

**Subject: Pharmaceutical Sciences**

Production of Courseware

**e-Content for Post Graduate Courses**



### Development Team

Principal Investigator

Prof. Farhan J Ahmad  
Jamia Hamdard, New Delhi

Paper Coordinator

Dr. Javed Ali  
Jamia Hamdard, New Delhi

Content Writer

Dr RabeaParveen  
Jamia Hamdard, New Delhi

Content Reviewer

Dr. Jasjeet Kaur Narang  
Department of Pharmaceutics, Khalsa College of  
Pharmacy, Amritsar

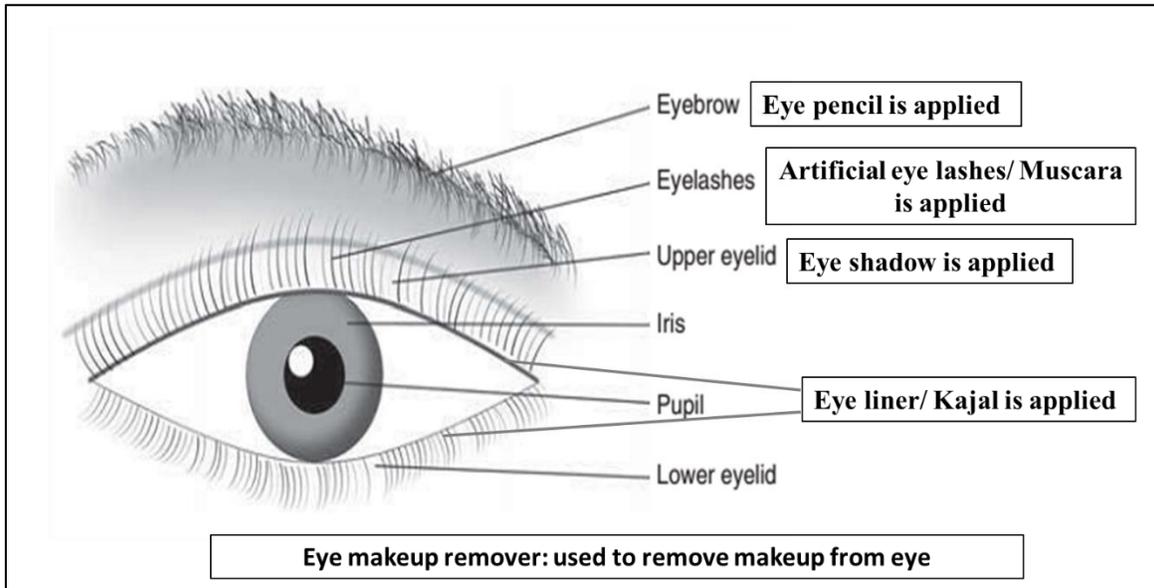
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## 1. INTRODUCTION

The eye is the delicate organ in human body, with a several parts in a near-spherical structure. Each part of the eye is responsible for a certain action. The external structure of eye is given in Fig. 1. The external structures of eye includes:



**Fig. 1: Anatomy (external parts) of eye and points for eye makeup**

### Eyebrow

- Thick and delicate hairs above eyes to prevent water, sweat or other debris from dropping down into the socket of eye.
- Important to facial expression and human communication.

### Eye lids

- Thin layer of skin on outer surface to protect surface of eyes from injury.
- Protect eyes by blinking if foreign matters (dirt, dust or debris) come too close to eyes, and bright light that will be harmful to eyes.
- Helps to moisten eyes.

### Eye lashes

- Gives additional protection to eyes.
- Filter foreign matter like dirt, dust, debris or dandruff and prevent them from falling the eye surface.

### Eye makeup

During all dynasties and periods, the eye makeup remained a daily pre-requisite for women. Eyes are not only the windows to the human soul, but also a powerful tool for communication. A brace of dazzling eyes is a sign of good looks and beauty. Since centuries, eye makeup has played an important role in highlighting the eyes. In historical eras and time periods, different types of colors, styles and trends were used to decorate the eyes. Black pigment/color in the form of kohl was used for centuries to accentuate eyelashes, eyebrows and eyelids.

## 2. TYPES OF EYE MAKEUP PRODUCTS

### 2.1. Mascara

Mascara (Fig. 2) is intended to make eyelashes longer, thicker and darker thereby producing an intense look. It makes the contrast between the sclera (white part of eye) and the iris (colored part of eye) and dramatizes and accentuates the eyes. Mascara consists of a combination of waxes, texturizers, pigments, emulsifiers and aqueous/ non aqueous solvents. Earlier it used in the form of cake but nowadays is used in liquid form.



