hair bleaches remove the hair color** through a chemical reaction. They can be **used alone or in combination** with permanent hair colors.

- Based on the **permanency of the new color**, the following hair coloring product types are available on the market today:
- Temporary
- Semi-permanent
- Demi-permanent
- Permanent dyes
- Hair bleaches.

Based on the **process of dying**:

➤ Non-oxidative hair dyes including:

- Temporary
- Semi-permanent
- Permanent progressive hair dyes

➤ Oxidative hair dyes including:

- Demi-permanent
- Permanent dyes (except the progressive dyes)
- Hair bleaches.

- **Types, Typical Ingredients, and Formulation of Hair Coloring Products**
- Hair coloring products can be categorized based on the **presence or absence of the chemical reaction (oxidation)**
- Non-oxidative products include **temporary** dyes and **semi-permanent** dyes
- **Demi-permanent dyes, permanent dyes, and hair bleaches** fall into the category of oxidative products.
- Progressive hair dyes are **permanent but not oxidative.**

- **NON-OXIDIZING PRODUCTS**

- Non-oxidizing dyes are not able to produce lighter shades than the originally presenting shade and cannot significantly darken the originally presenting color.

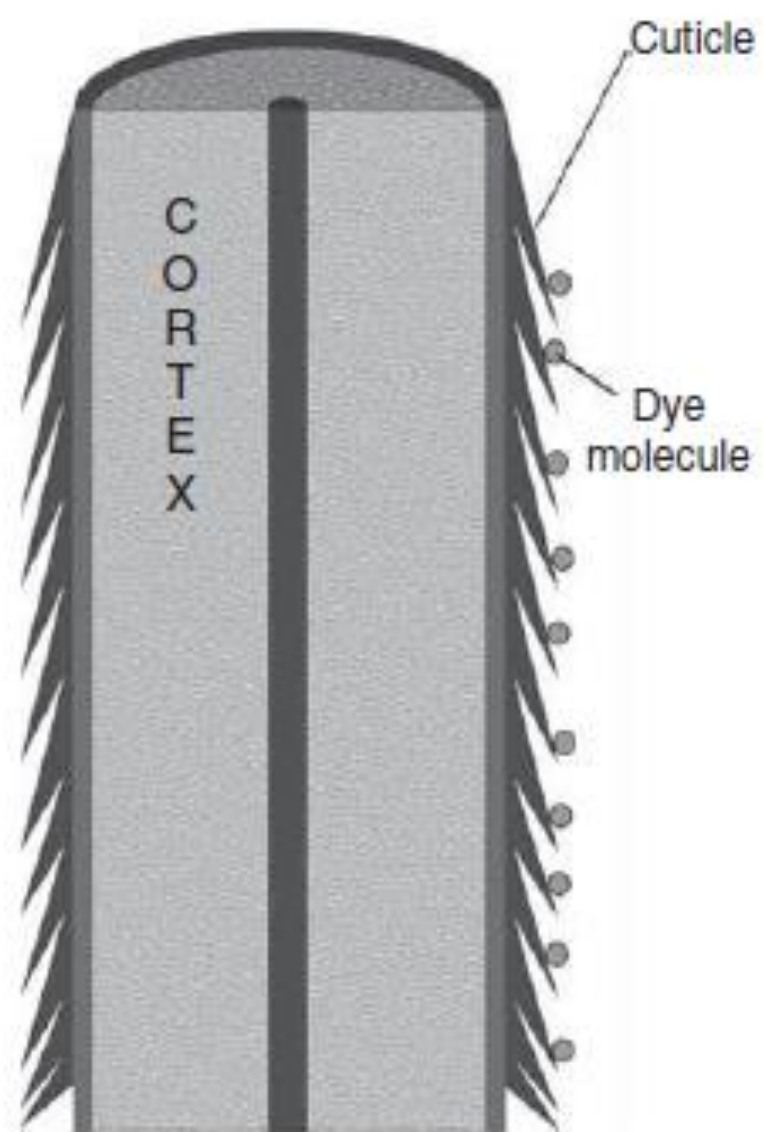


Figure 5.12 Coloring mechanism of temporary hair dyes.

