

THE CHEMISTRY OF PERMANENT HAIR DYES

There are a number of different types of hair dyes, but the most commonly used are permanent (oxidative) dyes. These dyes have a range of different components that react with each other to produce the desired end colour. In this graphic, we examine some of these chemicals, and how they form dyes.

1 PRIMARY INTERMEDIATES



p-PHENYLENEDIAMINE (PPD) & p-AMINOPHENOL

All permanent hair dyes contain a 'primary intermediate'; these are often p-diamines or p-aminophenols. They are oxidised by hydrogen peroxide to give reactive species which then go on to react with couplers to produce dyes. The exact structure of the reactive species produced by oxidation is still the subject of some debate.

2 OTHER COMPOUNDS



HYDROGEN PEROXIDE, AMMONIA, & ETHANOLAMINE

Hydrogen peroxide is the agent responsible for oxidation of primary intermediates, and also lightens the natural pigments present in the hair, the melanins eumelanin and pheomelanin. The dye-forming reactions are carried out at an alkaline pH, which is why ammonia is also required in the dye mixture. This raised pH causes the hair cuticle to swell, which in turn allows hydrogen peroxide and dye molecules to pass into the cortex. Ethanolamine can be used as an alternative, milder alkaline agent.

3 COUPLING AGENTS



RESORCINOL
BROWN YELLOW



m-AMINOPHENOL
LIGHT BROWN



2,6-DICHLORO-1,4-DIAMINO-BENZENE
BROWN



p-TERPHENYLENEDIAMINE
DARK BROWN



1,4-DIAMINODIPHENYL ETHER
PURPLE BLUE



1,2-DIAMINONAPHTHALENE
BLACK Violet



1,8-DIAMINONAPHTHALENE
BROWN



1,4-DIAMINONAPHTHALENE
DARK BLUE



m-TERPHENYLDIAMINO-BENZENE
DARK BROWN



p-AMINODIPHENYL ETHER
DARK RED

Coupling agents, also referred to as colour couplers, are the other component in the dye mixture. Independently, they contribute little in the way of colour, but they can react with primary intermediates in the presence of an oxidising agent to produce dye molecules, some examples of which are shown below. Most dyes will contain a mix of different coupling agents, rather than just one. Primary intermediates can, in some cases, couple to themselves to produce colouration. In the end, multiple different dye products are formed from a single formulation of hair dye.



GREEN INDO DYE
INDO-PTO & RESORCINOL



BROWN INDO DYE
INDO-PTO & m-AMINOPHENOL



MAGENTA INDO DYE
INDO-PTO & p-AMINODIPHENYL ETHER



Hair Dye Chemical Composition

H. Stanley Redgrove, Gilbert A. Foan



Hair Dye Chemical Composition:

Hair-Dyes and Hair-Dyeing Chemistry and Technique H. Stanley Redgrove, Gilbert A. Foan, 2013-09-17 Hair Dyes and Hair Dyeing Chemistry and Technique the result of a collaboration between a chemist and a practical hairdresser is the most complete treatise on the subject which has been written in any language and one moreover which will fill a very real need The book is organized into four parts Part I discusses the structure and pigments of the hair Topics covered include the hair root the sebaceous glands the hair shaft the chemistry of color and the problem of hair dyeing in relation to structure Part II deals with the nature composition and uses of hair dyes bleaches and decolorants It includes discussions of the ethics and aesthetics of hair dyeing hair bleaching the preparation and use of kohl and hair restorers Part III takes up the practical art of hair dyeing It discusses the techniques of wet shampoo dry shampoo oil shampoo hair drying hair bleaching the application of liquid dyes and henna dyeing Part discusses the causes of gray hair along with tips for those who want to avoid premature grayness Encyclopedia of Color Science and Technology Renzo Shamey, 2023-09-29 This fully revised and expanded 2nd edition provides a single authoritative resource describing the concepts of color and the application of color science across research and industry Significant changes for the 2nd edition include New and expanded sections on color engineering More entries on fundamental concepts of color science and color terms Many additional entries on specific materials Further material on optical concepts and human visual perception Additional articles on organisations tools and systems relevant to color A new set of entries on 3D presentation of color In addition many of the existing entries have been revised and updated to ensure that the content of the encyclopedia is current and represents the state of the art The work covers the full gamut of color the fundamentals of color science the physics and chemistry color as it relates to optical phenomena and the human visual system and colorants and materials The measurement of color is described through entries on colorimetry color spaces color difference metrics color appearance models color order systems and cognitive color The encyclopedia also has extensive coverage of applications throughout industry including color imaging color capture display and printing and descriptions of color encodings color management processing color and applications relating to color synthesis for computer graphics are included The broad scope of the work is illustrated through entries on color in art conservation color and architecture color and education color and culture and biographies of some of the key figures involved in color research throughout history With over 250 entries from color science researchers across academia and industry this expanded 2nd edition of the Encyclopedia of Color Science and Technology remains the most important single resource in color science **Hair-Dyes And Hair-Dyeing Chemistry And Technique** H. Stanley Redgrove, 2011-10-25 This early works on Hair dying contains a wealth of information on the subject it was originally published in 1929 under the title Blonde or Brunette In the making of this book a chemist and a practical hair dresser have collaborated and we believe that we have produced the most comprehensive treatise on the subject which has been written in any language and one moreover which

