Lecture 59: Polymer applications in different fields: Polymer in cosmetics

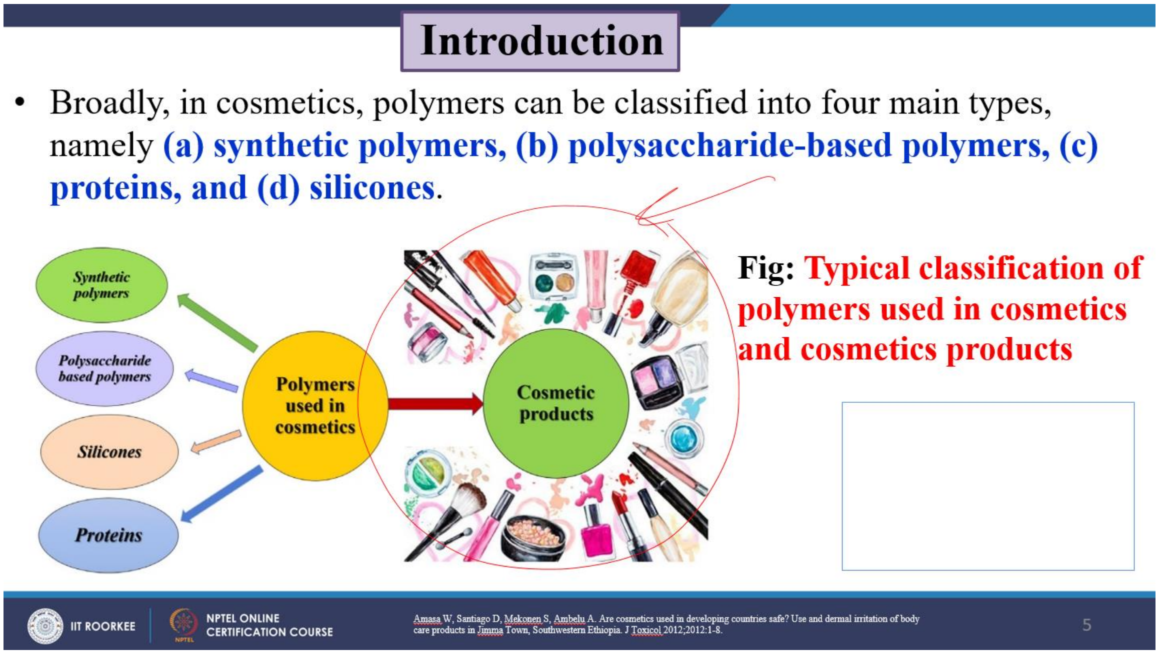
Welcome to the next aspect of polymers in cosmetics. As we continue our discussion on various applications of polymers under the domain of polymer process engineering, let's briefly recap what we've covered so far. We explored polymer uses in textiles, delved into the brief history of man-made fibers, and examined the terminologies and definitions relevant to the textile application of polymers. Subsequently, we delved into fiber manufacturing, discussing the diverse methods through which polymers are used to create fibers. Additionally, we covered the characterization and testing of various textile fibers.

In the preceding segments, we explored man-made fibers and high-performance fibers. Now, in this specific segment, our focus turns to the application of polymers in cosmetics. We will also delve into the interaction between polymer surfactants and cosmetics. Furthermore, we'll explore polysaccharide-based polymers in various types of cosmetics.

The use of polymers in cosmetics encompasses a broad spectrum. Additionally, we will explore protein modification in cosmetics. Numerous examples and case studies relevant to this specific aspect will be discussed.

Cosmetics, constituting an integral part of our daily lives, are widely used, whether it's shaving products or ladies' cosmetics. In the Indian context, the use of cosmetics is prevalent across the population. Now, let's proceed to define what cosmetics entail. The question arises: How do we define cosmetics, and what do they encompass? Cosmetics can be defined as the science that deals with articles intended for application on the human body for beautifying, cleansing, promoting, modifying appearance, and treating the human body, especially the skin and other aspects. Polymers play a crucial role in formulating these cosmetic products, as they may contain various types of polymers based on their intended functions. Polymers in cosmetic formulations serve as rheological modifiers, stimuli-responsive reagents, film formers, foam stabilizers, and skin-feel beneficial agents, contributing to various aspects of cosmetic applications and formulations.

In the realm of cosmetics, polymers can be broadly classified into four types: synthetic polymers, polysaccharide-based polymers, proteins, and silicones. The accompanying figure visually presents this classification, highlighting the diverse applications of cosmetics. The market is flooded with a myriad of cosmetic products, evident in the abundance of cosmetic shops within shopping arcades. Monomers serve as the building blocks for synthetic polymers, a familiar concept in polymer science.



Now, let's delve into the specific roles of polymers in cosmetics, particularly their functions in formulations.

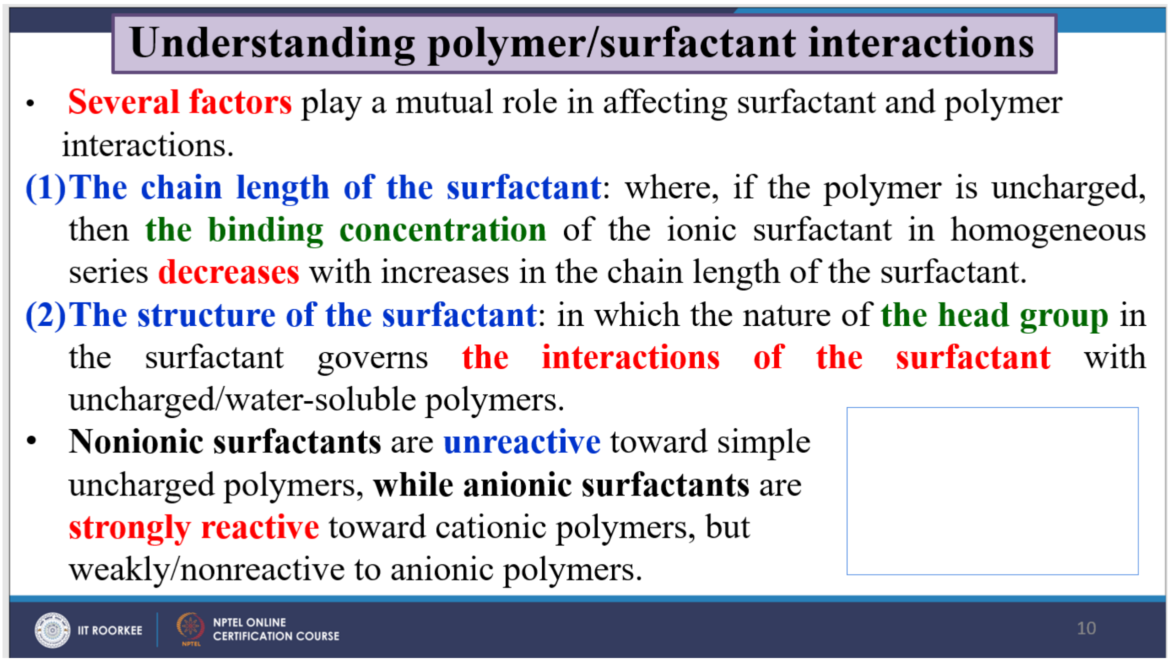
Polysaccharides have been utilized in cosmetics for centuries, playing a vital role in the development of personal care formulations. When combined with other ingredients, polysaccharides undergo modifications, resulting in properties that make them well-suited for various cosmetic applications. In liquid form, polysaccharide-based polymers can exist as loose rigid helices or randomized coils. They may exhibit cationic, non-ionic, anionic, or amphoteric properties, depending on their chemical identity and can be further influenced by temperature, concentration, and the presence of salts.