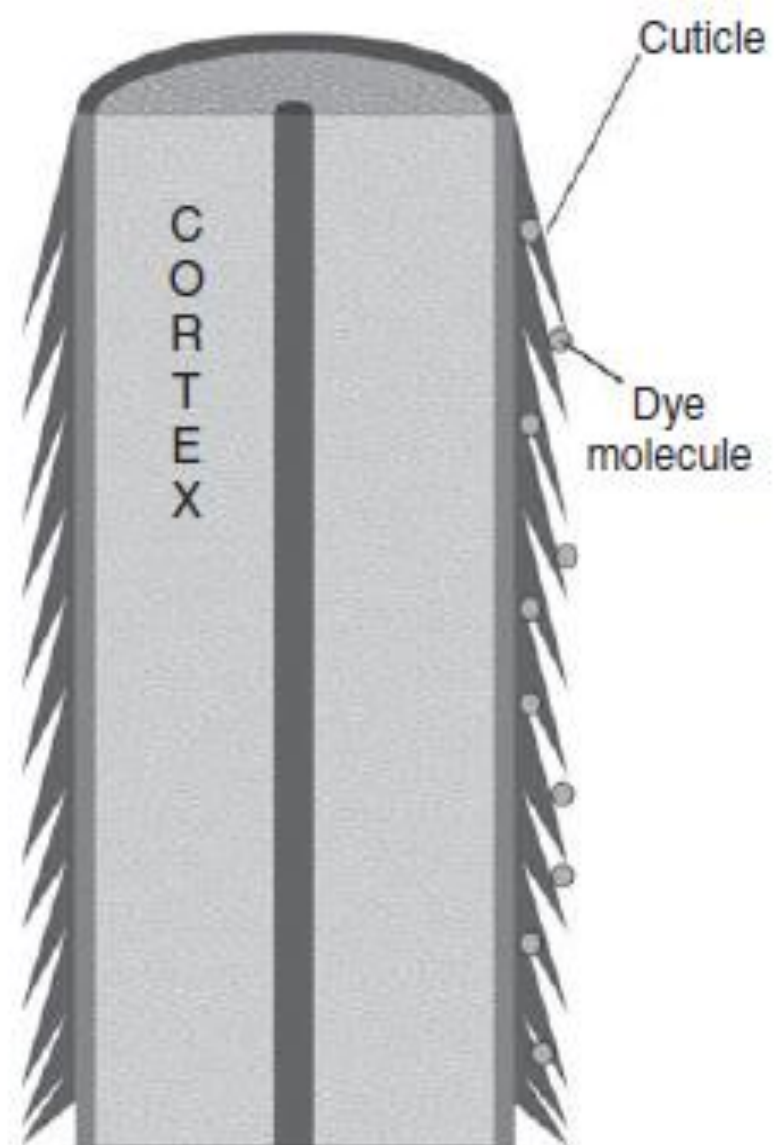


Figure 5.13 Coloring mechanism of semi-permanent hair dyes.

➤ **Temporary Dyes**

- Usually contain molecules that are **too large to penetrate** the hair cortex and also have **low affinity to hair**, meaning that the binding forces between the hair cuticle and the dye molecules are low.
- As a result, temporary dyes provide a **weak coating** on the hair cuticle and are easily washed out after the **first shampooing**.
- **Temporary coloring agents include** azo compounds, triphenylmethane-based dyes, indoamines, and indophenols.

- People who had permanent straightening, permanent waving, or even previous permanent coloring may have **damaged cuticle**, making the hair **less resistant** to the dyes.
- In such cases, the dyes can **enter the cortex**. Under these conditions, it may take **more than one shampooing** to remove the color.
- Temporary hair coloring products are often **used to** add a slight tone, brighten the hair, refresh the already colored hair, or try out a hair color before permanently dyeing the hair.
- **Product forms include** liquids, shampoos, hair mousses, gels, and hair sprays.

- Color **rinses** are usually **liquid products** that are applied after shampooing, with the excess dyestuff being removed by rinsing.
- Color-enhancing **shampoos** combine the action of a shampoo with that of a color rinse.
- Hair color **sprays** used for parties also contain temporary dyes, which makes them easy to remove.

- **Mousses** and **gels** serve as both styling and coloring products. Products with glitters are also popular, which give the hair a shimmery effect.
- Temporary hair dyes are ideal for people with **less than 15% gray hair**
- These dyes can readily **stain the scalp and skin.**

➤ **Semi-Permanent Dyes**

- Usually employ dyes that are **small enough** to **penetrate** the hair cuticle to some degree in addition to **staining** it from the outside
- Semi-permanent coloring agents **include** nitrophenylene diamines, nitroaminophenols, and azo dyes.
- Similar to temporary dyes, their effect may be longer, if **applied to damaged, porous hair**.
- **They are usually used on** natural, unbleached hair to cover gray, add highlights, and cover up unwanted tones.

