Chapter 7

Some Textile Dyeing Materials (Methylene Blue, Malachite Green and Crystal Violet) and Their Effects on Health

Ali Rıza Kul[1]

Saadet Yeşiltaş[2]

Neşegül Aybar[3]

Veysel Benek[4]

Abstract

Dyes are substances that produce color in the most appropriate way and cause changes in the structure of substances. In leather, pharmaceutical, food, cosmetics, textile factories , etc. It is widely used. Although it is estimated that around 7x105 tons of dyestuffs are produced annually worldwide, the majority of dyestuffs produced (54%) are used in the textile industry. As a result, approximately 10-15% of the paint used in the dyeing process ends up in wastewater. Dyes, It is resistant to light, temperature and oxidative deterioration. Therefore, dyes are not biodegradable, which causes negative toxic effects in wastewater, the environment and human health. The decrease in the amount of dissolved oxygen in water negatively affects the habitat of aquatic life. This materials are not biodegradable , live potentially for organisms toxic to be And some of dyes carcinogenic to be It poses a serious threat to human health due to threatening. In this study, the usage areas, physicochemical structures and health effects of malachite green, crystal violet and methylene blue dyes were examined in detail.

1 Yüzüncü Yıl University, Vocational School of Health Services, Department of Health Care Services, Van, alirizakul@yyu.edu.tr, ORCID:0000-0001-9331-775X

2 Yüzüncü Yıl University, Science Teacher, Van, zilan.saadet@hotmail.com ORCID:0009-0009-9830-0768

3 Yüzüncü Yıl University, Science Teacher, Van, aybarnesegul65@gmail.com ORCID:0009-0002-5451-3197

4 Yüzüncü Yıl University, Science Teacher, Van, vbenek@gmail.com, ORCID:0000-0002-8523-6922

https://doi.org/10.58830/ozgur.pub387.c1602

1.INTRODUCTION

1.1 Dye

Fabric, fiber or similar materials to color the organic substances used for dyeing are called dyes. However, not every substance gives color. And This Therefore it cannot be described as paint. Paints are created by mixing the binders without dissolving them and layer by layer without changing the structure of the material . These are mixtures applied in layers . This process is superficial and can be repaired by physical means . Dyes are substances that produce color in the most appropriate way and cause changes in the structure of substances . In leather, pharmaceutical, food, cosmetics, textile factories , etc. It is widely used . Paint is rubbed off the surface cannot be removed. This is because, of the paint physically or chemically with the surface of the material interaction is to enter (Önal and Tantekın , 2018, Aybar, 2023).

1.2 Dye Matter

Dyes are chemical substances that give color to materials or cause color changes. These substances are often used to color fabric, paper , plastic, leather, food, metal and other materials. These organic compounds are produced naturally from plant waste and animal skin, but most are produced synthetically. The use of dyestuffs has a wide range of industrial applications and is used for aesthetics, identification, security, marking and many other purposes. It is widely used in the food industry, textile industry, automotive industry and many other industries. Although it is estimated that around 7x105 tons of dyestuffs are produced annually worldwide, the majority of dyestuffs produced (54%) are used in the textile industry. As a result, approximately 10-15% of the paint used in the dyeing process ends up in wastewater (Oyar, 2020).

Textile dyes are chemical substances used to give color or color changes to textile materials. These substances are generally in liquid or powder form and provide coloration by interacting with textile fibers. Textile dyestuffs are widely used in coloring cotton, wool, silk, synthetic fibers and other textile materials. Color options and application methods are diverse, offering a wide range of colors and design possibilities in the textile industry.

The textile dyeing process generally begins with dissolving or dispersing the dyestuff in water. The textile material is then contacted with this dye solution. This interaction allows the dyestuff to adhere to the textile fibers.

The color is then fixed, usually by a fixing process, making the material washable and color-fast.

Cosmetic, It is widely used in many areas such as paper and textile. Environmental impact of paints used increasingly It is important. The most important of these environmental effects is industrial of wastewater important to the extent to contamination path trench (Aybar,2023).