**Fig. 2: Mascara intended for highlighting the eyelashes to make thicker and longer.**

Different types of brushes or wands (Fig. 3) are available for applying mascara onto the eyelashes to increase the volume, lengthen, curl or taper the eyelashes.



**Fig. 3: Different types of wands for applying mascara**

## 2.2. Eyeliners

Eyeliners (Fig. 4) are formulated to contour the eyes by drawing a precise line at the base of lower and upper eyelashes. Eyeliners give the illusion of smaller or bigger eyes, and bring out the contrast between sclera and iris. Eyeliners are emulsions consisting of texturizers, emollients, pigments, emulsifiers and water. Polymers are added to increase the viscosity of liquid liners, to provide texture to the formulation and also to increase the adhesiveness of product to eyelids. Eyeliners are available in different forms like pencil, gel/crème, liquid and cake.



**Fig. 4: Types of eyeliners designed for making an outline of eyes for giving proper shape**

### 2.3.Eyebrow liners

Eyebrow liner (Fig. 5) is used to highlight the natural outline and hairs of eyebrows, creates fuller brows, and covers areas of having no hair. Their composition (water, emollients, texturizers, pigments, and emulsifiers) is identical to eyeliners but they are little harder than the eyeliners.



**Fig. 5: Eyebrow liners designed to accentuate the eyebrow and make it darker and properly shaped**

## 2.4. Eyeshadows

Eye shadows (Fig. 6) are available in the market to add dimension and depth to the eyes, make eyes bigger and attractive thereby drawing attention to the eye color or eye appearance. They are designed to apply to eyelids and below eyebrows. Eye shadows are formulated in the form of crème/gel, stick and powders, either pressed or loose.



**Fig. 6: Different colors of eye shadows with varying shades used to accentuate the eyelids**

## 2.5. False eyelashes

Eyelashes extension is becoming the latest trend throughout the world for creating bold and good looks. False eyelashes (Fig. 7) are used for modifying the length and thickness of the natural eyelashes to enhance beauty. False eyelash is synthetic and looks like a real eyelash, which applies hair by hair basis on to the eyelashes for a natural look.



**Fig. 7: Different sizes and thickness of eyelashes to enhance the beauty**

## 2.6. Eye makeup removers

Makeup remover products (Fig. 8) are formulated to remove eye makeup from eyes. These removers are available in the form of cream, lotion, and wet remover pads. Makeup remover pads are soft moisturizing pads that make easy to clean eye makeup even waterproof mascara and safe for sensitive eyes.



**Fig. 8: Eye makeup remover products in the form of cream, lotion and wet pads**

## 3. REQUIRED QUALITIES AND CHARACTERISTICS AND CONSUMER NEEDS

From a consumer point of view, the quality of eye makeup products should have the following features:

- Non-irritant , non-toxic and non-allergic
- Available in different attractive shades

- Produce homogeneous color after application
- Long lasting effect
- Good coverage property
- Water resistance
- Dry quickly on application
- Ease in application and remove without hurting the skin/eye
- Adhere firmly to eyelashes and eyelids without brittleness and tackiness
- No clumping and flakiness in mascara
- Good gliding property in eye pencils or liners

Eye makeup products should possess some technical qualities, summarized as below:

- It should have long-term stability
- It should be dermatological safe
- It should have rheological properties
- It should have high retention power
- The color intensity should be same without any change in shade
- It should have good pay-off in case of pressed powders.
- Loose powders should have good free-flowing properties.
- Eye makeup removers should be able to clean the skin around the eyes and remove waterproof eye makeup without producing any undesirable effect.

The eyemakeup removers should possess the following characteristics:

- Should have good tolerance capacity and produce no irritation
- pH should be equal to that of human tear
- Should be isotonic to avoid irritation
- Should have sufficient cleansing power to remove eye makeup without any undesirable effect
- Should have pleasant odor or neutral

- Should be non-greasy and non-tacky
- Should be dermatological safe

## 4. INGREDIENTS AND FORMULATION OF EYE MAKEUP PRODUCTS

### 4.1. Mascara and its type

There are two types of mascara available in the market: cake mascara and liquid mascara. Again classified as water-proof and water-resistant mascara. Water-resistant type of mascaras prevent smudging and smearing; and water-proof type does not prevent the penetration of water, but resists smudging or smearing when subjected to water or tears.

