Polymers Part III: Synthetic Polymers

MAKING COSMETICS

Uses of Synthetic Polymers

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

Important Thickening 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 EM

Fixative polymers are applied to hair in liquids, such as hair gel.

Synthetic polymers gained significance in professional cosmetic formulation due to their large variety of functions and generally very good tolerability by skin and hair. Based on their structure, they can be classified into various chemical groups (see January newsletter). However, it's more practical to categorize synthetic polymers based on their function.

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're extensively used in shampoos, conditioners, creams, and lotions to increase the viscosity and thickness giving the product more richness, along with 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 advantage of PEG-thickeners is they're water-soluble at all user levels. They also provide emulsifying properties to help stabilize emulsions.

Another important group of synthetic thickeners is the anionic acrylate polymers, also known as acrylate copolymers or carbomers. While PEG polymers thicken by surrounding themselves with a sheet of water (cluster effect), carbomers cross-link each other forming a net. As a consequence, carbomers can help stabilize emulsions, allowing the formulator to decrease the number of primary emulsifiers and still hold the emulsion together. Hence, carbomers are excellent agents to form stable, high-viscosity creams and lotions.

Another important feature of carbomers is their ability to suspend hard-to-dissolve agents like pigments, particles, anti-dandruff agents, or other polymers. Unfortunately, carbomers are not easy to formulate. Since they're powder, they need to be hydrated by being slowly added into a highly-agitating liquid (Vortex), avoiding the formation of lumps.
A rotor-stator-homogenizer might be necessary. Additionally, carbomers must be neutralized (with triethanolamine, sodium hydroxide) to a higher pH (at least 7.0) in order to function, which might not be desirable in skincare products.

To circumvent these disadvantages, we highly recommend our GelMaker EMU, an acrylate copolymer that is liquid and pre-neutralized. It does not require laborious agitation and neutralization and works in a wide pH range.

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.

Important Thickening Polymers

Cyclomethicone

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

Dimethicones

- Skin: Anti-whitening, anti-dusting, spreading agent, emollient, lubricant, skin protectant, water-resistant film former.
- Hair: Wet/dry combing, shine, improved feel and 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 (Silsesquioxanes, siloxysilicates).

- Skin: Water-resistant film-formers, humectants.
  Hair: Improved volume/body, humidity resistance Silica.

- Skin: Anti-foamer, thickener, suspending agent Hair: anti-foamer, thickener, suspending agent.

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. They also make 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. X is simply sequentially chosen. Examples include polyquaternium-6, polyquaternium-7, polyquaternium-11, etc.

Silicones (The Multifunction Polymers) are polymers that contain silicon atoms that 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. Silicones are also used as defoamer or profoamer, and as they are generally very mild. They are often added to cleaning products to reduce irritation of harsh surfactants. Finally, numerous specialty silicones help to incorporate difficult-to-dissolve agents like sunscreens, fragrances, proteins, pigments, and natural waxes.
Below is an overview of the most important silicones and their primary function.