Unlocking the Potential of Bis-aminopropyl Diglycol Dimaleate: A Review of its Applications, Mechanisms, and Influence in Modern Hair care

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Abstract: Bis-Aminopropyl Diglycol Dimaleate is a new ingredient used for hair treatment to protect and repair hair during chemical processes such as coloring and bleaching. This article explores the importance and mechanism of Bis Aminopropyl Diglycol Dimaleate, shedding light on its innovative role in strengthening and repairing hair bonds. It specially focuses in reconstructing disulfide bonds within the hair shaft.

Keywords: Bis-Aminopropyl Diglycol Dimaleate, Hair Bond, Hair coloring.

Hair Bond

The hair shaft, composed primarily of a fibrous protein called keratin, derives its strength and resilience from various types of bonds, notably the disulfide bond. The disulfide bond, a crucial component of the hair's structural integrity, forms between two sulfur atoms present in adjacent cysteine amino acid residues along the protein chain. This covalent bond arises from the oxidation of the sulfur atoms, resulting in the loss of two hydrogen atoms and the creation of a strong cross-link between the cysteine molecules. These cross-links act as anchors, providing stability and strength to the hair shaft, enabling it to withstand mechanical stress and environmental factors. Disulfide bonds contribute significantly to the hair's ability to maintain its shape and elasticity, crucial for enduring various styling treatments and everyday wear and tear. However, chemical treatments such as perming, coloring, and straightening can break these bonds, altering the hair's structure. Nonetheless, the subsequent reformation of disulfide bonds is essential for restoring the hair's integrity and shape post-treatment. In essence, the disulfide bond serves as the cornerstone of the hair's resilience, playing a pivotal role in its overall health and appearance. [1]

Various Factors affecting Haircare

A variety of factors influence haircare, including genetics, overall health, environmental conditions, and lifestyle choices. It is essential to comprehend these many components to create a customized and successful haircare regimen. The following are some variables that may affect the condition and appearance of hair:

Chemical Treatments

• **Perming (Perm Solution):** To change the natural structure of hair, sulfide links are broken and then reformed chemically. [2]

• **Hair Relaxing (Chemical Straightening):** In a manner analogous to perming, relaxing modifies the structure of hair by dissolving and reorganizing sulfide bonds to produce a straightened appearance.[3]

• **Hair coloring (bleaching/dyeing):** To enable color penetration into the hair shaft, chemical dyes and bleaching chemicals disrupt sulfide bonds.[4]

Bis-Aminopropyl Diglycol Dimaleate

A specific chemical called bis-aminopropyl diglycol dimaleate is used in hair treatment products. By re-linking broken disulfide bonds which are frequently harmed by chemical treatments like bleaching and coloring it serves as the main technique for strengthening and repairing hair. This novel component is a favorite in both at-home and salon hair care regimens since it enhances the general health and resilience of hair. [5]

Properties

**Synonym:** 3-2-[2-(3-azaniumylpropoxy)ethoxy]ethoxy]propan-1-aminium di[(2Z)-3-carboxyprop-2-enoate].
**Source**: Bis-Aminopropyl Diglycol Dimaleate (BADGD) salt of maleic acid and the diamine entre diethylene glycol and 1-aminopropane.

**Molecular Formula**: C10H24N2O3.2C4H4O4.

**Chemical structure**:

![Chemical structure of Bis-Aminopropyl Diglycol Dimaleate](image)

**Figure no 1- Chemical structure of Bis-Aminopropyl Diglycol Dimaleate**

**Molecular weight**: 452.46

**CAS No**: 1629579-82-3

**Form**: Colorless Liquid

**Concentration**: ≥ 0.1%

**pH**: 3.30-3.55

**Mechanism**:
The primary function of Bis-Aminopropyl Diglycol Dimaleate (BADGD) is to create and strengthen disulfide connections inside the hair shaft.