#### 4.1.1. *Cake mascara*

Cake mascara was the first eye makeup product available in the market in 1920s and is still present in the today's market. It has a waxy touch and is used for applying onto the eyelashes by wetting an applicator wand, and rub it onto the surface of the mascara cake to pick up the product, and then apply over the lashes. Most of the cake type formulations tend to have slight water sensitivity and smudge with tears or when rubs the eye. This is due to presence of blend of wax/soap/pigment present in cake mascara, which on emulsification with a wet brush produces smudging. To optimize the water repellency and degree of hardness of the formulation, a proportion of excipients can be changed. Glossy appearance of cake is due to presence of waxes, and on the other hand soap gives a dull appearance to formulation. An ideal formulation consists of a low concentration of soap and higher concentration of wax and other fatty materials to provide water resistance to cake mascara film.

The basic components for cake mascara include soaps, like glyceryl monostearate (GMS) and triethanolamine (TEA) stearate, etc; emollients like isopropyl myristate (IPM), lanolin etc; waxes for example carnauba wax, beeswax, etc; antioxidants and pigments. Mascara cakes are generally formulated by incorporating pigments into the blend of soap and hot wax, heat the mixture with continuous mixing. It is then solidified on cooling and the cold mass is moved onto a 3-roll mill

and the size is reduced to form a smooth homogenous mass. The mass produced is either compressed into plastic or metal pans or re-melted and transfer to warm molds.

#### **4.1.2. Liquid mascara**

Water-resistant liquid mascara (cream mascara) is formulated in the form of O/W emulsions by using polymers, waxes, pigments and other components. It is an advanced type of cake mascara, which already includes water.

Water-proof liquid mascaras are anhydrous formulations, which are prepared by dispersing the wax in non-aqueous solvent. The non-aqueous solvent provides a waterproofing effect and at the same time helps in quick drying of the formulation. It provides a long-wearing film on eyelashes, which is resistant to smudging, smearing and water. The main disadvantage of cake type of mascara is that the water-proof property makes difficult to remove from the lashes and necessitates the use of special eye makeup remover.

### **4.2. Excipients used for the preparation of mascara**

The excipients used for water-resistant and water-proof mascaras are almost similar except the solvent, that is non-aqueous solvents are used in water-proof mascaras whereas anhydrous raw materials are used in water-resistant type of mascaras.

#### **4.2.1. Solvents**

Solvents act as a base/vehicle and help in delivery of other ingredients. Water-resistant mascara, contains water as the primary solvent. Other solvents include propylene glycol, glycerin, and sorbitol. Water-proofing solvents include hydrocarbons (polyisobutene, isoeicosane and isododecane), silicones (cyclomethicone) and paraffin distillates (C8-9 isoparaffin).

#### **4.2.2. Structurants**

Structurant provides an optimal and creamy texture to the formulations, which helps in gliding onto the eyelashes. They also help in maintaining the viscosity of the formulations and

known as consistency materials. Examples include waxes (beeswax, carnauba wax, candelilla wax, ozokerite wax) and cetyl alcohol.

#### **4.2.3. Thickeners and stabilizers**

Thickener increases the viscosity thereby improving the stability and texture of the eye formulations. The examples include waxes (beeswax, carnauba wax and candelilla wax), clays (bentonite clay) cellulose derivatives (hydroxyethyl cellulose), gums (arabic gum and xanthan gum), acrylates copolymers, and some emulsifiers having thickening properties (stearic acid). Talc, silica, kaolin and starch are also used as texturizing agents.

#### **4.2.4. Emulsifiers**

Emulsifiers are the important excipients in both types of mascaras. They help in stabilizing the two immiscible phases of formulation and prevent phase separation. The nonionic emulsifiers are generally used like glyceryl stearate, steareth-2 and isoceteth.

#### **4.2.4. Color additives**

Colorants are very important ingredients in every cosmetic preparation since users buy mascaras to highlight or color their eyelashes. All color additives are not approved for sensitive area of eye. The most commonly used colors are brown, black, and blue.

#### **4.2.5. Film-formers**

They promote adhesion of the mascara on the eyelashes and also helps in film formation. Examples include gums (Arabic and xanthum gums), cellulosic polymers (hydroxyethyl cellulose), acrylate copolymers and others (polyvinylpyrrolidone, polyvinyl alcohol, vinyl alcohol-polyvinylpyrrolidone copolymer, and carboxy methyl chitosan).

#### **4.2.6. Preservatives**

Preservatives are used to provide protection against environmental and microbial contamination, mainly in water-based preparations. The examples include potassium sorbate, phenoxyethanol and parabens.

#### **4.2.7. Antioxidants**

Antioxidants are used to prevent rancidification of fixed oils and waxes. The best examples are vitamin E, butylated hydroxytoluene, and butylated hydroxyanisole.