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Handbook of Biological Dyes and Stains R. W. Sabnis, 2010-04-07 A complete up to date resource of information on more than 200 dyes and stains Handbook of Biological Dyes and Stains is the most comprehensive volume available on the subject covering all the available dyes and stains known to date in the literature for use in biology and medicine Top dye expert Dr Ram Sabnis organizes the compounds alphabetically by the most commonly used chemical name He presents an easy to use reference complete with novel ideas for breakthrough research in medical biological chemical and related fields This is the first book to give the CAS registry number chemical structure Chemical Abstracts index name all other chemical names Merck Index number chemical dye class molecular formula molecular weight physical form solubility melting point boiling point pH range color change at pH pKa absorption and emission maxima of dyes and stains as well as to provide access to synthesis procedures lab scale and industrial scale of dyes and stains This user friendly handbook also features references on safety toxicity and adverse effects of dyes and stains on humans animals and the environment including acute chronic toxicity aquatic toxicity carcinogenicity cytotoxicity ecotoxicity genotoxicity hepatotoxicity marine toxicity mutagenicity nephrotoxicity neurotoxicity oral toxicity phototoxicity phytotoxicity The use of biological dyes and stains has extremely high potential in today s business environment This makes Handbook of Biological Dyes and Stains a convenient must have reference Its staining biological and industrial applications make it a vital resource for industrial and academic researchers the book also serves as a valuable desktop reference for medical professionals biologists chemists chemical optical engineers physicists materials scientists intellectual property professionals students and professors

Chemical and Physical Behavior of Human Hair Clarence R. Robbins, 2012-02-23 Human hair is the subject of a remarkably wide range of scientific investigations Its chemical and physical properties are of importance to the cosmetics industry forensic scientists and to biomedical researchers The fifth edition of this book confirms its position as the definitive monograph on the subject Previous editions were recognized as concise and thorough Journal of the American Chemical Society an invaluable resource Canadian Forensic Science Society Journal and highly recommended Textile Research Journal Chemical and Physical Behavior of Human Hair is a teaching guide and reference volume for cosmetic chemists and other scientists in the hair products industry academic researchers studying hair and hair growth textile scientists and forensic specialists Features of the Fifth Edition Recent advances in the classification and characterization of the different proteins and genes in IF and keratin associated proteins in human hair are described The mechanism and incidence of hair growth and loss and hair density vs age of males females are described for Asians Caucasians and Africans in different scalp regions Details of hair surface lipids and cuticle membranes provide a better understanding of the surface and organization of the CMC and its

involvement in stress strain is presented Recent evidence demonstrates a more bilateral structure in curly hair and a more concentric arrangement of different cortical proteins in straighter hair SNPs involved in hair form curl and coarseness and pigmentation and genes in alopecia and hair abnormalities are described The latest biosynthetic scheme for hair pigments and structures for these and the different response of red versus brown black pigments to photodegradation is described A new method for curvature on 2 400 persons from different countries and groups is used to assign curvature throughout this book Additional data for age and effects on diameter ellipticity elastic modulus break stress and other parameters are presented with much larger data sets featuring statistical analyses Hair conditioning strength breakage split ends flyaway shine combing ease body style retention manageability and feel parameters are defined and described A new section of different life stages by age groups considering collective and individual changes in hair fiber properties with age and how these affect assembly properties Databook of Rheological Additives Anna Wypych, George Wypych, 2022-03-15