Proteins, derived from sources like milk and eggs, have been traditionally known for their benefits in hair and skincare. Protein extracts from animal fats, plant oils, and mineral pigments show promising applications in the cosmetic field, attracting attention from researchers. Leveraging the amphoteric and buffering properties of proteins has led to the development of products that provide glow, softness, and conditioning to the hair.

The use of silicon-based materials in hair and skincare products has been well-established since the mid-20th century.

Polydimethylsiloxane or dimethicone, part of the silicon family, was the first commercially used silicone in the cosmetic industry. In the late 1940s, Revlon introduced the silica skin lotion, gaining immense popularity due to its skin protection and nurturing qualities. Dimethicone, as an ingredient, forms a breathable barrier on the skin. The 1950s saw the introduction of a silicone-based lotion spray in the hair care market, sparking a new area of research in silicone applications.

Understanding the interaction between polymers and surfactants is crucial since both are integral components of cosmetic products. The use of polymers in cosmetics is heavily influenced by polymer-surfactant interactions. Surfactants play various roles in skincare products, acting as spreading agents, emulsifiers, and aiding in breaking up oily components for easier removal. The interaction between surfactants and polymers is controlled by forces such as Van der Waals forces, dispersive forces, hydrophilic effects, dipolar interactions, acid-base interactions, and electrostatic interactions.

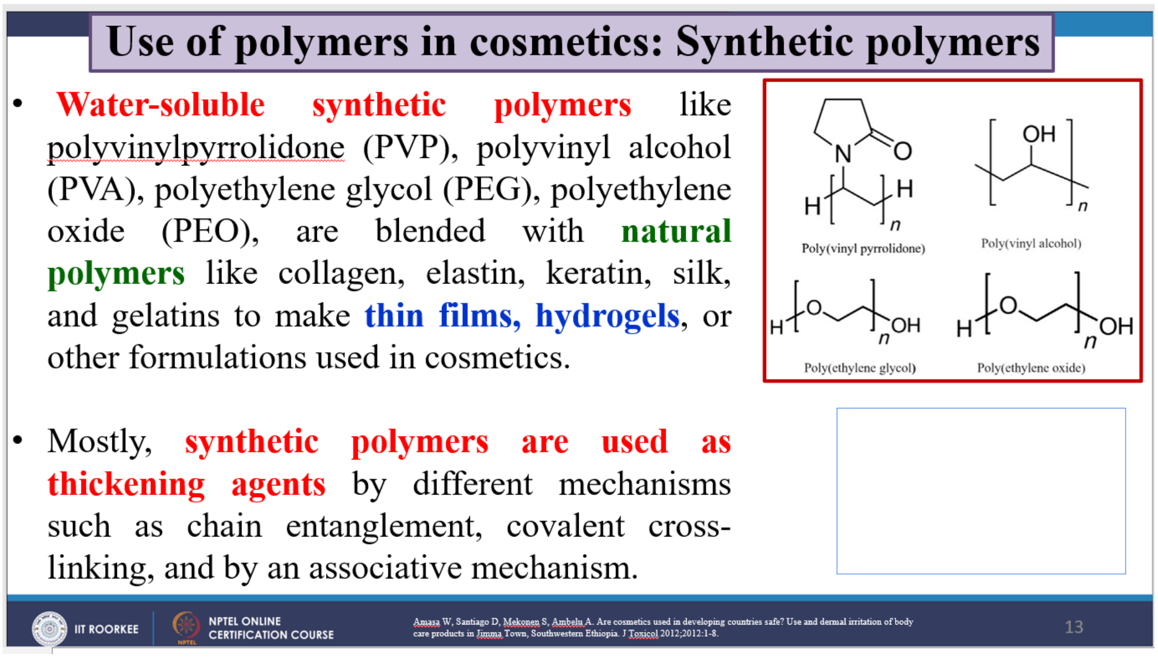


Several factors affect surfactant and polymer interaction. Firstly, the chain length of the surfactant is significant, particularly in the case of uncharged polymers. The binding concentration of ionic surfactants in homogeneous series decreases as the chain length of the surfactant increases. Secondly, the structure of the surfactant, particularly the nature of the head group, governs the interactions of the surfactant with uncharged or water-soluble polymers.

Non-ionic surfactants exhibit low reactivity towards simple uncharged polymers, while anionic surfactants strongly react with cationic polymers but exhibit weak or no reactivity with non-anionic polymers. Polymer characteristics play a crucial role, including the weight of the polymer, requiring a specific range for interaction, and the molecular weight criteria must be met, considering number average molecular weight and weight average molecular weight.

The amount of polymer and surfactant must be balanced for effective interaction. Polymer structure influences the reaction affinity with surfactants. The addition of salt affects interactions, especially between ionic surfactants and polymers.