#### **4.2.8. Chelating agent**

It helps to maintain product stability by reacting with metal ions. Ethylene-diamine-tetraacetic acid (EDTA) and its derivatives, like disodium EDTA and tetrasodium EDTA.

#### **4.2.9. Emollients**

They are used in combination with some waxes to maintain the required consistency of the formulations. Emollients used in mascara are palm oil, jojoba oil, castor oil, panthenol and provitamin B5.

#### **4.2.10. Lash-elongating synthetics**

These provide the illusion of false eyelashes. They build on the eyelashes and extend beyond the natural end of the eyelashes. Nylon fibers and rayon silk are the examples of eyelashes elongating synthetics.

#### **4.2.11. Additional ingredients**

Other excipients can include hollow particles to create thicker eyelashes or pearlescent pigments for an extra effect.

### 4.3. Formulation of mascaras

Water-based mascaras are prepared by o/w emulsification process. The water-soluble stabilizers/thickeners are dissolved in water and neutralized. Then, other water-soluble ingredients are added to aqueous phase and heat it. All the oily components like oil, waxes and emollients are mixed and heat the oily phase to melt the excipients. Both the phases should have temperatures and then mixed together by adding drop wise with continuous mixing. Colorants are dispersed in oily phase. After cooling the emulsion, preservatives and other thermo-sensitive components are added and mixed.

A typical formula for cake mascara:

<i>Triethanolamine stearate</i>	<i>15-30 parts</i>
<i>Paraffin</i>	<i>15-30 parts</i>
<i>Yellow beeswax</i>	<i>10 parts</i>
<i>Lanolin</i>	<i>10 parts</i>
<i>Carnauba wax</i>	<i>5-10 parts</i>
<i>Inorganic pigments</i>	<i>10-15 parts</i>
<i>Preservatives</i>	<i>quantity sufficient</i>
<i>Antioxidants</i>	<i>quantity sufficient</i>

A typical formula for liquid type of mascara (quantity in parts by weight):

<i>Pigments</i>	<i>5.0-10.0</i>
<i>Beeswax, yellow</i>	<i>26.00</i>
<i>Ozokerite</i>	<i>4.00</i>
<i>Lanolin</i>	<i>0.50</i>
<i>Preservative</i>	<i>0.25</i>
<i>Aluminium stearate</i>	<i>2.50</i>
<i>Hydrocarbon solvent</i>	<i>quantity sufficient to 100</i>

#### 4.4. Eyeliners

Eyeliners are applied after the eyeshadow in order to give eyes a more attracting appearance. It is available in the form of liquid, pencil, cream/gel or cake.

##### 4.4.1. Liquid eyeliners

Liquid eyeliner can make perfectly defined eye, when applied properly, and provides longer wear than other forms of eyeliners. Liquid type of liner contains color additives dispersed in solvents and are applied with a brush or fine pen-like applicator. Water-resistant liners are deeply pigmented blends/emulsions in water or any other solvents whereas water-proof contains non-aqueous solvents or anhydrous base, containing film-forming agents as used in mascaras. The emulsion should be viscous enough to circumvent running and must dry fast as a smooth and strong film. Polymers are incorporated as thickeners. Thickeners can also increase the adhesiveness of the product to eyelids. Eyeliners consist of almost same type of excipients as mascara but liners have low viscosity than mascaras. The ingredients for liquid type of eyeliners include solvents (water), glycerine, hydrocarbons (polyisobutene and isododecane), thickening agents (xanthan gum), emulsifiers/surfactants (polysorbates, lecithin, polyethylene glycol and glyceryl monostearate), structurants (waxes), pigments, film-formers (polyvinyl pyrrolidone, acrylic derivatives, polyvinyl alcohol, or polyvinyl pyrrolidone-polyvinyl alcohol-copolymer) and preservatives/antioxidants. The method of preparation of liquid eyeliner is same as in case of water-resistant liquid mascaras.

##### 4.4.2. Pencil eyeliners (Soft crayon pencils)

Pencil/crayon eyeliner is supplied in either mechanical plastic cases or wooden cases. The plastic cases are softer and deliver the content with less pressure. The leads are mixture of waxes, oils, hardened fats, pigments and/or pearls. The softness of the blend can be modified by changing the concentration and types of the components used. For example, higher concentration of high melting point, hard wax results in harder leads. The leads are formulated by extrusion

process or by using molds, similar to lip pencils. Eye liners are softer than the lip liners because the skin around eyes is more sensitive than lips.

#### 4.4.3. Eyebrow liners

Eyebrow liners are similar to eyeliners and are available in different range of colors, like black, brownish-black, brown and blue. The pencil type or the wooden-cased type is typically hard, whereas plastic-cased type is little softer. The formula of eyebrow pencils is almost similar to the eyeliners except the higher concentration of waxes in eyebrow pencil to increase hardness. Because the skin under eyebrow is not highly sensitive. The method of preparation is also similar to that of eyeliners (molding and extrusion).

