

Health Hazard Manual for

COSMETOLOGISTS

HAIRDRESSERS

BEAUTICIANS AND

BARBERS

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New York State Department of Labor Grants #4991, 5413.

ACKNOWLEDGEMENTS

Development and preparation of this manual has been funded by the New York State Department of Labor, Thomas Hartnett, Commissioner. Training and Education Program grants #4491, 5413 were received from the Hazard Abatement Board through the Division of Safety and Health.

I would like to thank William Scheider, Professor, State University of New York College at Buffalo, for his critical reading and helpful comments in preparing this manual; and Catherine Gawinski, Nona McQuay, Sheila Suggs, and Germain Harnden for assistance in typing, editing, and format design.

Illustrations are by Robert Durlak, New York State Department of Health, from photographs courtesy of Orleans-Niagara Board of Cooperative Educational Service West, Douglas Jank, Principal.

Printed in the public interest for New York State by the

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HEALTH HAZARDS MANUAL FOR COSMETOLOGISTS, HAIRDRESSERS, BEAUTICIANS AND BARBERS

Why hairdressers?

Because studies indicate that approximately 20% of hairdressers leave the profession due to health problems such as allergies or dermatitis. After such an investment in time, money, training, and experience - what a waste!

Because studies show that there is an increase in cancer risks and reproductive risks for hairdressers (male and female) compared to the general population.

But, if you knew in advance what problems could develop, you could take the appropriate precautions. Much of the information in this manual is not necessarily intended for immediate use, but can serve as a future reference or resource:

- to help you select products to minimize hazards;
- to ask intelligent questions when purchasing;
- to provide information on chemical exposures and routes of entry and how these are related to the use of appropriate ventilation, protective equipment (gloves), use, or form of a product;
- to help you read product material safety data sheets (MSDSs);
- to help you to troubleshoot health problems and trace possible work-related health problems.

While we look at product health hazards and case histories, see if the experiences of these hairdressers/cosmetologist/barbers sound familiar. Have they happened to you or others you know or have heard of who are in this profession?

We will look at the principal occupational health hazards and exposures themselves and some of the related issues. We will look closely at the chemical composition of hairdressing products to see what components appear to be particularly hazardous, how you are exposed to them, and what you can do to minimize exposure.

The health effects discussed for hairdressing products are based upon the exposure of the professional, not the consumer; for example, we will examine the health effects of hair dyes for the hairdresser who dyes hair several times a day, not for the patron whose exposure is once every one or two months.

We will not be looking at products used to clean the salon, but information on this subject is available upon request.

I REGULATIONS OF INTEREST TO COSMETOLOGISTS

Food, Drug and Cosmetic Act and the Coal Tar Exemption

The Food and Drug Administration (FDA) does not have the legal authority to require pre-market testing of products by their manufacturers. For cosmetics, the FDA has the burden of proof of demonstrating that a product is a hazard to the public rather than the industry demonstrating that their product is safe. Also, the FDA does not have the authority to require a cosmetic manufacturer to provide them with the necessary information to enable the FDA to conduct its own pre-market testing. Consumer products such as hair dyes which are sold for professional use in salons and shops, do not require the ingredients listed on the label.

If a cosmetic contains a substance considered to be adulterated, the FDA may ban or restrict its use. However, the FDA can only seize or restrict products after sufficient evidence is gathered (customer complaints/research) to prove a product harmful. This can be difficult because the FDA was not given the authority to require manufacturers to:

- register manufacturing plants or products;
- file data on a product's ingredients;
- file reports of injuries related to a cosmetic's use;
- test products for safety before marketing them.

How does the FDA find out about adverse reactions to cosmetics?

This is done by:

- direct consumer complaints;
- voluntary reporting by the cosmetics industry;
- the National Electronic Injury Surveillance System (NEISS) through which selected hospital emergency rooms make reports;
- surveys conducted under contract to the FDA, such as by the North American Contact Dermatitis Group (NACDG).

In 1938, due to the bright future of the coal tar derivative industry, both industry and labor argued successfully before Congress that coal tar dyes should be exempt from regulation. Therefore, coal tar-derivative colors are not regulated, even though there is information indicating that some of them are carcinogenic.