The use of polymers in cosmetics is discussed based on classifications, with synthetic polymers gaining significant popularity in the 21st century. Synthetic polymers are categorized into condensation polymers or additive polymers, such as water-soluble polymers like polyvinyl pyrrolidone (PVP), polyvinyl alcohol (PVA), polyethylene glycol (PEG), and polyethylene oxide (PEO). These are often blended with natural polymers like collagen, elastin, keratin, silk, and gelatin to create formulations like thin films, hydrogels, or other cosmetic products. The basic structures of PVA, PVP, PEG, and PEO are depicted in the illustration.



Synthetic polymers are predominantly utilized as thickening agents in cosmetics through mechanisms such as chain entanglement, covalent crosslinking, and associative mechanisms.

Thickening by Chain Entanglement:

- This mechanism involves dissolving polymer chains in solvents like water or low-molecular-weight alcohol, resulting in soft entanglement.

- As the polymer concentration increases, the viscosity of the solution rises due to more chains occupying less space.

- At higher concentrations, individual polymer chains face difficulty separating due to increased shear forces, contributing to thickening.

- The increase in molecular weight is crucial for effective chain entanglement.

Thickening by Covalent Crosslinking:

- Covalent crosslinking thickening occurs when two polymer chains are linked through bifunctional monomers, modifying their properties.

- The process involves a radical reaction with bifunctional monomers, leading to the attachment of two polymer chains.

- An example is the vulcanization of rubber, a well-known instance of functional crosslinking in polymer thickening.

These mechanisms play a vital role in achieving the desired viscosity and consistency in cosmetic formulations

Rubber Crosslinking for Thickening:

- Rubber, initially found in the form of natural gum, possesses a tacky, growing resin nature upon harvest from the natural rubber tree.

- When subjected to heat in the presence of sulfur, rubber undergoes covalent crosslinking, transforming it into a material suitable for use in automobile tires.

- Covalent crosslinking represents a crucial and significant method for achieving thickening in rubber.

- This process involves the formation of covalent bonds, imparting enhanced properties to the rubber, making it durable and well-suited for specific applications.

- The utilization of covalent crosslinking exemplifies a fundamental approach to achieving thickening, particularly in the context of rubber for specialized applications such as tire manufacturing.

Thickening by Associative Mechanism:

- This mechanism employs hydrophobically modified polymers with surfactant-like behavior to achieve thickening.

- The hydrophobic modification allows the polymer to exhibit surfactant-like characteristics.

- Associative aggregation impacts various aspects, including solution viscosity, spreading behavior, film thickening, and the overall feel of cosmetic products.

- The behavior of amphiphiles and surfactants in aqueous solutions influences associative thickening.

- In aqueous solutions, amphiphiles can serve dual functionalities with a hydrophilic head group and a hydrophobic tail group, governed by their interactions.

Polysaccharide-Based Polymers:

- Polysaccharides are complex carbohydrates with hydroxyl groups, showcasing robust interactions with water.

- Their excellent mechanical properties make polysaccharide-based polymers suitable for diverse applications, such as adhesives, fibers, hydrogels, and as drug delivery agents in cosmetics.

These mechanisms and polymers contribute significantly to achieving the desired consistency, viscosity, and performance in cosmetic formulations.

Role of Polysaccharide-Based Polymers in Cosmetic Formulation:

- Polysaccharide-based polymers hold a significant role in cosmetic formulation alongside surfactants, salts, and other polymers.

- These versatile polymers serve various purposes in personal care products, functioning as thickeners, stabilizing agents, skin cleansers, sunscreens, and moisturizing ingredients.

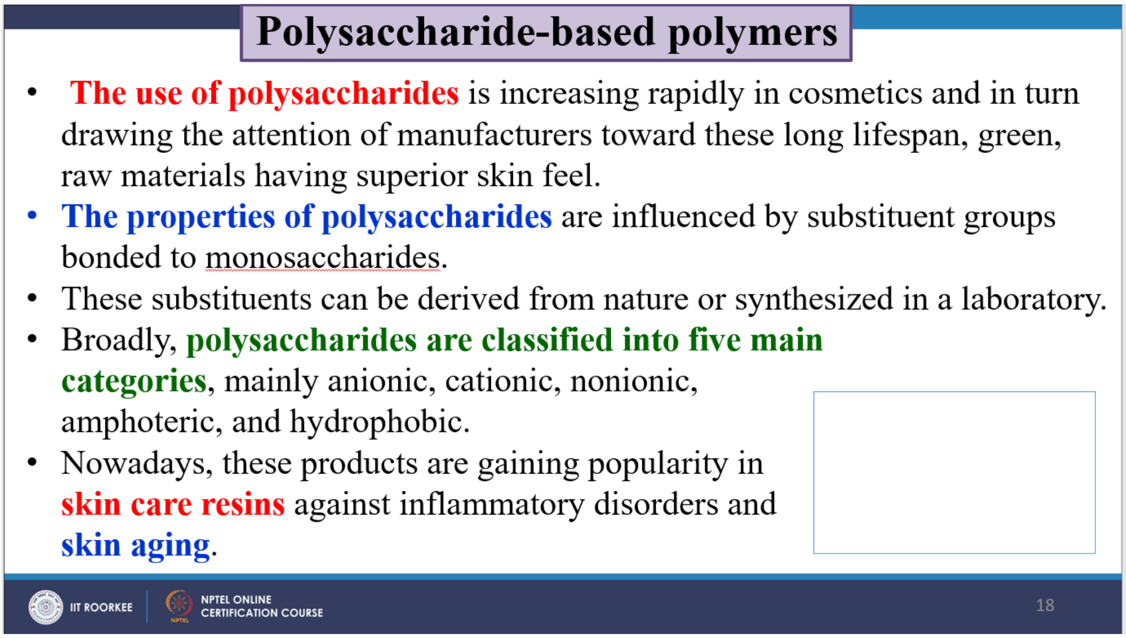
- The increasing use of polysaccharides in cosmetics reflects a growing interest among manufacturers due to their extended lifespan and environmentally friendly attributes, coupled with superior skin feel.

- The properties of polysaccharides are influenced by the substituent groups attached to monosaccharides, which can be derived from natural sources or synthesized in a laboratory setting.

- Polysaccharides can be broadly classified into five main categories: anionic, cationic, nonionic, amphoteric, and hydrophobic, reflecting the diverse spectrum of polysaccharides available.