A typical formula for cake type of eyeliner (amount in percent weight):

<i>Kaolin</i>	<i>5%</i>
<i>Zinc stearate</i>	<i>12%</i>
<i>Precipitated calcium carbonate</i>	<i>7%</i>
<i>Pigments</i>	<i>10%</i>
<i>Talc quantity sufficient to</i>	<i>100%</i>

A typical formula for liquid type of eyeliner (amount in percent weight):

<i>Bees wax</i>	<i>25%</i>
<i>Ozokerite</i>	<i>25%</i>
<i>Butyl stearate</i>	<i>8%</i>
<i>Lanolin</i>	<i>2%</i>
<i>Castor oil</i>	<i>25%</i>
<i>Mineral oil</i>	<i>15%</i>
<i>Perfumes</i>	<i>quantity sufficient</i>
<i>Antioxidants</i>	<i>quantity sufficient</i>

## 4.5. Eyeshadows

Eyeshadows are available in the form of creams, sticks and powder either pressed or loose.

### 4.5.1. Cream and gel eyeshadows

Cream eyeshadows are anhydrous emulsions prepared by using oils thickened with either waxes or clay gelling agents. Anhydrous cream eyeshadow is called as cream-to-powder eyeshadow because it glides onto the eyelids in a cream form and then transform into a super soft powder. They have higher viscosity and therefore, the pearls and pigments are uniformly distributed into the cream base. There is an ease in application due to their rheological properties.

The method of preparation of cream type of eyeshadows includes mixing of all ingredients, followed by heating. After heating pearls and the pigments are homogeneously distributed in the hot mixture, cool, and fill it into an appropriate case. Cream eyeshadows are also available as o/w emulsions containing two phases; oily phase contains oils, thickeners and emollients and aqueous phase contains pigments, pearls and preservatives. Their preparation includes an o/w emulsification process and heating, if required. Gelform are water-free or anhydrous type whereas water-based eyeshadow contains solvents along with other excipients.

### 4.5.2. Eyeshadow sticks

Eyeshadow sticks are prepared from oils, waxes and texturizing agents and colors are dispersed in the same blend. They have a soft cream-like texture and glide smoothly onto the eyelids. The main excipients are almost same as of lipsticks. But, eyeshadow stick is softer than lipstick. For formulation of eyeshadow stick, first homogeneous mixture is prepared using pigmented powder with white or off-white components (called as base) like talc blending and grinding. This step is known as extension. After extension of pigments, other white bases are mixed together. Then, fragrances if present, are added to a homogeneous mix. The blend is sprayed onto the powder with mixing. Pearls are added and mixed at last. The powder mixture is then ready for compression.

### 4.5.3. Powder eyeshadows

Powder eyeshadows, either loose or pressed type, are the most popular types. They are applied onto the upper eyelid by lightly stroking a fine brush or a soft sponge-tipped applicator, across the skin. Pressed powder eyeshadows represent the on-the-go form of loose powders. Both types of powders are almost similar except that pressed type contains binders to hold the powder components together.

### 4.5.4. Excipients used in eyeshadows

Powder type formulations are composed of powder excipients, like fillers, pearls and pigments.

- **Fillers:** provide a base for pigments, also helps in diluting the color, e.g. fcolo
- **Absorbents:** used to increase the overall density of the powders, to make them easier for compression, provide matte effect and absorb liquids, e.g. starch, kaolin and calcium carbonate.
- **Binders:** powder binders are used to hold powder particles and provide adherence to skin, e.g. starches. Liquid binders are used as emollients and to disperse pigments, e.g. mineral oil, silicone oils and isopropyl myristate.
- **Thickeners:** used to stabilize the formula, and helps in adherence to the lid, e.g. waxes, clays and natural gums.
- **Emollients:** to maintain the required consistency of formulations, e.g. palm oil, jojoba oil, castor oil and panthenol.
- **Colorants:** used to provide dramatic effects on eye, e.g., iron oxides for brown and black shade, chromium oxide for green shade, ultramarine for blue shade and titanium dioxide for white shade.
- **Preservatives:** to prevent attack of microorganisms, e.g. parabens.