It should be noted that FDA warnings on products were primarily aimed at consumers who use hair dyes every few weeks, not at hairdressers who apply the products on a daily basis.

The OSHA Hazard Communication Standard

A principal complaint of cosmetologists, hairdressers, and barbers is the difficulty they have in obtaining information on the ingredients of the chemicals they work with. Without this information, it is difficult to:

- assess workplace hazards;
- trace health effects to their source;
- choose products so as to minimize hazards and avoid serious health problems.

More information on ingredients is required for sale of the same or similar products to consumers than is required for sale to professionals. This lack of information will hopefully be filled now that the Occupational Safety and Health Administration (OSHA) Hazard Communication Standard has been expanded to cover all workplaces. Expansion of the Standard was urged by groups such as the United Food and Commercial Workers International Union (AFL-CIO and CLC) and opposed by industry groups such as the Cosmetic, Toiletry and Fragrance Association.

The OSHA Hazard Communication Standard is an occupational safety and health regulation which was extended to all industry, including the service sector, as of August 24, 1987. The purpose of this regulation is to ensure that the hazards of all chemicals produced or imported are evaluated and that this information is transmitted to employers and employees.

This Standard requires the manufacturers and importers of chemicals to assess the hazards of the chemicals which they produce or import. Then, employers are required to provide information to their employees about the hazardous chemicals to which they are exposed by means of a hazard communication program, labels (and other forms of warning), material safety data sheets (MSDSs), and informative training. Distributors are required to transmit the required information to employers.

For cosmetologists, this means that the hazardous ingredients and health effects of the chemical products which you use are now available in the form of the above-mentioned MSDSs. The labeling of cosmetic products as covered by the Federal Food, Drug and Cosmetic Act has not changed. Chemical manufacturers, importers and distributors must provide MSDSs with every shipment of hazardous chemicals to employers after September 23, 1987. All employers must be in compliance with all provisions of this regulation by May 23, 1988.

You may wish to take advantage of this newly expanded Regulation to obtain material safety data sheets (MSDSs) on all the products you use by asking your distributor, manufacturer, or sales representative to provide them. Try to obtain MSDSs before you purchase products to compare them with respect to their health hazards. MSDSs are useful for writing bid specifications as well as to help you obtain the products you want. You may wish to deal only with manufacturers who respond to your requests for product information.



II AN OVERVIEW OF OCCUPATIONAL DISEASE TYPICAL OF HAIRDRESSERS

The principal health problems confronting hairdressers tend to involve:

- inhalation of solvents and dusts or particles resulting in allergies;
- skin contact with instruments or equipment;
- skin absorption of liquids or skin contact with dusts (this includes eye hazards as well);
- an elevated cancer risk compared to the general population;
- an increased risk of adverse reproductive effects relative to the general population;
- ingestion of hair dressing chemicals by holding combs, pins, or clips in the mouth while working.

Beauticians are especially exposed to the risks of sensitization (becoming allergic to the products or instruments that they work with). Generally speaking, atopic individuals, that is, individuals with a history of allergies prior to becoming cosmetologist, do not tend to do well as hairdressers. In small workplaces, if only one person experiences a health problem in relation to a product, that person tends to think of him/herself as an isolated case and the problem as not being work-related. In allergic-type reactions, only the sensitive individual will respond anyway, so numbers are not significant in indicating risk.

Adverse reactions to products seem to have changed over the years as the formulation of products has changed. For example, younger workers tend to have allergic contact dermatitis due to p-phenylenediamine and hair dyes; older workers tend to have allergies to formaldehyde. Allergies tend to develop faster in younger workers due to these chemicals. In fact, chronic exposure of young hairdressers to irritant effects of shampoos makes them more susceptible to allergic contact sensitization when they use dyes, waving solutions, and other chemicals later on. **This is why it is so important to inform young hairdressers and apprentices of the occupational risks with irritants and how to minimize these risks.**

Many allergic reactions to products involve fragrances and dyes used to color products which can be forestalled by using unscented products including those without masking fragrances, and by changing colors.