- The classification becomes crucial due to the extensive variety of polysaccharides in use, with each category having specific characteristics.

- Anionic polysaccharides predominantly consist of naturally occurring materials and find applications in skincare, particularly for anti-inflammatory purposes and addressing skin aging concerns.



Anionic Polysaccharides in Cosmetics:

- Anionic polysaccharides are modified by human intervention to impart anionic properties.

- Commonly used and commercially available anionic polysaccharides include carboxymethyl cellulose or cellulose gum, carboxymethyl butane, and carboxymethyl glucane.

- Naturally occurring anionic polysaccharides encompass alginic acid, carrageenans, xanthan gum, and tragacanth gum.

- Alginic acid, a linear polysaccharide composed of uronic and mannuronic acid, serves as a thickening agent in various formulations like toothpaste, soap, shaving creams, and hair gels.

Cationic Polysaccharides in Cosmetics:

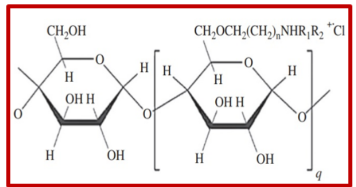
- Cationic polysaccharides utilized in the cosmetic industry are primarily synthetically modified, as nature lacks polysaccharides with inherent cationic charges and nitrogen content.

- The structure of cationic polysaccharides involves synthetic intervention, and chitosan, a cationic polyglucan found in nature, can carry a cationic charge up to pH 7.0.

- These polysaccharides often form tight bonds with anionic surfaces in cosmetic applications

Cationic polysaccharides

- **Cationic polysaccharides** that are used in cosmetic industries mainly consist of a group of synthetically **modified polyglycans** because nature does not provide any polysaccharides that can carry **cationic charge** and contain nitrogen.
- **For a polysaccharide** to conduct a charge it requires synthetic intervention. **The structure** of cationic polysaccharide can be represented as shown in Fig.
- **Chitosan is a cationic** polyglucan found in nature. It can be cationically charged up to **pH , 7.0**. Most of these polysaccharides are tightly bound to anionic surfaces.



Anjali Patil, Michael S. Ferritto. Polymers for Personal Care and Cosmetics, ACS Symposium Series, Vol. 1148
ISBN13: 9780841229051, eISBN: 9780841229068

Non-Ionic Polysaccharides in Cosmetics:

- Non-ionic polysaccharides are devoid of formal charges, although nearby charges might influence their characteristics.

- These polysaccharides play a crucial role in cosmetic formulations, particularly as rheology modifiers and thickeners.

- Rheology, especially for various skin types (dry, normal, oily), is significantly influenced by these non-ionic polysaccharides.

- They serve as essential components in achieving desired texture, viscosity, and thickness in cosmetic products.

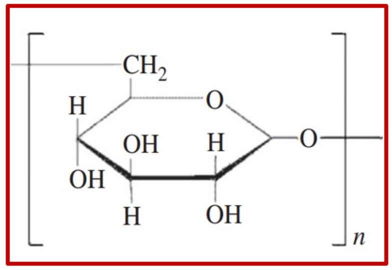
- Viscosity in cosmetic formulations is closely tied to the ratio of amylose or amylopectin content.

- Guar-based materials and ether-modified cellulose are commonly utilized in the synthesis of non-ionic semi-natural polysaccharides.

- Although most natural non-ionic polysaccharides are not widely used in personal care products due to cost, they find applications in high-end formulations.

Non-ionic polysaccharides

- **Factors that affect** the behavior of nonionic polysaccharides include the solvent used, surfactants, polymers, added salts. The structure of nonionic polysaccharides can be seen in Fig.
- **A potential use of nonionic polysaccharides** is as rheology modifiers/thickeners in cosmetic formulations.
- **Examples of these polysaccharides** are starch, maltodextrins/cyclodextrins, guar/locust bean gum, sclerotium gum, cellulose ethers, nitrocellulose, hydroxypropyl guar.



- Several factors influence the behavior of non-ionic polysaccharides, such as the choice of solvent, surfactant, polymers, salt types, and the polysaccharide's own structure.

- Non-ionic polysaccharides, represented by examples like starch, maltodextrin, cyclodextrins, guar, locust bean gum, cellulose ethers, nitrocellulose, and hydroxypropyl guar, play a role as rheology modifiers or thickeners in cosmetic formulations.

Amphoteric Polysaccharides in Cosmetics:

- Amphoteric polysaccharides possess both cationic and anionic charges on the same chain.

- The term "amphoteric" is derived from the Greek word meaning "both."
- Amphoteric polysaccharides are mostly semi-natural and are derived from natural polysaccharides through modification.

- Their use poses a challenge due to the presence of both cationic and anionic charges, resulting in insoluble masses in zwitterionic form.

- Examples of this type include carboxyl methyl cellulose and modified potato starch.

- Generally, two types of polysaccharides, namely modified polysaccharides and those with topical physiological effects, are used in cosmetic preparations.

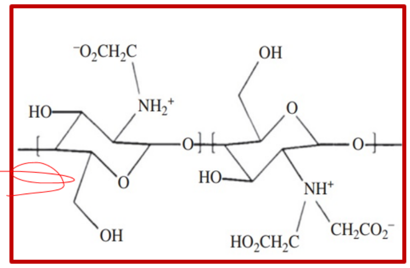
- Amphoteric polysaccharides, being chemically sophisticated, require formulators to explore their applications, and their structure is illustrated in a provided figure.

Amphoteric polysaccharides

- **Amphoteric polysaccharides** are chemically sophisticated and need formulators to explore their applications. The structure of amphoteric polysaccharides is shown in Fig.

- **The pH of a cosmetic formulation** is used to classify whether the polysaccharide is cationic, anionic, or both.

- **Examples of these polysaccharides** are carboxymethyl chitosan, N-[(20-hydroxy-20,30-dicarboxy) ethyl] chitosan, and potato starch



Lochhead R. The role of polymers in cosmetics: recent trends. ACS Symp Ser 2007;3-56

- The pH of cosmetic formulations is crucial, as an imbalance can lead to skin issues. The pH helps classify whether the polysaccharide is cationic, anionic, or both.

- Examples of amphoteric polysaccharides include carboxyly methyl chitosin, N20 hydroxy 2030, dicarboxy ethyl chitosin, and potato starch.