The typical formula for cream type of eyeshadow is (amount in % by weight):

<i>Stearic acid</i>	<i>16%</i>
<i>Petrolatum</i>	<i>25%</i>
<i>Lanolin</i>	<i>5.0%</i>
<i>Propylene glycol</i>	<i>5.0%</i>
<i>Triethanolamine</i>	<i>4.0%</i>
<i>Hydroxybenzoate</i>	<i>0.2%</i>
<i>Water</i>	<i>44%</i>
<i>Perfume</i>	<i>quantity sufficient</i>

A typical formula for powder type of eyeshadow (amount in % by weight):

<i>Pigment</i>	<i>15%</i>
<i>Kaolin</i>	<i>20%</i>
<i>Zinc stearate</i>	<i>7.5%</i>
<i>Lusture pigment</i>	<i>25%</i>
<i>Talc</i>	<i>32.5%</i>

#### 4.5. Eye Makeup Removers 3

Makeup remover is a liquid formulation prepared for thorough removal of eye makeup. It contains an oily phase to dissolve water-proof makeup and an aqueous phase to remove water soluble eye makeup thereby producing conditioning effect to the eyelashes and surrounding area. There are three types of eye makeup removers, available in the market, used to remove the eye makeup from the eye and surrounding area.

- Cleansing milks as o/w emulsions,
- Cleansing waters as aqueous solutions with ultra-mild surfactants
- Cleansing pads & wipes impregnated in makeup remover solution.

#### 4.5.1. Excipients used for preparation of eye makeup remover

- **Solvents:** to provide the base for the formulation, e.g. water used in water-based liquid preparation.
- **Emollients:** to maintain the required consistency and creamy texture of formulations, e.g. mineral oil, jajoba oil, cyclohexasiloxane and isodecylolate.
- **Extra mild surfactants:** are used to help in mixing the oil with water-proof makeup and thereby producing the cleansing action, e.g. poloxamer 184, poloxamer, sulfosuccinate, and PEG-40 stearate
- **Humectants:** to produce moisturizing effect to the skin, e.g. triethylene glycol, propylene glycol, tripropylene glycol and glycerin.
- **Thickeners:** used to provide appropriate rheology to formulation and improve stability of the product, e.g. carbomers.
- **pH buffers:** maintains the overall desired pH level of the final product, e.g. disodium phosphate, dipotassium phosphate and potassium phosphate.
- **Preservatives:** used to enhance product's shelf-life, e.g. cyclotetrasiloxane, benzalkonium chloride, parabens and iodopropynylbutylcarbamate.
- **Chelating agents:** help in cleansing process, allow foaming, and prevent the metals to be deposited onto the skin, e.g. calcium disodium ethylene-diamine-tetraacetic acid and citric acid.
- **Proteins:** to provide skin nourishing effect after cleansing effect.
- **Natural extracts:** are added to the product for different purpose like antioxidant effect, soothing effect, moisturizing effect, etc, e.g. aloe extract and cucumber extract.

A typical formula for eye makeup remover cream:

<i>Imwitor 960</i>	<b>8%</b>
<i>Lanette N</i>	<b>4%</b>
<i>Miglyol 812</i>	<b>3%</b>

<i>Softisan378</i>	<i>7%</i>
<i>Mineral Oil</i>	<i>7%</i>
<i>Hostaphat KL 340N</i>	<i>0.5%</i>
<i>Preservative</i>	<i>quantity sufficient</i>
<i>Perfume</i>	<i>quantity sufficient</i>
<i>Water</i>	<i>100%</i>

Formula for eye makeup remover cleansing milk:

<i>Dextran</i>	<i>0.5 g</i>
<i>2-Ethylhexyl palmitate</i>	<i>25 g</i>
<i>Glycerol</i>	<i>3 g</i>
<i>Carboxyvinylpolymer</i>	<i>0.5 g</i>
<i>Sodium hydroxide</i>	<i>0.3 g</i>
<i>Preservative</i>	<i>quantity sufficient</i>
<i>Water quantity sufficientfor</i>	<i>100 g</i>

Eye makeup removers are formulated as per the prescribed methods for solution preparation or by emulsification method. All hydrophilic excipients are dissolved or dispersed in water with stirring followed by heating at 40°C). Surfactants and preservatives are added to an aqueous phase. All lipophilic components are mixed together and is heated at the same temperature. The oily phase is added to the aqueous phase with thorough mixing to complete the emulsification step. At last, the pH is adjusted.

## 5. EVALUATION OF EYE MAKEUP PRODUCTS

The common parameters tested for evaluation of eye makeup products include:

- **Pressed cake:** cake strength
- **Powder mixtures:** flow properties, bulk and tapped densities, compressibility index
- **Liners:** rigidity
- **Creams and gels:** Spreadability, firmness and texture

- **Common for all eye products:** viscosity, color uniformity, pH, glazing and pay-off, transfer resistance, water resistance and dispersion of pigments, etc.