In most cases of occupational allergy, improvement tends to occur when away from the job as long as the exposure ceases; for example, you are not likely to see improvement with hairdressers sensitized to rubber gloves who continue to use them at home.

Health Studies

The following is a preview of major health problems in cosmetology arising from inhalation, skin contact, skin absorption, and long term exposure.

Inhalation: Particulates and solvents can be inhaled from the use of hairsprays (and other aerosol products), from the solvents and dusts from artificial nail preparations, or from the asbestos in some hair dryers. These exposures can lead to pulmonary and respiratory abnormalities; even cosmetologists with only a few years of exposure have shown early signs of chronic obstructive lung disease which appears as a reduction in the functional volume of the lung. You may wish to consider having your lung function evaluated with inhalation testing. Possible thesaurosis due to aerosol product use has been linked to an accumulation of inhaled nonbiodegradable polymers, especially PVP (polyvinylpyrrolidone) found in many hairsprays. Usually these lesions lessen when exposure is discontinued, but accumulation of these chemicals in the lower lung can result in alveolar-capillary-block syndrome, a condition in which the oxygen and carbon dioxide exchange is impaired between the lungs and blood.

Propellants, solvents, or solvent carriers such as fluorocarbons (Freon 11), methylene chloride, isobutane, propane and ethanol have been linked to a variety of adverse health problems. Because of the close contact between the air sacs of the lungs and the bloodstream, these chemicals enter the blood through inhalation and are carried throughout the body to cause effects on other body systems. Moreover, hydrocarbon propellants and solvents are highly flammable and can cause a blowtorch effect if ignited.

Skin Contact: Hairdressers tend to have a high rate of nickel allergy, and experience contact sensitization to the nickel in scissors. It may be possible to avoid this by using silver-plated scissors or scissors with plastic-coated handles. Contact allergy to rubber gloves is also a frequent cause of sensitization. This appears to be due to antioxidants in the rubber and could probably be avoided by using gloves of other materials such as PVC.

Skin Absorption: This is a major route of exposure for permanent hair dyes which may cause sensitization and thus allergies (skin rashes, asthma, etc.). They are considered mutagenic and thus potentially or definitely carcinogenic. Permanent wave solutions also tend to be absorbed through the skin; these are linked with sensitization and/or irritation. Another type of adverse skin effect is increased skin pigmentation (phytophotodermatitis) caused by perfumes and eau de cologne when followed by exposure to the ultraviolet light in sunlight.

Epidemiological evidence indicates that cosmetologists, hairdressers and barbers may experience an **elevated cancer risk** when compared to the general population for cancers of the bladder, lungs/respiratory system, digestive organs, breast and genitals; and a possible elevated risk of leukemia. The National Institute for Occupational Safety and Health (NIOSH) epidemiological studies show increased cancer incidence among cosmetologists, especially bladder cancer and multiple myeloma. The difficulty with these studies is that the risk covers the profession as a whole, but does not show which particular chemicals may be responsible among many potential exposures. However, bladder cancer, a predominantly male disease, has appeared in textile dyeing workers exposed to some of the same dyes.

The cosmetologist should avoid skin exposure to permanent hair dyes. Studies with animals have shown that dyes such as 2,4-diaminoanisole (4-methoxy-m-phenylenediamine) do penetrate the skin. Although substitute dyes have been suggested, a cautious use of substitutes is best since some of these are chemically, almost identical to the original chemical. Certainly protective gloves should be worn in working with these dyes. Although the International Agency for Research on Cancer (IARC) concluded that there was an elevated risk of cancer in those with occupational exposure to certain hair dyes (barbers and hairdressers), they suggested that the evidence was inconclusive relating specific cancer sites to hairdressing.

There appears to be a possible higher incidence of cancer of the larynx in males in this profession. Females appear to experience a higher incidence of uterus and ovarian cancer, stomach cancer and lung cancer. It is difficult to conclude from these studies if there is truly a higher incidence of lung cancer because some of these studies did not take into consideration smoking habits.

Exposure to carcinogens is not limited to the known ingredients in hairdressing products, but has also been linked with chemicals such as dioxane and NDELA (a nitrosamine), contaminants which are formed during the manufacture of hair care products and cosmetics.