- Washing the hair **opens the cuticle**, allowing the color to **escape** over time because of the solubility of the dyes in water.
- The formulation of a **typical semi-permanent hair dye** includes a dye, an alkalizing agent, a solvent, a surfactant, a thickener, a fragrance, and water.
- Usually, **10–12 dyes** are mixed to obtain the desired shade.
- Typically, semi-permanent hair colorings **are available as** lotions, shampoos, gels, creams, and mousses.

- **Shampoos** are usually applied to hair and left on it for 20–30min. **Thickness of such products** is important as low-viscosity products would run off the scalp.
- **Mousses** incorporate the dye in an **aerosol form**. It is also applied to wet hair and left on the hair for 20–30min before rinsing.
- They are gradually washed out, usually during 6–8 shampooing.
- Semi-permanent dyes are ideal for people with **less than 30%** gray hair.

- **Henna** is also a semi-permanent dye.
- It adds **red hues** to natural brunette hair.
- Most recently, henna is **combined with metallic salts** to provide a wider range of colors

➤ Progressive Hair Dyes

- Progressive hair dye products, also known as **gradual hair dyes or metallic hair dyes**
- Contain **water-soluble metal salts**, which are gradually deposited on the hair shaft.
- The metals interact **with cysteine** in the **cuticle** to form **metal sulfides**, and the deposits gradually accumulate on the cuticle.
- The most commonly used ingredient is **lead acetate**. **Bismuth citrate**, is used to a much lesser extent.

- Progressive hair dyes change the color of the **hair gradually from gray to yellow-brown to black over time**. For a continuous effect, these products have to be **continuously applied**.
- Sometimes, **trace metals left** on the hair can **interact with** bleaching or permanent waving products. Therefore, it is recommended to **allow the hair grow** out before undergoing other coloring or waving procedures.
- These products are more popular **among men**, who usually do not undergo permanent waving and **have their hair cut more frequently**; therefore, the potential damaging effect in their case is relatively lower.

- **OXIDIZING PRODUCTS**

- Oxidizing hair dyes are two-component systems:

1. One component (called tint) contains **colorless dye intermediates** (such as PPD; *p*-toluenediamine, PTD; and *p*-aminophenols) and **couplers** (such as resorcinol and *m*-aminophenols) in a highly alkaline formulation.
2. The other component contains **hydrogen peroxide** (the oxidizing agent, otherwise known as the developer or activator).

- These products are **mixed right before application**, which generates a chemical reaction.