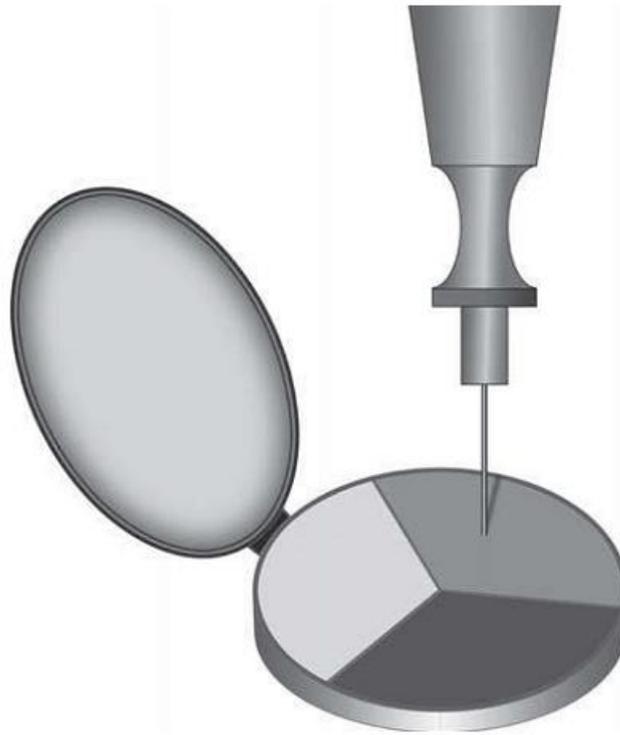
### 6.1. Cake strength

Eyeshadow cakes should be compacted and hard enough to have required stability that prevents the eyeshadow cake from flaking, crumbling and dusting during transportation and use. This property is checked by measuring the cake strength. There are two tests used to determine the cake strength.

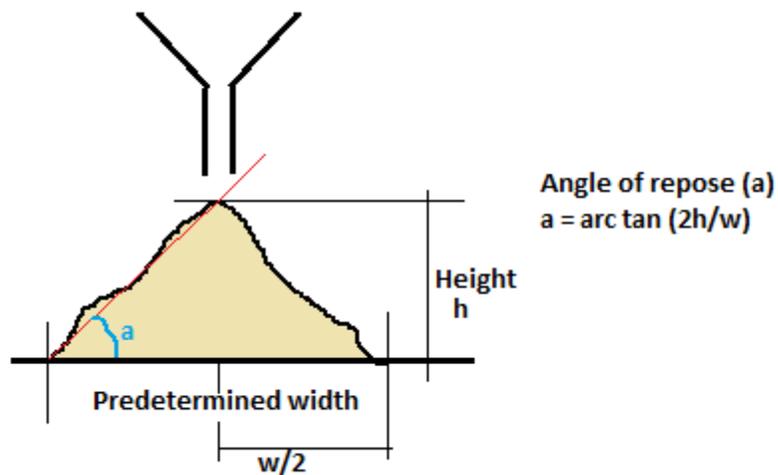
- **Drop test:** Filled godet is dropped on a surface like rubber mat or wooden floor from a set height to determine the ability to resist shock. The number of drops till it breaks will give the idea about the cake strength, which is compared with the standard acceptance values. The drop test simulates the accidental fall off the product by the consumer.
- **Penetration test:** A needle probe (Fig. 9) pierces into pressed cake with a pre-defined force and the length of penetration is noted, or the needle probe penetrates up to a defined distance and force of piercing is determined. This test can also determine the presence of any void space/air pocket beneath the surface, which should not be present.

### 6.2. Flow properties of powders

The flow properties of powder type of eye makeup products should be determined especially during filling process of loose powder to the final container or before the compression of pressed cake in case of compressed powders. Control of the powder flow and density of final product is important to achieve high quality of the finished eye makeup products. Flow properties are measured in terms of angle of repose. Smaller the angle of repose, better will be the flow and vice versa. The angle of repose is determined by powder pile method (Fig. 10).