Proteins in Cosmetics - Classification and Applications:

- Milk protein was the first protein used in the cosmetic industry.

- The hydrophobicity of the peptide linkage impacts the cosmetic properties of proteins, influencing factors such as substantivity to human skin, binding capacity, emulsification performance, and solubility.

- Proteins in cosmetics are classified into five major categories, including hydrolyzed proteins and non-hydrolyzed proteins like abdomen, calcium, calcinate, iron, bench, and protein.

- In the hydrolyzed category, examples include ammonium hydrolyzed gelatin and zinc silo protein.

- Quaternary proteins, such as coca-aminopropyl, dimethyl-aminocollagen to sulfate, hydrolyzed collagen, and hydrolyzed plant protein, constitute another category.

- Condensate isochloride hydrolyzed collagen, iodized hydrolyzed sodium, subsidized gelatin, and enzymatic types like amylase, cartage, and glucose oxide paper are part of the condensate category.

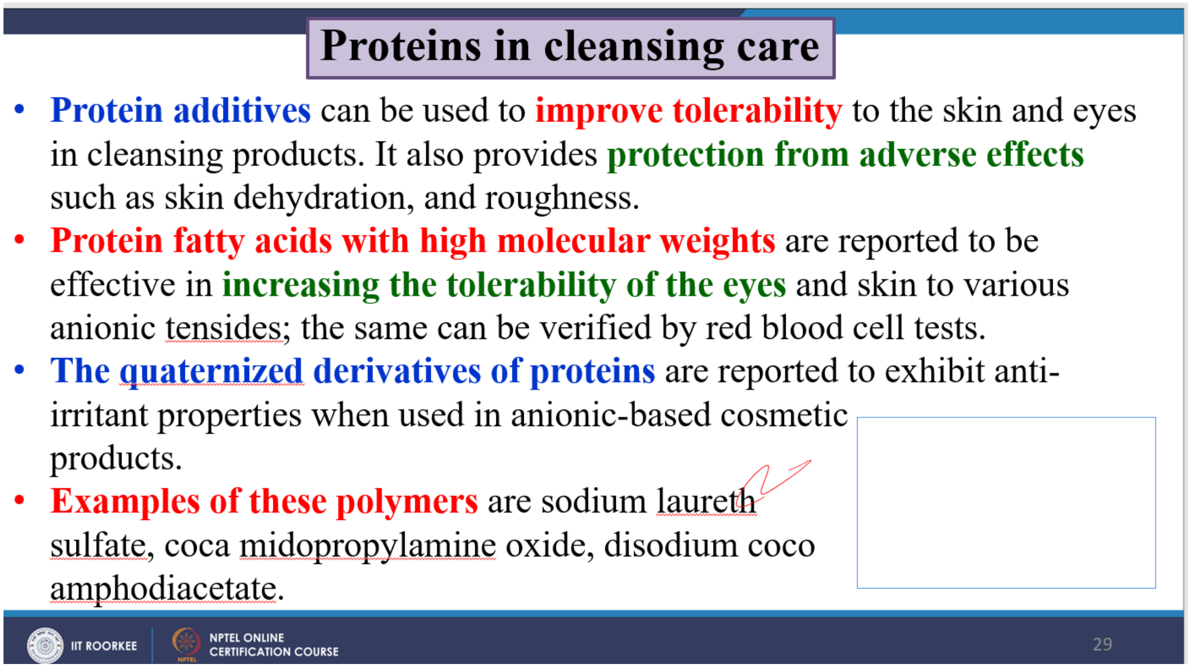
- Lather in hearth cellulosic protein is a personal care product, enhancing lather during shaving and other applications.

- The multifunctional family of water-soluble polymers, methylcellulose ether, comprises an extensive family of polymers like hydroxypropyl methylcellulose, widely used in personal care products.

- Proteins find applications in skin care and makeup products, with soluble protein ingredients added in various forms such as gels, powders, and lotions. Insoluble proteins, like micronized powder of insoluble elastosaccharitin, serve specific applications in cosmetic powders.

Proteins in Skin Care and Cleansing:

- Insoluble Fibrous Collagen:
  - Prepared by lipophilization of aqueous dispersion.
  - Used in moisturizers to make the skin smoother and shinier.
- Fibroin Protein:
  - Obtained from powder made by fine grinding of pure silk.
  - Used in face makeup and other decorative products.
- Native Proteins with Higher Molecular Weight:
  - Used in skin care products due to film-forming properties.
  - Soluble collagen, for instance, forms a colloidal film on the skin surface, creating a soft feel.
- Cleansing Care with Proteins:
  - Protein additives enhance tolerability of skin and eyes, increasing product effectiveness.
  - Provides protection against adverse effects like skin dehydration and roughness.
  - Protein fatty acids with high molecular weights prove effective in improving tolerability to anionic tensides.
  - Quaternized derivatives of proteins exhibit anti-irritant properties in anionic-based cosmetic products.



Proteins in Hair Care:

- Cosmetic Products:

  - Examples include sodium lauryl sulfate, coca mid-propyl amine, disodium coco amphodiacitate.

- Hair Hygiene and Care:

  - Proteins and derivatives used in shampoos, conditioners, coloring lotions, hair straightening products.

  - Proteins contribute to increased strength, elasticity, softness, and repair of split ends.

  - Protects hair from adverse effects of bleaching.

- Hair Treatment:

  - Different protein derivatives found useful for specific hair treatments, varying with formulation.

  - Hair conditioning by proteins attributed to their interaction with cuticle keratin.

- Protein Attachment to Hair Keratin:

  - Some proteins attach to hair keratin, used in shampoos with shorter contact times.

  - Achieves protein conditioning even in non-favorable application conditions.

- Protein Hydrostates in Shampoo:

  - Protein hydrostates and derivatives enhance tensile strength when used in shampoos.

Scientists observed a more prominent protective effect in quaternized derivatives compared to the parent hydrolyzed state. Testing revealed the effectiveness of the protein hydrostate of wheat over collagen hydrolyzed state, possibly due to higher hydrophobicity exhibited by wheat protein. These findings have significant implications for cosmetic formulations, providing insights into the superior protective properties of specific proteins and derivatives. This information is valuable for formulators aiming to enhance protective effects in cosmetic products.