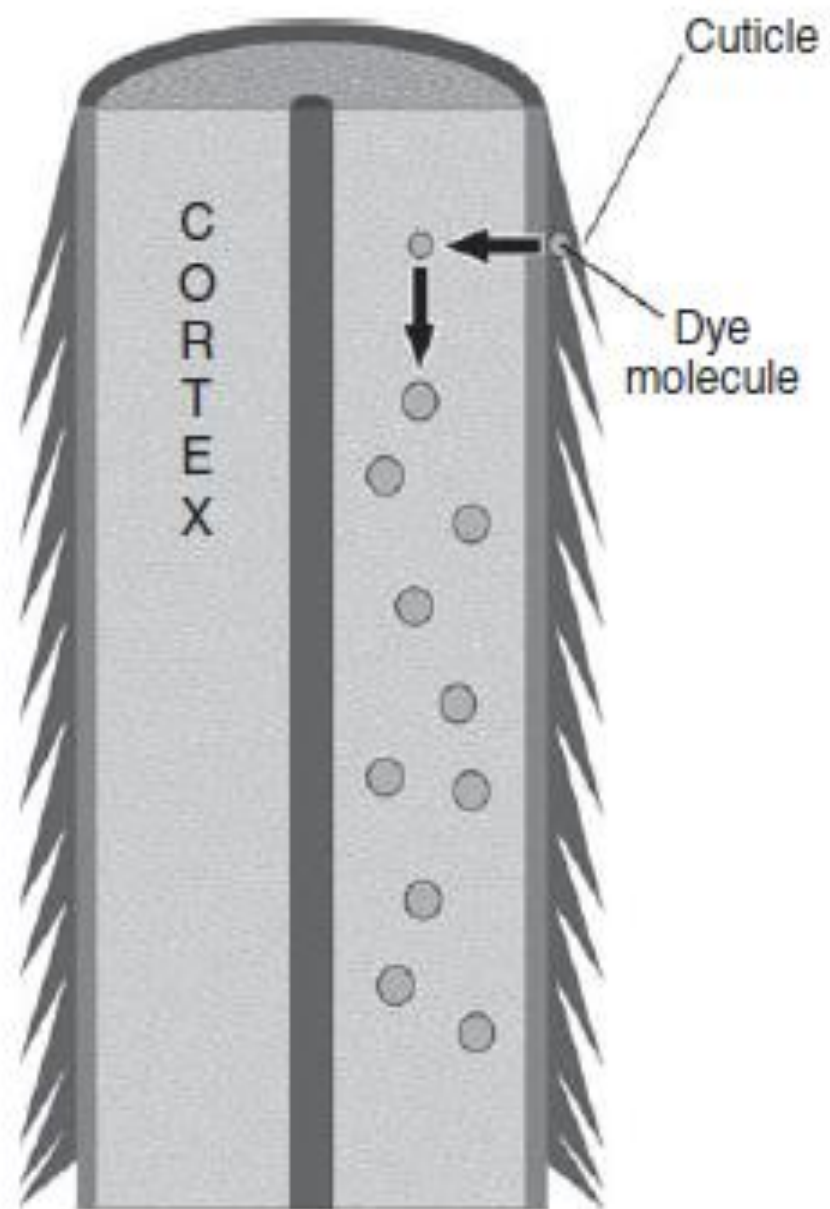


Figure 5.14 Coloring mechanism of oxidizing hair dyes.

- The alkaline agent **swells** the hair cuticle and thus helps the **penetration** of the relatively small dye intermediates into the cortex.
- In addition, it also **destabilizes hydrogen peroxide to liberate oxygen**. The oxygen released **destroys the hair's natural melanin** (i.e., lightens hair) and also **oxidizes the dye intermediates** and allows them to **react with the couplers** within the hair shaft to form a colored molecule.
- The final color molecule is **too large to be removed** by shampooing, which makes the color resistant to shampooing.

- Couplers **do not produce hair color** but alter the color of the oxidized dye intermediates.
- The color depends on the **type and amount** of dye intermediates and couplers used.
- Two main groups: **demi-permanent** dyes and **permanent** dyes.
- The primary distinctions between these two are the **type** and **level** of alkalizing agent and the **concentration** of the peroxide.
- These differences **result in** different color, coverage, lasting power, and lightening performance.

➤ **Demi-Permanent Hair Dyes**

- They typically employ **2% hydrogen peroxide** and **lower levels of alkalizers** (usually monoethanolamine).
- Their effect is **longer lasting than that of semi-permanent** colors
- It is still **not permanent** due to the use of non-ammoniacal alkaline agent.
- They are gradually washed out, usually during 20–24 shampooing.
- Demi-permanent colors can be used to **enhance and brighten** the natural hair color

- Due to the lower amount of hydrogen peroxide, they **do not lighten the hair**
- For the same reason, they are **milder to the hair than permanent hair** colors and have a **less disturbing smell** during application
- Most commonly, they are used to add **red highlights to brown hair**
- Demi-permanent dyes can **cover up gray hairs up to 50%**
- Demi-permanent hair dyeing products **are available as gels, creams, or liquids.**

➤ Permanent Hair Dyes

- Their popularity is due to the **wide variety of shades** available as well as their ability to both **lighten and darken** the hair.
- Permanent hair dyes can be used to **entirely cover gray hair** and produce a completely **new color**.
- Permanent colorants use up to **6% hydrogen peroxide** and contain **ammonia** as an alkalizer to bring the pH of the final product to 9.0–10.5.
- This allows complete penetration across the cortex.

- Additional ingredients of permanent hair dye:
- **Solvents** include water, glycerin, and ethanol.
- **Boosters**, such as ammonium persulfate or potassium sulfate, can be used when dark-haired customers want to have blond hair. Hydrogen peroxide is not able to remove melanin completely by itself. Boosters enhance its effectiveness.
- **Conditioners**, such as quaternary compounds, proteins, and emollients.

