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Product Name: Polyquaternium-6

INCI Name: Polyquaternium-6

CAS: 26062-79-3

Chemical Classification: Cationic polymer (quaternary ammonium polymer), synthetic polyelectrolyte

Functional Category: Hair and skin conditioning agent, antistatic agent, film former, sensory enhancer for skin and hair

IUPAC Name: Poly[(dimethylimino)-1,3-propanediyl chloride]

Description: Polyquaternium-6 is a water-soluble cationic polymer widely used in cosmetic formulations due to its strong affinity for keratin in hair and skin. Its structure is based on permanently positively charged quaternary ammonium groups, which enable strong binding to negatively charged surfaces of hair fibers and the epidermis. After application, Polyquaternium-6 forms a thin, uniform, and flexible film that remains stably attached even after rinsing, providing a long-lasting conditioning effect. In hair care products, it contributes to cuticle smoothing, reduction of static electricity, and improved detangling on both wet and dry hair. The film it forms does not weigh hair down but enhances mechanical strength and gives hair a fuller, neater, and more controlled appearance. It is particularly valued in shampoos, conditioners, and styling products because it retains conditioning properties even in the presence of anionic surfactants, without destabilizing the system. In skin care products, Polyquaternium-6 acts as a mild film-forming and conditioning agent that improves the sensory profile of formulations. It enhances skin smoothness and softness, reduces transepidermal water loss, and supports even product distribution during application. Due to its good compatibility with various formulation types, it can also be used in products intended for sensitive areas, such as sensitive regions, including the area around the eyes, at appropriately adjusted concentrations. From a technological standpoint, Polyquaternium-6 is stable over a wide pH range and can be easily incorporated into the aqueous phase without the need for heating. It does not clog pores and does not contribute to a sticky or heavy feel on skin or hair, making it suitable for modern, lightweight formulations that require a good balance between efficacy and pleasant sensory performance.

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Mechanism of Action: The mechanism of action of Polyquaternium-6 is based on permanently positively charged quaternary ammonium groups integrated into the polymer structure. This positive charge enables strong electrostatic interactions with negatively charged sites on the surface of hair fibers and the epidermis, primarily with carboxyl groups of keratin and skin proteins. After application, the polymer selectively adsorbs onto these surfaces and remains bound even after rinsing. Following adsorption, a thin, continuous, and flexible polymer film is formed. This film acts as a physical barrier that smooths micro-irregularities on the hair cuticle, reduces friction between hair fibers, and mitigates static electricity. As a result, hair becomes easier to detangle, less prone to tangling and mechanical damage, while its visual and tactile quality is improved. In formulations containing anionic surfactants, Polyquaternium-6 exhibits a specific co-deposition mechanism. During rinsing, a reduction in polymer solubility promotes its deposition onto hair or skin surfaces instead of complete removal. This process allows the conditioning effect to remain present in rinse-off products without the need for high concentrations or additional fatty components. On the skin, the formed polymer film contributes to more even product distribution, reduced transepidermal water loss, and improved smoothness. The mechanism of action is predominantly physical and surface-based, without penetration into deeper skin layers, which is why Polyquaternium-6 is considered a stable, predictable, and technologically reliable conditioning polymer in modern cosmetic formulations.

Benefits:

- Improves hair detangling by reducing friction between hair fibers.
- Reduces static electricity and unwanted hair flyaway.
- Forms a thin film that smooths the hair surface.
- Increases mechanical strength of hair and reduces breakage.
- Provides a neater, more controlled, and fuller hair appearance.
- Retains conditioning performance in rinse-off products.
- Enhances the sensory feel of products on skin and hair.
- Contributes to a smooth and soft skin feel.
- Reduces transepidermal water loss by forming a surface film.
- Compatible with anionic surfactants without destabilizing formulations.
- Easily incorporated into the aqueous phase without heating.
- Does not clog pores and does not leave a heavy or sticky feel.