Silicon in Cosmetics:

- Historical Usage:

  - Silicon materials used in hair care and skin care in the cosmetic industry for over 50 years.

  - Initial use more prevalent in hair formulations.

- Revlon's Introduction:

  - Revlon pioneered the use of silicon in skin care by launching a lotion containing silicon.

- Increased Silicon Use:

  - Technological advancements in suspending agents, emulsification, and associative thinning led to increased silicon use in cosmetics.

  - Organofunctional silicones offer multifunctional benefits to formulations.

- Cosmetic Applications:

  - Used in deodorants, shampoos, anti-perspirants, and skin care lotions.

- Natural Source:

  - Silicon derived from natural products, known as silica, can be used in personal care after suitable chemical modification.

- Effectiveness Comparison:

  - Quaternized derivatives of proteins observed to exhibit more prominent protective effects than the parent hydrolyzed state.

- Testing showed wheat protein hydrostate more effective than collagen hydrolyzed state, possibly due to higher hydrophobicity of wheat protein.
Modified Silicon in Personal Care Products:

Biomethane and cyclomethane serve as examples of modified silicon utilized in various personal care products. These compounds contribute to the waterproofing, silky texture of hair, water resistance in creams, lubrication, massaging, and anti-aging properties. Silicon polymers such as cyclomethicones, dimethicones, and amidomethicones find applications in these products.

Dimethicone for Uniform Film Formation:

Dimethylene and dimethicone, two types of silicon, exhibit the ability to uniformly spread into thin films over hair surfaces. They impart hydrophobicity to the skin and hair, adding lubricity and humidity resistance to hair creams, thereby offering protection to the skin. Formulations can be enhanced by incorporating high molecular weight dimethicone gums or silicon resin to increase the durability of the thin film.

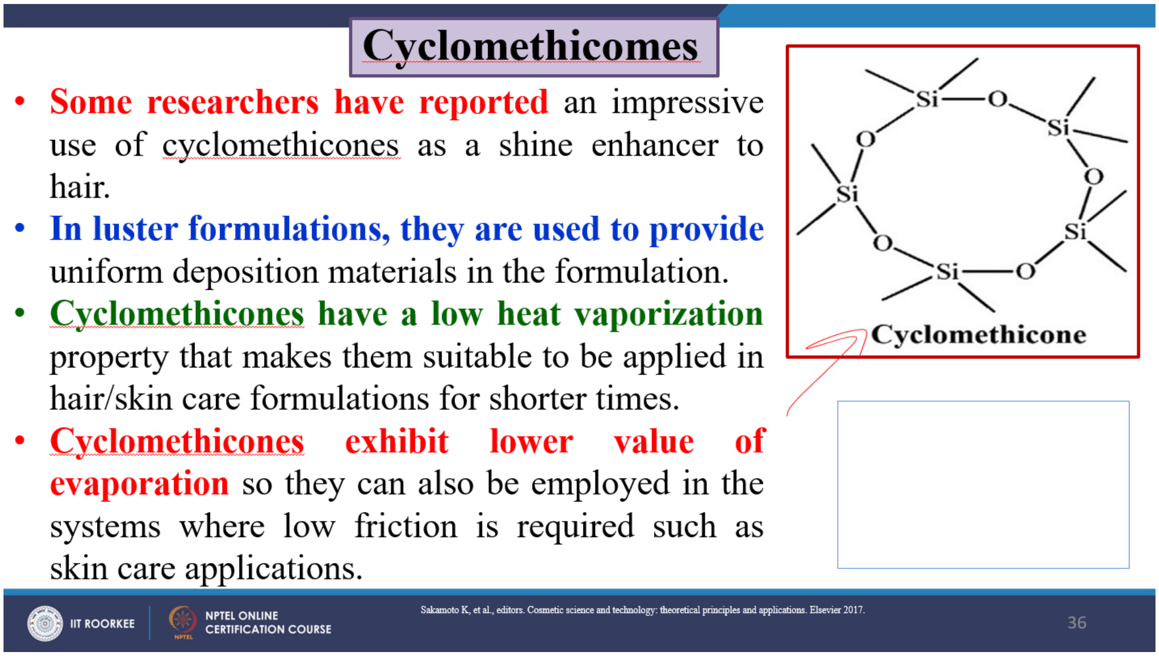
Alkyne Modified Silicon (ARMS) for UV Protection:

Alkyne modified silicon, known as ARMS, is employed in sunscreens and cosmetic products for skin care. It forms a protective barrier on the skin, preventing penetration of adverse effects from UV radiation.

Cyclomethicones as Carrier Agents:

Cyclomethicones, colorless non-polar fluids with low viscosity, act as carrier or diluent agents in hair care products. They facilitate the uniform delivery of fluids with high molecular weights to hair fibers, contributing to the effectiveness of the products.

Understanding the diverse applications of modified silicon in personal care products provides valuable insights for formulators seeking to enhance the performance and properties of cosmetic formulations.



Cyclomethicones in Hair Care Formulations:

Cyclomethicones play a crucial role in conditioners and shampoos, supporting wet combing. However, it is advisable to incorporate external thickeners and stabilizing agents for optimal performance. Researchers have highlighted the impressive use of cyclomethicones as shine enhancers for hair.

Structure and Application of Cyclomethicone:

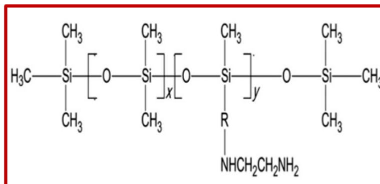
The typical structure of cyclomethicone is illustrated. In luster formulations, cyclomethicones ensure a uniform dispersion of materials. Their low heat vaporization property makes them suitable for short-term application in hair and skincare formulations. Cyclomethicones, with their low evaporation values, are also effective in systems requiring low friction, such as skincare applications.

Amodiethicones for Wet and Dry Combing:

Amodimethicones, fluid polymerized by emulsion through linear processing technology, undergo condensation reactions during drying, forming a film on hair. These amino silicones, whether linear or branched, provide advantages in both wet and dry combing. They mitigate the effects of charge and enhance hair softness when integrated into hair formulations.