Reproductive Effects: Epidemiological studies indicate that there appears to be an increase in toxemia of pregnancy (a condition during pregnancy whose symptoms include high blood pressure, excessive protein in urine, and leg swelling), miscarriages, premature deliveries and smaller babies among cosmetologists.

III SHAMPOOS AND CONDITIONERS

Shampoos

At the base of each hair follicle are the sebaceous glands which secrete the oily substance called sebum. Sebum passes along the hair shaft by capillary action and coats the hair with a greasy layer. It lubricates and conditions hair, but tends to collect dirt. Therefore, cleaning the hair involves the removal of this greasy layer of sebum. This is usually done with liquid shampoos consisting of surfactants (detergents) along with additives such as colors, fragrances, preservatives, anti-dandruff agents, opacifiers, viscosity modifiers, solubilizers and conditioners (which may be packaged separately as cream rinses.)

Principal Surfactants: Their purpose is to foam and clean hair. These are generally surfactants (detergents) based on sulfated fatty alcohols (such as lauryl and myristyl alcohols) and give rich foams. Some manufacturers feel that triethanolamine- or ammonium-laurylsulfate should be preferred over sodium-laurylsulfate. Sodium-laurylsulfate is believed to be too harsh, despite its better degreasing action. This harshness could also be overcome by coupling sodium lauryl sulfate with conditioners or other surfactants such as:

- sodium lauryl sulfate;
- sodium laureth sulfate;
- triethanolamine (TEA) lauryl sulfate;
- diethanolamine (DEA) lauryl sulfate;
- monoethanolamine (MEA) lauryl sulfate;
- ammonium lauryl sulfate;
- polyethylene glycol sulfates.

Modifying Surfactants: Modifying additives may be used to improve foam characteristics, improve condition of hair, modify eye-irritancy effects of primary surfactant, or improve cleansing power. These are usually other detergents used as secondary surfactants, such as fatty acid alkanolamides; usually ethanolamides of lauric, myristic, palmitic, stearic or oleic acids. Most commonly used is lauric monoethanolamine. Others include:

- monoglyceride sulfates;
- secondary alkyl sulfates;
- sodium decyl (or dodecyl) benzene sulfonate;
- alkyl sulfosuccinates such as sodium dioctyl sulfosuccinate;
- isothionates;
- cocamides such as cocamide DEA;
- methyl taurides;
- acyl amino acids or acyl peptides;
- acyl sarcosines;
- amine oxides, such as lauramine oxide.

Opacifiers: These give the shampoos an opaque or pearlized appearance, rather than transparent. Cream shampoos may actually be liquid shampoos to which an opacifier is added for a thicker appearance. These include:

- glycol stearates such as polyethylene glycol 400 stearate;
- metal stearates such as magnesium stearate;
- alkylolamides such as stearic amides;
- stearyl alcohol;
- cetyl alcohol.

Viscosity Modifiers: These modifiers make the shampoo more viscous so it is thicker and less able to flow easily. Examples are:

- electrolytes such as sodium chloride;
- alkylolamides;
- sodium stearate;
- stearic amides.

Solubilizers - Couplers: If present, these enable the product to stay mixed, that is, keep the ingredients from separating, such as:

- ethyl alcohol;
- isopropyl alcohol;
- glycerol;
- propylene glycol monethyl ether;
- diethylene glycol monoethyl ether.

Preservatives: These are usually germicides which are used because mild surfactants readily spoil. The choice of germicide is important since some detergents tend to interfere with the antibacterial action of some germicides. Preservatives include:

- p-hydroxy benzoic acid and its esters (methyl or propyl paraben);
- formaldehyde;
- 2-bromo-1, 2-diol (Bronopol);
- methyl- or methylchloro-isothiazolinone;
- dibromosalicylanilide;
- bithionol.