Dyes; It is resistant to light , temperature and oxidative deterioration. Therefore, dyes are not biodegradable, which causes negative toxic effects in wastewater, the environment and human health potential quality carries (Karadağ, 2007; All Cebeci,2020).

Colored water disrupts its naturalness and reduces dissolved oxygen permeability. The decrease in the amount of dissolved oxygen in water negatively affects the habitat of aquatic life. This materials are not biodegradable , live potentially for organisms toxic to be and some of dyes carcinogenic to be It poses a serious threat to human health due to threatening (Karadağ, 2007; Tüm Cebeci, 2020).

These dyes, which are used in every aspect of life in daily routine, mix with water. Some of these dyestuffs.

2. MALACHITE GREEN

2.1 Structure

Malachite, consisting of basic copper carbonate it is a light green mineral. Malachite is a common copper ore. Each sometimes together with copper sulphides, especially chalcopyrite, and also this it is found at the end of oxidation in the upper parts of the deposits .

Malachite green (MG) is a synthetic color used in dyeing textiles such as silk, fabric , wool and leather. Cationic one it is paint and same in time fishery in the field It is also preferred as a fungicide. Molecular formula; C52H54N4O12 and its molecular weight is 927 mol /g (Benek.2022).

20. From the first quarter of the century popular halo incoming malachite green in water living and on land toxic to living animals , toxic to humans It has carcinogenic effects . Solubility in water increasingly high MG, which is broken down by microorganisms difficult therefore, it stays in water for a long time (Benek. 2022).

One of the reasons for the popularity of MG is its use in the treatment of parasites. Use and especially trout plays an effective role in the treatment of kidney diseases. This feature MG's use of lead to rapid increase has opened

however years as we go in the water paint concentration in has increased. This situation, some studies MG to the paint exposed remainder fish of your eggs in offspring A lot to abnormality From where is to show upon, America in 1978 Unified States to take some measures and MG use led to the limitation (Atamanalp , 2003; Tanyol, 2017; Uysal and Belibağlı , 2020).

2.2 Usage Areas

Used in silk, leather and paper dye. It prevents the fungal disease called saproleglia in fish eggs . It is used as a dye for microscopic analysis of cells and culture samples. Jimenez staining involves staining bacteria red with a dye. Malachite green, on the other hand, colors bacteria blue-green, making them more visible. Leuco-Malachite Green (LMG) is used to reveal seemingly missing blood in criminal activities. Hemoglobin in the blood reacts with hydrogen peroxide to form colorless LMG. Since the LMG is chromatic, the color turns green. This is how blood is dye. Direct staining of bacterial endospores . It is used as a pH indicator.

Laboratory Applications: Malachite green is used in biology and chemistry laboratories to color cells and tissues under the microscope.

Use as an Antiseptic: Malachite green can also be used in medical applications such as wound cleansing and treatment of skin infections due to its antiseptic properties.

Skin and Feather Coloring: It can be used in animal husbandry to color the skin and feathers. However, this application should generally be done in a controlled manner.

Textile Dyeing: Malachite green can be used in the textile industry to dye cotton, wool and other fibers.

Water Purification: In some cases , malachite green can be used in water purification processes to control bacteria and other microorganisms.

Biostaining: Used to identify cell nuclei and other cellular structures in biological samples. This is especially common in histology studies.

2.3 Physical Chemical Effects

Malachite green is Cu2(OH)2CO3. It is a copper-containing compound and is widely used as a colored pigment.

Malachite green malachite It does not contain minerals . their names origin simply of colors similar from being It is due to.

2.4 Effects On Health

Its structure is in the form of a green color called chromatic malachite green. After being absorbed into the body, it is converted into two different forms through metabolism. The first form is the carbinol form. The carbinol form has the ability to quickly cross cell membranes. Once inside the cells, it is converted to a form called leukomalachyte green (LMG). Although LMG is toxic , it remains in the body longer than other forms.

Malachite of green Carcinogenicity As a result of the test , two 100 ppb (parts per billion) throughout the year in concentration Tumor formation was observed in rats administered malachite green . Therefore It was concluded that this chemical is carcinogenic .