- **Surfactants**, in which helps wetting the hair during the coloring process, removing the dye formulation from the hair after application, as well as help stabilize the formulations. Examples include anionic, amphoteric, and nonionic surfactants.
- **Buffers, Thickeners, Antioxidants, preservatives, and chelating agents**

- Redyeing (touch-up) is usually necessary every **4–6 weeks** as new hair appears at the scalp
- Often this is called the dying of “**root**,” which, as discussed earlier, is **not the real root**, as the hair roots are located deep down within the scalp

- several factors can accelerate color changes and fading including:
 - Improper application of the dye
 - Mechanical factors, such as shampooing and permanent chemical procedures damaging the cuticle
 - Environmental factors, such as UV light and water exposure

➤ Hair Bleaches “Hair lightening”

- It is a **chemical process** that involves the removal of the natural hair pigment or artificial color from the hair.
- The bleach oxidizes the melanin molecule. The oxidized molecule is colorless.
- The hydrogen peroxide breaks chemical bonds in the hair, which releases sulfur that accounts for the characteristic odor of the hair coloring process.

- As melanin is located in the cortex, **the cuticle has to be opened** for optimal penetration of the bleaching agent. Therefore, bleaches are also **alkaline solutions** containing hydrogen peroxide, often with added **boosters** to accelerate the bleaching efficacy.
- **Examples for boosters** include ammonium persulfate or potassium sulfate.
- Since hydrogen peroxide is **not stable at an alkaline pH**, it is usually supplied as a diluted (6–12%) aqueous solution or cream, and it is combined with an alkaline ammonia solution or cream immediately prior to use.

- **The higher the volume used of hydrogen peroxide** , the more dramatic the achievable hair lightening.
- Ammonia serves to **speed up the oxidation reaction**. The reaction usually occurs more rapidly at the scalp due to the presence of body heat.
- Therefore, the bleaching product is usually applied to the hair tips first and then to the part close to the scalp.
- After leaving on the hair for a desired amount of time, **the product is removed with an acidic shampoo** to reset the pH to the normal level and minimize hair damage.

- The resulting color is **often flat and difficult to control**, and **toners** (dilute solutions of dyes) are used to make the color more aesthetically acceptable.
- The toner can be selected from either **the permanent or semi-permanent family of dyes**.
- Hair bleaching is commonly used by itself or to remove pigment before color is deposited.
- Similar to permanent hair dyes, **regular reapplication is necessary** to prevent visible regrowth of the naturally darker hair.

How Hair Coloring Products May Affect the Scalp and Hair?

- **Oxidative hair dyes**, including demi-permanent, permanent, and bleaching products, contain **hydrogen peroxide** and have an **alkaline pH**, which can have a significant effect on the hair shaft's **structure** and its **physical state**.
- The **higher the pH**, the **more damaging** the procedure.

- Oxidative hair dyeing **can result in** damaged cuticle, porous hair, decreased tensile strength, and increased hair breakage.
- All these can lead to **undesirable sensorial attributes**, such as poor shine, poor feel, coarse hair, which also lacks luster.
- Hair that has been permanently colored or bleached is **more sensitive** to physical and environmental damage.
- These changes are more prominent with **frequent use** and **inappropriate application technique**.

- Hair dyes can cause **allergic reactions**, mainly at the site of application.
- The number of adverse reactions is estimated to be **less than 0.5%** of the general population
- A key hair dye ingredient (**dye intermediate**), also known as a skin sensitizer, is ***para*-phenylenediamine (PPD)**.
- Main symptoms of allergy to this ingredient include **scalp redness and itching**.

- **Progressive and temporary hair dyes** present minimal risk for allergic reactions, as they do not contain PPD.
- **Permanent hair dyes** contain the highest amount of this ingredient
- Consumers are advised to **conduct a skin sensitivity test** with the product to be used **48 h** before hair coloring (for all types)
- **Hairdressers** are usually advised to wear **gloves** during the hair dyeing process.
- **Hair bleaching** has also been reported to cause **skin irritation**, including scalp burns and allergic dermatitis.

- An additional safety concern with regard to the use of oxidative hair dyes was **whether they cause cancer.**
- Oxidative hair dye ingredients belong to the large chemical family of **arylamines**, which includes known human carcinogens
- Although some arylamines are known to be carcinogenic in humans and other mammals, **many substances of this large chemical class do not have carcinogenic activity.**
- Numerous studies have been conducted on the safety of hair dyes; the vast majority of these studies concluded **no association of hair dye use and an increased cancer risk.**