Disulfide linkages, which give hair its strength, flexibility, and resilience, are essential parts of its protein composition. These linkages can break or get damaged during different chemical treatments like dyeing, perming, or straightening, which weakens the hair. Reactive groups found in BADGD, especially maleate groups, have the ability to create covalent connections with the sulfhydryl (-SH) groups found in hair protein cysteine residues. The keratin in hair is rich in the amino acid cysteine, which is needed to generate disulfide bonds. In a process known as "crosslinking", BADGD functions as a bridge to connect two cysteine molecules, creating a strong and long-lasting disulfide bond in the process. Through the formation of these new disulfide links, BADGD strengthens the protein structure of the hair from the inside out. This restores the strength, flexibility, and general integrity of the hair by repairing damage brought on by chemical treatments or external sources. Furthermore, BADGD can aid in preventing additional harm to the hair caused by chemical processes. It can function as a protective barrier by taking up reactive sites on the hair shaft, lessening the effects of abrasive chemicals and lowering the possibility of breakage or severe damage.

BADGD's compatibility with a range of hair treatments is one of its main benefits. When used with bleaching, dyeing, or other chemical treatments, BADGD gives the hair more protection while boosting the overall effectiveness of these treatments. [6]

**Efficacy across hair types**
The efficacy of BADGD across hair types brings out its versatility and broad applicability in addressing diverse hair care needs. Whether the hair is naturally curly, thick, thin, fine, or somewhere in between. BADGD has shown effectiveness in improving and maintaining its overall health.
- **Damaged Hair:** For hair that's heavily damaged from frequent coloring, bleaching, or heat styling, bis-aminopropyl diglycol dimaleate can be highly effective. It helps to rebuild broken disulfide bonds within the hair structure, which are often damaged during chemical treatments. [7]

- **Fine Hair:** Fine hair tends to be more delicate and prone to breakage. Bis-aminopropyl diglycol dimaleate can strengthen fine hair and provide some protection against damage, but it's essential to use it in moderation to avoid weighing down the hair [7]

- **Curly or Coily Hair:** Curly and coily hair types are naturally drier and more prone to frizz and breakage. Bis-aminopropyl diglycol dimaleate can help strengthen these hair types and improve overall manageability by repairing damage and reducing frizz. [8]

- **Thick or Coarse Hair:** Thick or coarse hair often requires more intensive treatments to penetrate the hair shaft effectively. Bis-aminopropyl diglycol dimaleate can still be beneficial for these hair types, but leave-on treatments or products with higher concentrations may be more effective. [9]

- **Healthy Hair:** For those with relatively healthy, undamaged hair, bis-aminopropyl diglycol dimaleate can still provide benefits by strengthening the hair and preventing future damage. However, its effects may be less noticeable compared to severely damaged hair. [10]

![Figure no 2- Efficacy across hair](image)

**Examples**

**Marketed Haircare products:** Marketed products containing BADGD (refer to fig no- 3). It is a hair treatment which is designed to repair the damage caused by chemical treatments such as bleaching, coloring, highlights. It focuses on making hair stronger from inside. Instead of just making hair look better on the surface, it goes deep to ensure that hair is healthier, stronger and less prone to breakage. The major innovation lies in its ability to reconnect and strengthen disulfide bonds within the hair shaft.

Disulfide bonds in hair are strong chemical bonds that play an important role in maintaining the structure and strength of the hair shaft. During chemical processes such as coloring and bleaching, these disulfide bonds can be broken or rearranged, leading to damage and weakening of the hair. It is designed to reconnect these bonds, helping to restore the health and flexibility of hair shaft. It contains patented ingredient Bis-Aminopropyl Diglycol Dimaleate, is designed to target the millions of disulfide bonds within our hair that give it structure and stability. It forms a protective barrier during chemical treatment. This helps to minimize the potential damage to disulfide bonds, helps in keeping the fundamental structure of the hair intact. [11,12]
Conclusion:

Bis-aminopropyl diglycol dimaleate is a well-known and adaptable ingredient in hair care products that is used to repair and shield hair from environmental stresses and chemical treatments. Its effectiveness varies depending on the kind of hair, but it is very beneficial for thick, curly, damaged, and fine hair. On healthy hair, though, its effectiveness can be less noticeable. When added to a comprehensive hair care regimen, bis-aminopropyl diglycol dimaleate provides an excellent way to fortify and enhance the general health and look of different hair types. It can be concluded that it is a valuable ingredient in hair care formulations aimed at repairing and strengthening damaged hair by restoring the structural integrity of hair bonds.

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