Health problems were reported in Canada in 1992 in people who consumed seafood containing malachite green.

This chemical in canada Class 2 (to health damaging being possibility of low) aspect classified. Because the chemical was found to cause liver tumors.

However, due to its low cost and ease of use malachite green In some countries it is now only about water in products is used . In research conducted in China, Taiwan and Hong Kong in 2005, it was revealed that this toxic substance was detected in fish. 2006 In the US Food and Drug Administration (Food oath Drug Administration (FDA).

The use of the chemical malachite green in water-related products forbidden is from china person consumption for imported made in fish detection was made specified. In June 2007, the FDA approved malachite they contain green for from china sea products banned its import .

Jimenez painting, staining bacteria red with a dye Contains. Malachite green colors bacteria blue-green. more visible to be provides. Leuco -Malachite green (LMG), crime in its activities seemingly loss bring out blood using for . Hemoglobin in blood, hydrogen peroxide with It reacts with colorless LMG . Since the LMG is chromatic , the color turns green. Blood This way makes. bacterial endospores directly dyeing. PH used as an indicator .

Malachite green is a dyestuff that carries potential health risks due to the copper salts it contains. Copper can be toxic when taken in excessive amounts . Exposure through inhalation or skin contact is one way in which such substances can harm health.

Overexposure to copper-containing substances such as malachite green can lead to gastrointestinal upset , difficulty breathing, skin irritation, and

other health problems. When working with such substances, appropriate safety precautions should be taken and exposure limits should be observed. Therefore, people working with such chemicals must follow safety procedures.

3 CRYSTAL VIOLET

3.1 Structure

Crystal Violet, with the molecular formula k, C25H30ClN3 and a molecular mass of 407.99 g/ mol , located in the triphenylmethane group , is a cationic dyestuff widely used in laboratory applications and microscopy studies.

3.2 Usage Areas.

Crystal violet offers a wide range of uses in textile applications such as silk and cotton dyeing, in dye and ink manufacturing, as a bacteriostatic agent in veterinary medicine, as a nutritional supplement as an anti-parasitic and anti-fungal agent in poultry, and as a disinfectant on human skin. In addition, since it is the active ingredient of gram stain and a protein dye, it is a dye that is frequently used in microbiology and to enhance bloody fingerprints.

Gram staining technique is a microbiological staining method used to distinguish bacterial species. With this technique, bacteria are easily identified and classified. The reactions of bacteria stained with the Gram staining technique share common features with bacterial groups that are closely related in terms of development. Recognition of bacteria is an important issue, especially in drug use. While some antibiotics affect especially gram-positive bacteria, some of them affect more gram-negative bacteria.

Gram-negative bacteria are bacteria that do not retain crystal violet dye during gram staining procedures. While gram-negative bacteria lose their blue color, gram-positive bacteria continue to retain the blue color even after washing with alcohol. Therefore, gram-positive bacteria are bacteria that turn very blackish blue and purple under the microscope after going through the gram staining process.

In fish farms, fish are given some chemicals and feed. These include the chemical compound crystal violet , which is given to fish eggs to make them strong against bacteria, fungi, various viruses and parasites . After the previously widely used malachite green compound was banned with new

legal regulations, crystal violet compound is used as an effective disinfectant today.

3.3 Physicochemical Properties

Located in the triphenylmethane group , it has the molecular formula C25H30ClN3 and a molecular mass of 407.99 g/ mol .

3.4 Effects On Health

Offering a wide range of uses, KV is a carcinogenic dye, and since it is cationic , it can cause eye irritation and permanent damage to the cornea. In extreme cases, it can cause respiratory problems and kidney failure (Saeed et al., 2010 ; Chakraborty et al., 2011).

Like malachite green, crystal violet compound is converted into two different forms by metabolism . When it quickly passes through cell membranes and enters the cell, it turns into another form called leuco crystal violet . In laboratories, in seafood products within the scope of chemical tests, leuko crystal Violet dyestuff analyzes are performed and LC-MS/MS method is used in these analyses.