Rheological additives are commonly applied in a wide range of industries and this databook provides readers with information on over 300 organic and inorganic additives This information is presented in individual tables for each product whether commercial or generic The data are divided into five groups those being General Information Physical Properties Health and Safety Ecological Properties and Use Performance The following information is included in each section General Information name CAS EC IUPAC name common name common synonyms acronym biobased cellulose functionality charge degree of substitution empirical formula chemical structure molecular mass RTECS number chemical category product class product composition moisture content and solids content Physical Properties state odor color bulk density density specific gravity relative density boiling point melting point pour point decomposition temperature glass transition temperature refractive index vapor pressure vapor density volume resistivity relative permittivity ash content pH viscosity rheological behavior absolute viscosity surface tension hydration time solubility in solvents solubility in water the heat of combustion the heat of decomposition specific heat thermal conductivity Henry's law constant particle size and volatility Health Safety NFPA classification HMIS classification OSHA hazard class UN Risk phrases UN Safety phrases UN NA class DOT class ADR RIC class ICAO IATA class IMDG class packaging group shipping name food approvals autoignition temperature self accelerating decomposition temperature flash point TLV ACGIH NIOSH and OSHA maximum exposure concentration IDLH animal testing oral rat rabbit dermal mouse oral guinea pig dermal rat dermal rat inhalation mouse inhalation ingestion skin irritation eye irritation inhalation first aid eye skin and inhalation carcinogenicity IARC NTP OSHA ACGIH and mutagenicity Ecological Properties biological oxygen demand chemical oxygen demand theoretical oxygen demand biodegradation probability aquatic toxicity algae Rainbow trout Sheepshead minnow Fathead minnow and Daphnia magna and partition coefficient Use Performance manufacturer product feature recommended for polymers recommended for products outstanding properties compatibility limitations a typical reason for use processing methods the concentration used storage temperature and food

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Hair-dyes and Hair-dyeing Chemistry and Technique Herbert Stanley Redgrove, Gilbert Arthur Foan, 1934

The Chemistry and Applications of Sustainable Natural Hair Products Kalyani Barve, Apurva Dighe, 2016-01-27

This book investigates the relationship between phytoconstituents and properties in specific plants such as Hibiscus rosa sinensis Cuscuta reflexa Citrullus colocynthis Nardostachys jatamansi and Ocimum gratissimum that are used in hair care

products including shampoos conditioners dyes and oils It explains the impact of these materials on the growth structure appearance and health of hair It also explores how the chemistry of certain plants from sustainable sources is exploited for use in hair products and nutraceuticals Additionally the authors include information on ingredients used for formulating green hair products that treat common conditions such as canities dandruff and alopecia **The Hair, Its Growth, Care, Diseases and Their Treatment** Charles Henri Leonard,1879

Color Trade Journal and Textile Chemist ,1922
American Druggists' Circular and Chemical Gazette ,1909 **Color Trade Journal** ,1922 **Index of patents** ,1926 *Commissioner of Patents Annual Report* United States. Patent Office,1926 The Science of Hair Care Claude Bouillon,John Wilkinson,2005-02-28 The most comprehensive source on the subject this Second Edition is completely revised and expanded to reveal the most recent advances technologies and trends in hair and hair care science tracking the development of hair care products the emergence of new regulatory practices and the latest methods in product safety and efficacy assessment Annual Report of the Commissioner of Patents United States. Patent Office,1925 Prior to 1862 when the Department of Agriculture was established the report on agriculture was prepared and published by the Commissioner of Patents and forms volume or part of volume of his annual reports the first being that of 1840 Cf Checklist of public documents Washington 1895 p 148 American Sheep Breeder and Wool Grower ,1921

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