Anti-Dandruff Agents: The causes of dandruff are not yet fully understood; many of them are not microbiological in origin, yet the majority of anti-dandruff preparations tried have been germicidal. Sometimes the white scale called dandruff is actually residue from incomplete rinsing of the hair after shampooing. Anti-dandruff additives include:

- salicylic acids such as dibromosalicylanilide;
- resorcinol;
- hexachlorophene;
- cadmium oxide;
- tellurium oxide;
- selenium disulfide;
- zinc pyridinethione, zinc pyridinium-thiol-N-oxide (Zinc Omadine);
- zinc undecylenate;
- undecylenic acid and diethanolamine (Loramine DU185);
- sodium salt of undecylenic acid monethanolamide sulphosuccinate (Loramine SBU185);
- trimethyl-mercapto-4-cyclohexene-2,2-dicarboximide;
- quaternized polythionates;
- hydroquinolines;
- tar;
- biphenamine hydrochloride;
- polyvinylpyrrolidone-iodine complexes;
- allantoin.

Conditioners

These are cationic compounds (positively-charged) which are used to counteract the anionic (negatively-charged) nature of shampoo which causes the tangling of hair and static fly-away. Conditioners increase the lubricity of hair making wet combing easier and make the texture smoother. Protein-containing conditioners add body, gloss and luster to hair. Conditioners include:

- beer;
- egg;
- balsam;
- proteins such as hydrolyzed animal proteins;
- lanolin;
- polyvinylpyrrolidone (PVP);
- silicones;
- modifying surfactants (see page 8);
- stearyldimethyl benzylammonium chloride;
- glyceryl esters;
- glycol esters.

Adverse Health Effects Associated with Shampoos and Conditioners

Skin irritation, dermatitis or allergies associated with shampooing may result from the detergents/surfactants or additives such as preservatives, fragrances or colors. The hairdresser experiences repeated exposure to the hands while shampooing which may involve many cycles per day of wetting and defatting with removal of natural skin oils by detergents and drying. In addition to this, some shampoo ingredients (such as isopropyl myristate and triethanolamine) are skin irritants. Irritant dermatitis, the most common form of dermatitis in hairdressers, is especially prevalent among the younger workers such as apprentices and appears to be due to shampooing. The younger or newer workers in a salon tend to be the ones doing a large proportion of shampooing, rather than other hairdressing tasks.

Allergic contact dermatitis to germicides in shampoos has been associated with formaldehyde, isothiazolines and dibromo-salicylanilide. Individuals sensitive to dibromosalicylanilide may also be sensitive to other germicides such as hexachlorophene and bithionol.

Some coal tar-derived colors used in shampoos may be carcinogenic. Shampoo colors and fragrances have also been found to sensitize. Some fragrances have also been linked with increased skin pigmentation.

Case History: *occupational allergy to lavender oil*

“An 18-year old female hairdresser had a red, scaly, itchy dermatitis on the back of her hands and fingers and front of the wrists. She had worked as an apprentice hairdresser for 4 years, mainly shampooing but also in contact with permanent wave liquids and dyes. She usually had dry fissured skin on the back of the hands, but in the previous 6 months it had become worse with extension to the fingers and itching. She had a history of nickel allergy but not atopy (inherited allergy). She was patch tested with the standard and hairdresser's series with several shampoos and other products with which she was in contact in her job. The lavender shampoo was the one she used several times a day. Although we could not obtain its composition from the manufacturer, she was patch tested some weeks later with lavender oil and several formaldehyde release preservatives. A strong positive reaction to lavender oil was observed.”¹

Allergies to other hairdressing chemicals can be enhanced by shampoo exposures. For example, allergies to hair dyes can be aggravated by handling the detergents in shampoos. Chronic exposure of young hairdressers to the irritant effects of shampoos seems to make them more susceptible to allergic contact sensitization when they later use dyes, waving solutions and other chemicals.

¹Brandao, F.M. Occupational allergy to lavender oil. *Contact Dermatitis* 15(4): 249. 1986.

Protection and Prevention

Product Substitution:

- Try milder detergents such as lauryl sulfates buffered with monoethanolamine, diethanolamine, triethanolamine or ammonium ions.
- Try different preservatives; avoid formaldehyde or formaldehyde-releasing preservatives and use parabens or isothiazolinones instead.
- Try different fragrances or avoid scented products or those containing a masking fragrance. Try unscented products. Change fragrance families.
- Consider natural rather than artificial colors. Avoid coal tar-derived colors.
- Change color families. For example, D & C Green No. 5 is an anthraquinone color and is a possible skin irritant. An individual who reacts to one anthraquinone color, may react to others of this family.