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Method of Use: Polyquaternium-6 is used in cosmetic formulations as a water-soluble cationic polymer and is added directly to the aqueous phase or into the finished formulation with gentle mixing. It does not require heating or special processing conditions, making it suitable for conventional formulations as well as formulations without heating. It can be added before or after surfactants and is stable over a wide pH range, without negatively affecting system stability. In shampoos and hair cleansing products, it is typically used at concentrations of 0.1–0.5%, where it provides conditioning, reduces static electricity, and improves detangling without weighing hair down. In mild, everyday shampoos, concentrations are usually closer to the lower end of this range. In conditioners and hair treatments, it is used at concentrations of 0.2–1%, contributing to cuticle smoothing, improved mechanical strength of hair fibers, and longer-lasting conditioning after rinsing. In hair styling products such as leave-on sprays, creams, or gels, concentrations typically range from 0.1–0.3%, forming a lightweight film that controls frizz and improves hair manageability without stiffness. In skin care formulations such as toners, serums, and lightweight emulsions, Polyquaternium-6 is commonly used at concentrations of 0.05–0.3%. Within this range, it enhances sensory performance, contributes to smoothness, and supports moisture retention without a heavy skin feel. In products intended for sensitive regions, such as sensitive regions, including the area around the eyes, lower concentrations, typically up to 0.1%, are recommended to achieve a mild conditioning effect with good skin tolerance.

Comparative Advantages and Disadvantages: Compared to Polyquaternium-7, Polyquaternium-6 provides a stronger and more persistent conditioning effect, particularly in rinse-off formulations, due to its more efficient binding to keratin and more stable retention on the hair surface. Its advantage lies in a cleaner sensory feel without pronounced slipperiness, while its limitation is a slightly lower softening effect compared to Polyquaternium-7, which delivers a more pronounced silky feel, especially in everyday shampoos. Compared to Polyquaternium-10, Polyquaternium-6 is significantly easier to formulate, as it is more stable across a broad pH range and less sensitive to the presence of surfactants. It does not significantly affect system viscosity and can be incorporated without prior hydration or heating. On the other hand, Polyquaternium-10 provides a stronger thickening effect and more pronounced surface smoothness, particularly in products for damaged hair, whereas Polyquaternium-6 forms a milder film and contributes less to visual hair fiber filling. Overall, Polyquaternium-6 stands out as a technologically stable and predictable conditioning polymer with a well-balanced performance and sensory profile. Compared to Polyquaternium-7, it offers more con-

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trolled and long-lasting performance, and compared to Polyquaternium-10, it is lighter, easier to formulate, and more suitable for lightweight formulations that do not require pronounced thickening or a heavy film.

Natural or Synthetic Ingredient: Polyquaternium-6 is a synthetic ingredient. It is obtained through controlled chemical polymerization of monomers and does not originate from natural sources, although it is designed to functionally mimic the conditioning effects of natural cationic components on the surface of hair and skin.

Safety of Use: According to the assessment of the CIR panel (Cosmetic Ingredient Review), Polyquaternium-6 is considered safe for use in cosmetic products under current formulation practices and reported concentrations. The first panel report was published as a preliminary assessment in 2020, while the final safety assessment was adopted in 2021 following additional evaluation of available data. Acute toxicity studies indicated low dermal and oral toxicity, with values showing no serious systemic effects at doses significantly higher than those relevant for cosmetic use. Subchronic studies with repeated dermal exposure showed no signs of systemic toxicity or pathological changes. Genotoxic potential was evaluated using standard mutagenicity tests, with negative results both with and without metabolic activation. The irritation potential is low at concentrations used in cosmetics, with only mild irritation observed at high experimental concentrations and under prolonged occlusive exposure. Sensitization studies did not demonstrate allergenic potential in either animal models or human testing. The risk of inhalation exposure in spray products was assessed as low due to the polymer's characteristics and particle deposition behavior. The CIR (Cosmetic Ingredient Review) assessment covers concentrations up to approximately 1.2% in leave-on products, up to about 3% in rinse-off products, and lower concentrations in products with potential mucosal contact. The panel emphasizes that formulations should be designed to avoid the formation of N-nitroso compounds, which is considered a standard principle of good formulation practice.

Animal Testing: In accordance with current European regulations (Regulation (EC) No 1223/2009 on cosmetic products), the substance has not been tested on animals. The safety assessment of the raw material is based on available toxicological data, scientific literature, and validated alternative testing methods (in vitro and in silico). The term in silico refers to testing and assessment methods conducted using computer models and simulations rather than in vivo (on living organisms) or in vitro (on cell cultures). This

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statement confirms compliance with the ban on animal testing and is provided solely for informational purposes regarding further use of the ingredient in cosmetic formulations.

GMO: Non-GMO

Vegan: Does not contain components of animal origin