Amodimethicomes

- **Amodimethicone is a fluid** that is polymerized by **emulsion, prepared by linear processing technology**, and its emulsification is performed by mechanical route.
- **The functional aminosilicones** may be linear or branched in structure. In both cases, they undergo a **condensation reaction** while drying in forming films on hair and provide wet as well as dry combing advantages.
- **They lower the effects** of charge and **increase the softness of hair** when used in hair formulations.



Amidomethicone

Aranaz I, Acosta N, Civera C, Elorza B, Mingo J, Castro C, et al. Cosmetics and cosmeceutical applications of chitin, chitosan and their derivatives. Polymers 2018;10 (2):213

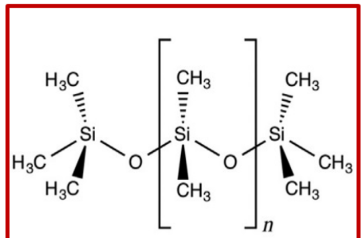
Understanding the specific properties and applications of cyclomethicones and Amodiethicones contributes to formulating hair care products that address combing, shine enhancement, and overall hair health.

Dimethicones in Cosmetic Formulations:

Dimethicones play a pivotal role in cosmetic formulations due to their unique properties and versatility. The structural representation of dimethicones illustrates their molecular composition.

Dimethicomes

- **Dimethicone is referred to** as a capped silicone polymer because of the attachment of nonreactive trimethylsilyl as the end group.
- **On the other hand, dimethiconol** is an uncapped polymer that may undergo **self-condensation** in drying with hydroxyl/methoxyl end units.
- **Dimethicone and dimethiconol uniformly** and readily spread on hair/skin, resulting in the formation of thin hydrophobic films providing lubricity, increases in shine, protection of hair from humidity, and generating a breathable barrier on the skin.



Dimethicone

Jones A, Kramer R. Facial cosmetics and attractiveness: comparing the effect sizes of professionally-applied cosmetics and identity. PLoS One 2016;11(10):e0164218.

Cap Silicon Polymer - Dimethicone:

Dimethicone, often referred to as a cap silicon polymer, features non-reactive trimethylsilyl as the end group. This specific structure distinguishes it from other polymers.

Uncapped Polymer - Dimethyl Conol:

Dimethyl conol, on the other hand, is an uncapped polymer, capable of self-condensation during drying, featuring hydroxyl methyl end units.

Applications and Benefits:

Dimethicone and dimethyl conol exhibit uniform spreading on hair and skin, forming a thin hydrophobic film. This film offers benefits such as increased lubricity, enhanced shine, humidity protection for hair, and the creation of a breathable barrier on the skin.

Functional Use as Deformers and Skin Protectors:

Dimethicones can function as deformers in formulations containing fatty alcohol, preventing the soaping effect. Their high gas diffusivities enable skin respiration, making them valuable as skin protectors.

Versatile Applications:

Dimethicone liquid formulations find applications in skincare, contributing to skin lubrication and softening. Their high molecular weight makes them a key ingredient in color cosmetics and sun skin lotions. Additionally, dimethyl silicon fluids are used in some bleaching and dyeing formulations.

Understanding the distinct characteristics and applications of dimethicones enhances their effective utilization in various cosmetic products, offering benefits across skincare, hair care, and color cosmetics.

Cellulose Derivatives in Personal Care:

Cellulose derivatives, particularly methylcellulose ethers, play a vital role in personal care products due to their water solubility and diverse applications.

Methylcellulose Ethers:

Methylcellulose ethers, soluble in water, belong to a versatile class of polymers widely used in cosmetics. They serve various functions such as thickening in liquid formulations and acting as binders in solid formulations.

Diverse Functions in Personal Care:

Products containing methylcellulose act not only as thickeners but also as film formers, lubricants, and leather enhancers in personal care formulations. Their gelling and reentering properties further contribute to their versatility.

Leather Enhancer in Cleaning Agents:

Alkyl ethoxylate sulfate and sodium salt of ethylene phthaloalkyl triethylene sulfate find application as leather enhancers in cleaning agents, enhancing the quality and feel of the leather.

Water-Soluble Non-Ionic Cellulose Ethers:

Commercially prepared hydroxyl group-based water-soluble non-ionic cellulose ethers serve as essential components in personal care products. They contribute to body washers, shaving creams as thickeners, and act as leather enhancers.

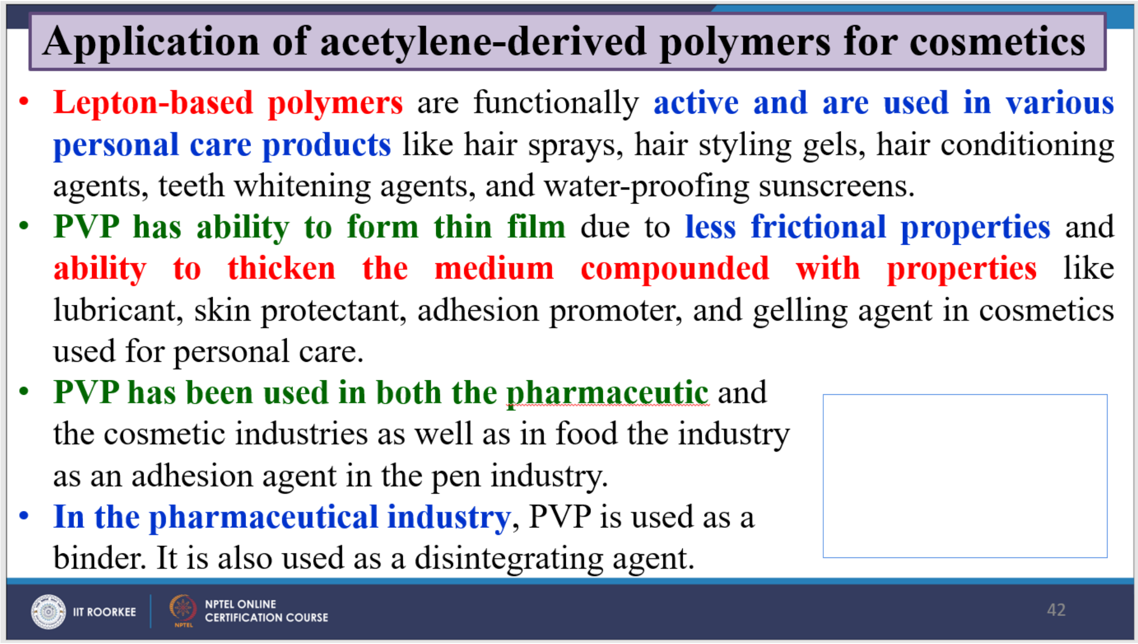
Acetylene-Derived Polymer for Cosmetics:

Polyvinyl pyrrolidine (PVP), invented by German chemist Walter Ripp through the Rippe process, involves acetylene reacting with formaldehyde under high temperature and pressure conditions. The resulting PVP or methyl vinyl ether polymers possess film-forming capacity and find applications in hair styling products.