Defined as liquid chromatography - mass spectrometry, this method is a chemical analytical method that combines the mass analysis capabilities of mass spectrometry with the physical separation properties of liquid chromatography . These studies are based on standards published by domestic and foreign organizations.

4.METHYLENE BLUE

4.1 Structure

Methylene blue is a dye that is chemically a type of organic compound. It is a dyestuff frequently used in the scientific world and also a medicine. It's chemical formula is C16H18ClN3S. Its molecular weight is 319.85 g/ mol . The structure of the compound contains an aromatic ring, methylene (CH3) groups and an azomethine (N=N) bond. It is used as a dyeing agent with coloring properties , especially known as a histology staining agent used to stain cells in biological studies.

Since it is used in the treatment of various diseases in the aquarium hobby, it is generally available in the form of solutions on the market. However, it is found in dark green crystal or powder form. Its solutions are dark blue in color. It has a light scent.

4.2 Usage Areas

Methylene blue is known as a dye and histology staining agent commonly used in laboratory and industrial applications. Here are some uses of methylene blue

Histology and Biology:

Methylene blue is frequently used as a histology staining agent used to examine cells and tissues under a microscope. This is important for examining biological samples and determining cell structures.

Microbiology:

Methylene blue is used as a staining agent in microbiological studies to identify bacteria and other microorganisms. It is especially widely used in the Gram staining method.

Veterinary Medicine:

Cell and tissue sample Water Analysis in animals: Methylene blue can be used to determine the presence of bacteria and microorganisms in water samples.

Textile Dyeing:

Methylene blue can be used in the textile industry to color fibers such as cotton, silk and wool.

Use as an Antiseptic:

Because it has antiseptic properties, it can be used in some cases to clean wounds and treat skin infections.

Factors to consider when using methylene blue are its potential for toxicity and the application of correct safety procedures. Its application and usage areas span a wide range of interdisciplinary fields. It can be used in veterinary medicine practices to examine the

4.3 Physicochemical Properties

Chemical Formula:

Methylene blue has the chemical formula C16H18N3SCl. Methylene blue, a cationic dye; C16H18N3SCl.3H2O and its molecular weight is 373.9 gmol-1 a strong adsorption ability (Gür,Demir ,Kul 2021).

Color and Appearance:

Methylene blue usually has a dark blue color and can often be found in solid crystal or powder form. Solubility: Methylene blue is generally soluble in solvents such as water and alcohol. This feature makes it easy to use, especially in laboratory applications.

pKa Value:

Because methylene blue contains an ammonium group, it can accept several different protons and therefore have various pKa values. These values vary depending on the acidic and basic environments in the solution.

Spectral Properties:

the UV- Vis spectrum, indicating the ability of methylene blue to absorb light at certain wavelengths .

Chemical Stability :

Methylene blue can remain stable under some conditions, but can degrade when exposed to light and other conditions.

Toxicity : Methylene blue can be toxic when taken in excessive amounts . Therefore, caution should be exercised during its use.

These properties are important for understanding how to use methylene blue in a laboratory and industry applications and under what conditions it may be stable or reactive. When working with any chemical, it is important to follow proper safety procedures and local regulations.

4.4 Effects On Health

Methylene blue may cause different health effects depending on the area where it is used and the level of exposure . It is a dyestuff generally used in histology and microbiology studies in laboratories. However, the following effects can be observed:

Respiratory System Effects: Exposure to methylene blue may cause respiratory irritation. This is especially true in cases of exposure in dust or vapor form .

Skin and Eye Irritation: May cause irritation to skin or eyes in case of direct contact. In case of improper use, contact with skin or eyes may cause effects such as redness, burning or itching.

Genotoxic Effects: Some studies have shown that methylene blue may cause genotoxic effects. This means it can damage DNA.

Toxicity : In cases of high exposure , methylene blue can be toxic and cause serious effects on the organism.

4.Conclusion and Recommendation

Appropriate safety precautions should be taken when using dyestuffs . In laboratory work, correct protective equipment must be used and safety instructions must be followed. People working with chemical dyestuffs must comply with occupational health and safety standards. Should be developed to minimize the environmental impacts of dyestuffs .

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