Protective Equipment:

- Wear protective gloves when using shampoos or conditioners.

IV HAIR COLORING: DYES AND RINSES

Hair colorants are usually classified according to how long the color lasts and how durable it is on the hair. There are temporary, semi-permanent and permanent colors - these also imply the degree of coverage of depth of coloring. We will look at each color type in detail below. Chemical names for dye components are given below to assist you in interpreting labels and material safety data sheets (MSDSs).

Temporary Coloring Preparations

These are typically applied in shampoos (rinses) or hair sprays. They are temporary dyes because they only produce a film over the hair shaft, so the color tends to be completely removed by the first shampooing. These products generally contain 0.5 - 2.0% of color, but may also contain urea or other compounds which increase the solubility of the color in the shampoo or hairspray.

There are 3 types of rinses:

water soluble acid dyes (generally azo dyes; see table below) with weak acids (such as citric or tartaric) in an shampoo base;

basic dyes, such as methylene blue, rhodamine, safranin, Bismark brown, chrysoidine, methyl violet, thioflavine or nigrosine; and

combination (anionic/cationic) complexes.

Colors Used in Temporary Hair Coloring¹

FDA Designation	Classification	Color Index No.	Common Name
FD&C Yellow No. 5	pyrazolone	19140	Tartrazine
FD&C Yellow No. 6	monoazo	15985	Sunset Yellow FCF
D&C Orange No. 4	monoazo	15510	Orange II
Ext D&C Orange No. 3	monoazo	14600	Orange I
FD&C Red No. 4	monoazo	14700	Ponceau SX
Ext D&C Red No. 8	monoazo	15620	Fast Red S or A
D&C Red No. 13	monoazo	15630	Lithol Red Sr
D&C Red No. 22	xanthene	45380	Eosin YS, Eosin G
FD&C Green No. 3	triphenylmethane	42053	Fast Green FCF
FD&C Blue No. 1	triphenylmethane	42090	Brilliant Blue FCF
FD&C Violet No. 1	triphenylmethane	42640	Wool Violet 5BN or Acid Violet 6B
D&C Brown No. 1	disazo	20170	Resorcin Brown

¹NIOSH (National Institute for Occupational Safety and Health). Information Profiles on Potential Occupational Hazards. Volume III, Industrial Processes. Publication SRC TR 80-610. July, 1980.

Semi-permanent Coloring Preparations

These are also typically applied in shampoos, but tend to dye more deeply and are retained longer by the hair. This occurs because they penetrate the hair somewhat and are only gradually washed out by repeated shampooing. They may be applied as rinses or used full strength and left on the hair for 5-30 minutes before being rinsed out. Many of these dyes are the same chemicals used in permanent oxidation dyes but without the addition of the oxidizing agent. These tend to be aromatic, nitro and amino dye compounds such as the nitrophenylenediamines or nitroanilophenyls. Some color directly, while others react with oxygen in air to produce colored compounds. Some also contain metal-complex dyes, usually azo dyes complexed with either cobalt or chromium; the metal is bound within the molecule and does not appear to cause sensitization.

Permanent Coloring Preparations

These almost exclusively use oxidation dyes to produce a permanent color which lasts until the hair grows out. Typically this is a two-part preparation: an alkaline solution of dye intermediates (small colorless molecules) is mixed with an oxidizing agent (usually peroxide) just before application to the hair. The alkali cause the hair to swell, allowing dye penetration. The coloring preparation contains dye "intermediates" because the dye pigment is formed within the hair by a chemical reaction. Within the hair shaft, the dye oxidizes to form a lightfast pigment in the hair itself. The resulting giant colored molecules are too large to exit through the hair cuticle and thus remain inside the hair cortex.

The permanent chemical oxidation type dyes consist of the dye intermediates, color modifiers/couplers, color vehicles, solubilizing agents, conditioners and antioxidants; the separate oxidizing agent, a developer, is added just before application to the hair.

