Application Data Sheet

DIGLYCEROL

Diglycerol in Cosmetics and Toiletries

Diglycerol is a clear viscous liquid much like glycerol. It has a higher molecular weight than glycerol and is less volatile. Its structure is a polyol consisting of two molecules of glycerol bonded by an ether linkage. It has been used since the 1980s in personal care products in Japan.

Solvay Diglycerol is free of material derived from animal sources, and is Kosher certified. The product is also free from GMO, as the glycerol raw material is not obtained from a genetically modified organism[1].

Solvay Diglycerol is listed in the Dictionary of Cosmetic Ingredients. It is used in the formulation of cosmetics, and can also be included as an excipient in OTC (Over the Counter) topical drugs such as antibacterial creams. It complies with the specifications listed in the diglycerol chapter of the 2000 edition of the Japanese Standards of Cosmetic Ingredients (JSCI).

For additional information about the properties of Solvay Diglycerol, please request technical data sheets DGL-01-001 and 002.

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Humectant properties

Humectants are hygroscopic materials that act as moisturizers by binding water. They are important ingredients in cosmetic formulations, as moisturizers and also to prevent formulations such as creams from drying out. Humectants' ability to moisturize the skin is a function of their propensity for water absorption as well as water retention.

The humectant properties of a polyol are determined by many factors including:

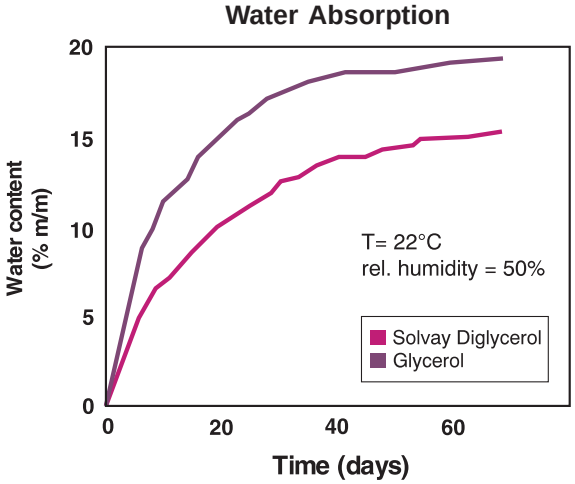
- The water binding properties at equilibrium ("static" moisturization), which are a function of the hydroxyl number.
- The rate of water absorption/desorption ("dynamic" moisturization), which decreases as the molecular weight of the moisturizer increases.
- The time during which the moisturizer will remain at the surface of the skin, which is also a function of the molecular weight. (The bigger the molecule, the lower its evaporation rate and the slower its penetration in the deeper layers of the skin.)

Skin moisturization is a balancing act since a humectant can draw moisture from air or from the skin, causing dehydration. Glycerol has very strong water binding properties making it a good moisturizer in many formulations. However, glycerol's moisturization ability has limitations.

- In low humidity, or in extreme weather conditions such as excessive wind or sun, glycerol tends to draw moisture from the deeper layers of the skin, thus drying it from the inside out. This is of particular concern in lip treatment products which are used to protect the skin from harsh environments.
- Under xerotic conditions such as deep wrinkles, and dry or squamous skin, glycerol tends to increase dryness by binding water from the stratum corneum.
- The use of glycerol in cosmetic formulations must be precise. If large amounts are used in a poorly formulated product, it has an even greater tendency to pull water from the lower levels of the epidermis, which can result in dryer skin.

The above limitations do not apply to cosmetics not left on skin, such as shampoos and hair conditioners, and glycerol is the humectant of choice in these products. For skin care products, when glycerol is properly used, it is an excellent moisturizer that is generally well tolerated by the skin. However, in the case of particularly sensitive skins (such as babies, dry skin profiles, and xerotic skins), or under harsh climatic conditions, glycerol's skin drying potential becomes critical and milder humectants are required.

Diglycerol has a lower hydroxyl number than glycerol, which imparts a lower water binding ability upon the product. Being a bigger molecule, diglycerol has a lower rate of moisture absorption and is retained on the skin surface for a longer period of time. Compared to glycerol, diglycerol absorbs less water, more slowly from the human skin. Formulations containing diglycerol are therefore milder and provide longer lasting effects on the skin.



