

Polymer Thickeners & Silicones

Synthetic polymers gained rapidly significance in professional cosmetics formulation due to their large variety of functions and generally very good tolerability by skin and hair. Based on the structure they can be classified in various chemical groups (see January newsletter). It is, however, more practical to categorize synthetic polymers based on their function. There are 6 major properties and uses of synthetic polymers:

Uses of Synthetic Polymers

1. Thickeners & Gel Builders
2. Fixatives & Styling
3. Conditioners
4. Pearlizers
5. Emollient
6. Film-formers

Thickening & Gelling Polymers

As all polymers are long, branched or unbranched molecules they can provide thickening effects simply by entanglement (like cooked spaghetti), cross-linking (bind to each other to form large net-like structures) or cluster formation (sit together forming micro lumps). They all are extensively used in shampoos, conditioners, creams and lotions to increase the viscosity and thickness of the product giving the product more richness and a smooth and creamy performance. Very effective thickening polymers are polyethylene oxide polymers such as polyethylene glycols (PEGs). Examples of widely used PEG-thickeners are PEG-150 distearate, PEG-7 glyceryl cocoate, PEG-200 hydrogenated glyceryl palmate and PEG-120 methyl glucose dioleate. The great advantage of PEG-thickeners is that they are water-soluble at all use levels and provide emulsifying properties helping to stabilize emulsions.

Another important group of synthetic thickeners are the anionic acrylate polymers, also known as acrylate copolymers or carbomers. While PEG polymers thicken by surrounding themselves with a sheath of water (cluster effect), carbomers cross-link each other forming a net. As a consequence, carbomers can help to greatly stabilize emulsions, thereby allowing the formulator to decrease the amount of primary emulsifiers but still hold the emulsion together. Hence, carbomers are excellent agents to form stable, high-viscosity creams and lotions. Another important feature of carbomers are their ability to suspend hard-to-dissolve agents like pigments, particles, antidandruff agents or other polymers. Unfortunately, carbomers are not

so easy to formulate. As they are powder they need to be hydrated by adding them slowly into a highly-agitating liquid (Vortex!) avoiding formation of lumps. A rotor-stator-homogenizer may be necessary. In addition, carbomers must be neutralised (eg. with triethanolamine, sodium hydroxide) to a higher pH (at least 7.0) to function what may not always be desirable in skin care products. To circumvent these disadvantages we highly recommend our [GelMaker EMU](#), an acrylate copolymer, that is liquid and pre-neutralised and, thus, does not require laborious agitation and neutralisation and works in a wide pH range.

Important Thickening Polymers

PEG-Polymers

- PEG-150 distearate
- PEG-7 glyceryl cocoate
- PEG-200 hydrogenated glyceryl palmate
- PEG-120 methyl glucose dioleate

Acrylate Copolymers / Carbomers

- Carboxymethylene polymer
- Carboxyvinyl polymer
- Acrylates/C10-30 alkyl acrylate crosspolymer
- GelMaker EMU

Fixative Polymers

Hair fixative polymers do exactly what their name implies: they fix the hair in place. Traditionally, hair fixative polymers have been applied to the hair as liquids (sprays, lotions), gels and foams (mousses). Some of the most widely used fixative polymers include polyimide-1, polyquaternium - 11, PVP/VA copolymers, and VA/butyl maleate/isobornyl acrylate copolymers. As formulation of hair fixatives and styling products is not so straightforward, I will discuss these polymers not further.

Conditioning Polymers

Conditioning polymers are effective skin and hair modifiers designed to deposit, adhere, or adsorb to proteins of the skin and hair. They improve the skin feel and hair manageability and make the skin and hair softer and smoother. There are cationic and nonionic conditioning polymers. Cationic polymers (positively charged) are preferred as they are held by the negatively charged skin/hair proteins by electrostatic forces, whereas nonionic polymers are easily washed off by surfactants. As all cationic polymers carry a quaternary ammonium compound they are called polyquaternium-X, where X is simply sequentially chosen. Examples include polyquaternium-6, polyquaternium-7, polyquaternium-11, etc.

Silicones (The Multifunction Polymers)

Silicones are polymers that contain silicon atoms which occur in nature primarily in silica (sand) or silicates (minerals comprising silicon, oxygen and metals). Silicones provide numerous benefits in all aspects of personal care. They act as emollient, skin protectant, conditioner, pearlizer, film-former, moisturizer, thickener, and emulsifier! Moreover, silicones are also used as defoamer or profoamer, and as they are generally very mild, they are often added to cleansing products to reduce irritation of harsh surfactants. Finally, there are numerous speciality silicones that help to incorporate difficult-to-dissolve agents like sunscreens, fragrances, proteins, pigments, and natural waxes. Below is an overview about the most important silicones and their primary function.

Silicones & Their Function

Cyclomethicones

Skin: transient emollient, improved rub-in & spreading, carrier of hard-to-dissolve agents
Hair: wet combing, transient shine, no buildup, prevention of clogging or windowing of pumps

Dimethicones

Skin: antiwhitening, antidusting, spreading agent, emollient, lubricant, skin protectant, water-resistant film former
Hair: wet/dry combing, shine, improved feel & softness, reduced static electricity, humidity resistance, resin plasticizer

Dimethicone Copolyols

Skin: emulsifier, foam stabilizer, improved skin feel, enhanced formulation stability
Hair: Resin plasticizer, emulsifier, foam stabilizer, reduction of irritation

Alkyl-Modified Silicones (Decyl Dimethicone, Stearyl Methicone, Cetyl Methicone)

Skin: occlusive barrier, moisturizer, emulsifier, thickener, water-resistance
Hair: improve volume/body, improved combing

Silicone Resins (silsequinoxanes, siloxysilicates)

Skin: water-resistant film-formers, humectants
Hair: improved volume/body, humidity resistance

Silica

Skin: antifoamer, thickener, suspending agent
Hair: antifoamer, thickener, suspending agent

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