Oxidation dye intermediates are the main color producers; generally p- and o-benzenediamines such as p-phenylenediamine; 2, 5-diaminotoluene; p-amino-diphenylamine; or other diamino and phenolic amines are used to produce intense shades (see table on following page). These so-called "para dyes" (indicated by "p-" or 4-amino. . .) are usually used for black shades or as mixtures for lighter shades. Permanent coloring preparations typically contain 1 to 4 % of dye intermediates.

Color modifiers/couplers such as m-diamines, m-aminophenols, naphthols, or polyhydroxyphenols also function as antioxidants, stabilizers and chemical timers to control the rate of color development.

Color vehicles or dye bases are the aqueous solutions of soaps or detergents which enable the product to wet the hair, spread and penetrate as needed. These are ammonium oleate soap, alkanolamides, fatty alkyl sulfates, fatty acid-polypeptide condensates, or oxyethylated fatty alcohols.

Solubilizing agents are used to increase the solubility of the dye intermediates; usually propylene glycol, ethyl alcohol or isopropyl alcohol.

Conditioners enable more even coloring by decreasing the porosity of the hair cuticle or replacing it as a filler if it has been damaged or lost. These are usually glycerol lanolin, oleyl alcohol or cetyl alcohol or cetyl alcohol.

Antioxidants, which help to prevent premature oxidation for better color control, may be sulfite or bisulfite compounds (such as sodium sulfite) or thioglycolic acid.

pH adjusters such as ammonium hydroxide, are used to make the dye base more basic or caustic (pH 9) to swell the hair cuticle and enable dye penetration.

The **oxidizing agent** or developer is usually hydrogen peroxide (a 6% solution) because it is easy to use, completely oxidizes the dyes, is fairly safe to work with, does not produce undesirable by-products. Urea peroxide is the typical oxidizer in cream type developers.

Colors Produced by Various Oxidation Dye Intermediates, Color Couplers and Modifiers

BLACK	DARK/MEDIUM BROWN
p-aminodiphenylamine	p-aminodiphenylamine
p, p' -diaminodiphenylamine	o-aminophenol
2,5-diaminophenol-4-sulfonic acid	p-aminophenol
1,8-diaminonaphthalene	N-(p-aminophenyl)-glycine
o-phenylenediamine	o-anisidine
p-phenylenediamine	2,4-diaminophenol
m-toluenediamine	N,N-dimethyl-p-phenylenediamine
p-toluenediamine	N-(p-hydroxyphenyl)-glycine
	p-methylaminophenol
	4-nitro-o-phenylenediamine
	m-phenylenediamine
	p-phenylenediamine
LIGHT BROWN	REDDISH
o-aminophenyl	2-amino-4-nitrophenol
p-aminophenol hydrochloride	4-amino-2-nitrophenol
p,p'-diaminodiphenylamine	2,4-diaminophenol
2,4-diaminophenol	4,6-dinitro-2-aminophenol
2-nitro-p-phenylenediamine	5-nitro-m-phenylenediamine
m-phenylenediamine	4-nitro-o-phenylenediamine
p-phenylenediamine hydrochloride	2-nitro-p-phenylenediamine
p-tolylenediamine	2,4,6-trinitroaniline

BLONDS

p-aminodiphenylaminesulfonic acid
4-amino-2-nitrophenol
p-aminophenol hydrochloride
2-aminophenol-4-sulfonic acid
4-aminophenol-2-sulfonic acid
5-aminophenol-2-sulfonic acid
2,5-diaminophenol-4-sulfonic acid
N-(2-hydroxy-5-nitrophenyl)glycine
N-(p-nitrophenyl) glycine
m-phenylenediamine hydrochloride
p-phenylenediamine sulfate

BLUE/GRAY MODIFIERS

p-aminodiphenylamine hydrochloride
N-(p-aminophenyl)-glycine
2,4-diaminoanisole (also called 4-MMPD or 4-methoxy-m-phenylene-diamine)
p,p'-diaminodiphenylmethane
2,4-aminophenetole
1,5-naphthalenediol
m-phenylenediamine
procatechol
pyrogallol
resorcinol
p-tolylenediamine