Typical concentrations of diglycerol to be included as a humectant in skin care formulations such as facial creams, body lotions, and suntan products are in the range of 2 - 4%. Synergies between diglycerol and other humectants have been observed. Unilever[2] reports synergy between diglycerol and glycerol at a ratio of 1:1 by weight. A synergy between diglycerol and lactic acid derivatives has also been identified[3].

Emollient properties

Ingredients that lubricate the skin, emollients give the product a soft smooth feeling. They remain on the surface of the skin and act as a barrier against the trans-epidermal water loss (TEWL) by evaporation. In general, larger molecules are better emollients due to their improved occlusivity.

Although not a true emollient like mineral oils, the larger molecular weight of diglycerol vs. glycerol enhances its emollient properties. Diglycerol is retained on the surface of the skin longer than glycerol, imparting some emollient characteristics to the product. Diglycerol is therefore a better skin conditioner and leaves a longer lasting skin feel than glycerol.

The emollient properties of diglycerol are better expressed, though relative to its fatty acid esters. Diglycerol esters are well known emollients due to the fatty character of their acid moiety, providing a high occlusivity which prevents water evaporation. Due to the diglycerol backbone, these esters are more hydrophilic than the corresponding glycerides. They are therefore superior products combining emollient and moisturizer properties.

Other advantages

In addition to its humectant properties, glycerol is added to cosmetic formulations to perform many other functions such as thickening and lubrication. It is also an auxiliary solvent in conjunction with water or alcohol and helps prevent inert materials from precipitating and crystallizing upon standing.

Diglycerol has many of the advantages that made glycerol such a popular ingredient in the formulation of cosmetics.

- It is a clear product that is practically colorless and odorless, allowing its incorporation in fragrance-free, colorless cosmetic formulations.
- It is compatible with electrolytes.
- Its biocompatibility makes it easily recognizable by the skin and its arsenal of enzymes.
- Its high hydrogen bonding capabilities offer:
  - Solubility in water and aqueous systems.
  - Humectant properties.
  - Solubilization of minor components in a formulation.
  - Reduction of the rate of crystallization for other ingredients (e.g., sugars and derivatives).
  - Multiple functionality allowing its use as a cross linking agent.
- It is environmentally compatible, as the product is easily biodegradable.

In addition to the above benefits, diglycerol offers several advantages over glycerol in the cosmetics area, as it imparts improved properties to the final product. It also facilitates the design of certain formulations.

- The higher refractive index of diglycerol vs. glycerol is valuable in formulating transparent personal care products. Transparent emulsions are obtained when the aqueous and oily phases have the same refractive index. The use of higher refractive index ingredients in the aqueous phase, such as Solvay Diglycerol, facilitates formulation and reduces the need to add other components to increase the refractive index of the aqueous phase.

- Diglycerol's higher viscosity vs. glycerol enhances its performance in many functions such as lubrication, thickening, pigment dispersion and spreading properties.
- Diglycerol imparts a non-sticky feeling to skin, important in the formulation of skin care products. Formulations containing a relatively high amount of glycerol (e.g., 5%) are known to give a sticky feeling.
- The lower hydrophilicity of diglycerol vs. glycerol enhances its capability of solubilizing poorly hydrophilic formulation components.
- Diglycerol gives a wet feel and gloss to hair.

Diglycerol derivatives

Diglycerol can be converted to derivatives such as esters or ethers which can be used as emulsifiers, solubilizers, thickeners, emollients, and skin fat replenishers. Please request technical data sheet DGL-01-003 for additional information about the use of diglycerol in fatty acid ester production, and their advantages vs. the corresponding glycerol and polyglycerol derivatives in cosmetic applications.

References

1 At the moment, the glycerol used to make Solvay Diglycerol is either synthetic or biodiesel glycerol. The latter is a coproduct of biodiesel production obtained by transesterification of rapeseed oil certified from countries where crops of genetically modified rape are forbidden.

2 US 4,829,092, Publ. 1 Feb. 1989, Glycerol and Diglycerol Mixtures for Skin Moisturizing.

3 DE 19838030, Publ. 5 Jan. 2000, Urea-containing Dermatological Composition Containing Diglycerol and Lactic Acid/ Sodium Lactate Buffer.

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