Laptone-Based Polymers:

Functionally active laptone-based polymers are employed in various personal care products, including hair sprays, hair styling gels, hair conditioning agents, teeth whitening agents, and waterproofing sunscreens.

Understanding the diverse roles of cellulose derivatives and acetylene-derived polymers allows for their effective incorporation into a wide array of personal care formulations, contributing to enhanced performance and user experience.



Polyvinyl Pyrrolidone (PVP) in Cosmetics:

Polyvinyl Pyrrolidone, commonly known as PVP, exhibits versatile properties in cosmetic formulations, making it a popular choice.

Diverse Cosmetic Applications:

PVP has the ability to form a thin film with low frictional properties, making it an ideal component for various cosmetic applications. Its versatility extends to functioning as a lubricant, skin protectant, adhesion promoter, and gelling agent in personal care products.

Widespread Industry Use:

PVP finds applications not only in cosmetics but also in the pharmaceutical, food, and pen industries. In pharmaceuticals, PVP serves as a binder and disintegrating agent, showcasing its multifunctional utility.

Chitin and Chitosan in Cosmetics:

Chitin and chitosan, though not naturally present in human skin, demonstrate remarkable properties when applied, particularly in the context of wound healing and scar reduction.

Chitin Fibers:

Chitin fibers, obtained through weight splitting in a sodium hydroxide solution, serve as non-allergenic, dual-action antibacterial agents and moisture controllers in cosmetics. Their application accelerates wound healing processes.

Hydrating Properties of Chitin:

Chitin proves to be an effective hydrating agent, delivering prolonged hydration effects by preventing rehydration. This natural compound plays a crucial role in supplying and retaining water on the skin.

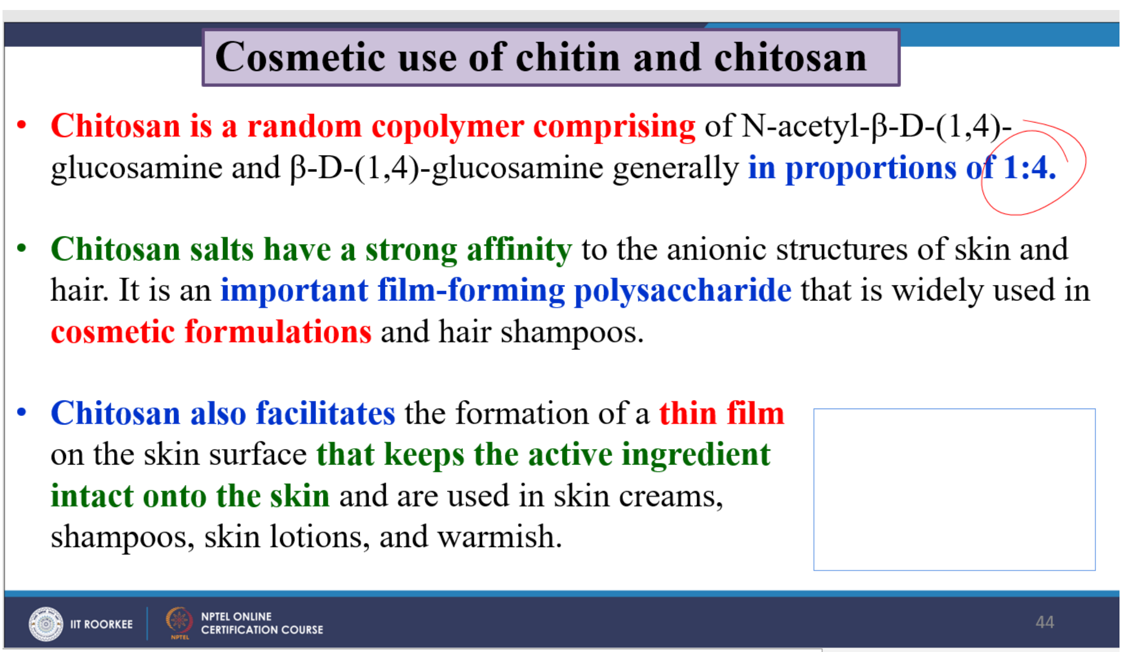
Cationic Nature of Chitosan:

Chitosan, a naturally occurring cationic polysaccharide, and its derivatives enable close contact between active principles and the skin. Chitosan salt exhibits a strong affinity for the anionic structures present in the skin and hair.

Understanding the diverse applications of PVP, chitin, and chitosan highlights their significance in enhancing the performance and functionality of various cosmetic and personal care formulations.

Chitosan's Role in Cosmetic Formulation:

Chitosan, a crucial film-forming polysaccharide, plays a significant role in cosmetic formulations, especially in hair shampoos. Its versatile applications extend to facilitating the formation of a thin film on the skin surface, ensuring the integrity of active ingredients. Chitosan finds use in various cosmetic products, including skin creams, shampoos, skin lotions, and varnishes.



Conclusion

In conclusion, polymers emerge as integral components in cosmetic formulations, each serving a specific function based on their unique properties. The discussion has covered five main types of polysaccharide-based polymers, emphasizing their role as thickeners and stabilizing agents.

Proteins and their derivatives contribute essential properties such as substantivity, binding capacities, solubility, and film formulation. These characteristics make them well-suited for a range of cosmetic formulations, enhancing their performance in emulsification.

Silicon and its derivatives have been explored for their applications in anti-wrinkle creams and makeup formulations. The technological advancements in suspending agents and processes, such as emulsification and associative thinning, have led to increased utilization of silicon in cosmetics.

The diverse range of polymers discussed underscores their vital roles in cosmetic products. For further exploration and understanding, a list of references has been provided. This comprehensive overview highlights the multifaceted contributions of polymers to the field of cosmetics. Thank you for your attention.