There are also one-part preparations which are oxidation dyes not requiring chemical oxidation. Considerable research has gone into developing dyes of this type which can be used under normal (non-oxidizing) conditions, without adding the oxidizing agent or developer. Oxidation dyes which do not require chemical oxidation may be:

- aromatic polyhydroxy compounds (di- and trihydroxybenzene derivatives);
- aromatic polyamino compounds (substituted diaminobenzenes, aminophenols, polyaminophenols, polyamino benzenes);
- substituted naphthalene compounds (aminohydroxynaphthalene);
- substituted pyridine compounds.

Another type of permanent coloring is the metallic dye made of metals which form insoluble metal oxides and/or sulfides. Lead acetate is the most commonly used; others are silver, nickel, cobalt, bismuth, copper, or iron salts.

Also, one type of permanent dye is the vegetable dye such as henna, a potential sensitizer source of occupational asthma.

Adverse Health Effects Associated With Hair Colorants

When considering the adverse health effects of hair dyes, consider not only how severe the health effect can be, but also how frequently you are exposed. Where available, the health effects discussed here were drawn from the actual experiences or health studies of hairdressers; however, the skin absorption and resulting health effects (such as cancer-causing potential) are the result of studies examining adverse effects on the person whose hair is being dyed; that is, effects on the consumer or patron. Some of the effects on the professional whose work involves repeated exposure to dyes may have to be inferred from the effects of dyes on textile workers and on patrons.

Serious injury or possible blindness could result if hair coloring chemicals are accidentally gotten into the eyes. Ammonia-containing pH adjusters can severely injure the eyes, especially strong ammonia solutions, because ammonia has a particular tendency to penetrate the cornea and damage the deeper structures within the eye. Speed is essential in washing the eye immediately with clean water. Strong ammonia solutions can also burn the skin; weak solutions, especially upon repeated exposure, can cause skin irritations. Hydrogen peroxide is also irritating to the eyes and can cause skin irritations; immediate flushing with water is necessary.

Dyes and color modifiers can be sensitizers; that is, can cause allergic reactions such as rashes and other skin irritations. Those dyes and modifiers with the amine in the para position (the "para" dyes discussed above) tend to be sensitizers. In fact, intolerance to "para" dyes is the most frequent of all sensitizations observed in hairdressers. The reaction is a dermatitis which appears most often on the left hand between the index and middle finger and on the dorsal face of the last three fingers; the hairdresser holds the hair being dyed between the index and middle fingers which can then contaminate the other fingers. p-Penylenediamine has been known to be an allergen since 1898. Suggested substitutes for it, such as p-toluylenediamine, p-aminophenol and diaminophenol, also tend to be allergenic, as is p-aminodiphenylamine (Diphenyl Black). See the table for other "para" dyes entitled "Colors Produced by Various Oxidation Dye Intermediates, Color Couplets and Modifiers" on page 18.

Reactions to henna tend to be asthmatic involving sneezing, nasal congestion, runny nose, cough, chest tightness, or wheezing when exposure occurs to the henna powder during mixing or preparation of the dye.

Case History:

"S.K. aged 21 years....had worked as a hairdresser for about 5 years, dealing almost exclusively with hair bleaching and tinting. Over the last year she noticed that she would get marked rhinitis and conjunctivitis soon after she, or someone else in the salon, used henna. She was largely free of symptoms away from work. Recently her symptoms had become so bad that she could only manage 3 days work in 5. She later changed her job and her problem was resolved."¹

Allergy to dyes can be enhanced by handling detergents (such as shampoo) or irritants (such as thioglycolic acid in liquids from permanents). Permanent liquids can induce sensitization to dyes. For example, hairdressers which used cold perms for several months could not then handle dyes which their skin had previously tolerated.

¹Pepys, J.; Hutchcroft, B.J.; and Breslin, A.B.X. Asthma due to inhaled chemical agents - persulphate salts and henna in hairdressers. *Clinical Allergy*. Vol. 6, pages 399-404. 1976.