**Fig. 9: Needle probe used to determine the cake strength of the pressed cake type of eyeshadow by penetration test**



**Fig. 10: Determination of angle of repose by powder pile method.**

### 6.3. Bulk density and tapped density

The bulk density ( $V_b$ ) and tapped density ( $V_t$ ) are measured for determining the trapped air in the powder and to ensure free flowability. The bulk density of a powder is the ratio of mass of powder sample (untapped) and its total volume including void spaces/volume. It is expressed as grams per milliliter. Tapped density is obtained after tapping and is measured as the ratio of the known mass of the powder and its total volume occupied without void volume. Tapping of powder is done in a apparatus that lifts and drops the volumetric cylinder containing powder at a fixed distance. Tapped density is always higher than bulk density. Both the densities provide information about the flowability of the powders. The formula for both the densities are given below:

$$\text{Bulk Density}(V_b) = \frac{\text{Mass}}{\text{Bulk Volume}}$$

$$\text{Tapped Density}(V_t) = \frac{\text{Mass}}{\text{Tapped Volume}}$$

### 6.4. Compressibility of powder mixtures

Percent compressibility (Carr's index) and Hausner's ratio are calculated using bulk and tapped densities. Inter-particle interactions significantly influence the powder flow, which are based on these parameters (formula given below). Lower the values of compressibility index and Hausner's ratio, better will be the flow. These interactions are less significant in free-flowing powder samples, and both the densities will be closer in values. Greater inter-particle interactions are there in poor flowing powder samples, and a more difference will be observed between bulk and tapped densities.

$$\text{Compressibility index} = 100 \times \left( \frac{\rho_{\text{tapped}} - \rho_{\text{bulk}}}{\rho_{\text{tapped}}} \right)$$

$$\text{Hausner ratio} = \frac{\rho_{\text{tapped}}}{\rho_{\text{bulk}}}$$

### ***5.5 Glazing and pay-off-pressure testing***

Pay-off means the weight of makeup material transferred onto the eyelids after application of an eyeshadow. Glazing means the appearance of dark and oily surface hardening in the pressed cake of an eyeshadow. By rubbing the pressed cake on a skin in a circular motion for pre-determined duration using a puff or small applicator will give measure of glazing. Signs are observed, and quantity of material transferred to the applicator is also measured. Correct balance should be attained between binder system, the amount of binder applied, and pressure applied while formulating a pressed cake having a good pay-off and is of such hardness that should not break and should not glaze.

### ***6.5. Water resistance***

The water-resistant or waterproof properties of mascaras, eyeliners or eyeshadows can be evaluated by applying a known concentration of the eye makeup product on the backside of the hand and is allowed to set for a minute. The hand is then immersed into water or hold it under running water again for a minute. Remaining amount left on the hand after removing the eye makeup product by/under water, is analyzed visually or using a software made for such analysis.

### ***6.6. Transfer resistance***

Transfer resistance of a cosmetics refers to the ability of a product to resist abrasive removal. It is defined as a resistance against transferring of product from skin to other surfaces like clothes, etc. The test transfer resistance is performed by applying a known concentration of eye makeup product onto the backside of the hand and is allowed to set for a minute. Then, a tissue

paper is touched with slight pressure over the area for a minute without rubbing. The amount of makeup product transferred to tissue paper is analyzed visually or by software used for such analysis.

### ***6.7. Dispersion of pigments and color uniformity***

Homogenous dispersion of pearls and pigments is a critical parameter for quality eye makeup products. Pigments are used in higher concentrations for powder eyeshadows and if any undispersed pigment is present that appears as streaks on application to the skin. Streakiness and color uniformity are evaluated either visually or by spectrophotometric and colorimetric techniques or by image analysis.

## **7. PACKAGING OF EYE MAKEUP PRODUCTS**

The commonly used materials for packing of eye makeup products are different based on the type of eye makeup products.

### ***6.1. Liquid mascara containers***

Mascara is typically marketed in distinct slim bottle containers containing an applicator attached to the cap. Earlier, the applicator was made of nylon; but nowadays molded applicators, with consistent gaps between bristles, of mascara are in use. The advantage of using such applicator is that the small quantity of mascara is loaded on applicator and penetrates deeper into the eyelashes to achieve regular and efficient separation of eyelashes. Wiper is located at the neck of the mascara bottle that prevent remove of excess amount of product, when the applicator is inserted in the bottle. There are number of applicators found with varying textures, colors and shapes.

### ***6.2. Pencil cases***

Eyebrows liners, eyeliners, and eyeshadows, which are available as pencils, are sharpened to allow a fine line to be drawn on specific area. They are found in plastic pencils from which the

lead twists and pushes up during application. The other type of pencil includes one end with a sharp lead with which a fine line is drawn, and other end has a pointed rubber end, which is used for smudging purpose.

### ***6.3. Liquid eyeliner containers***

Liquid type of eyeliners are packed in slim glass or polymeric bottles with a thin pointed brush. Pen type of eyeliners are also marketed, which have pen like more precise felt-tips.

### ***6.4. Godets***

Pressed powders and cake type mascaras are packed into plastic or metallic godets. They are supplied with or without applicator in the final packing. Some may have mirror also.

### ***6.5. Plastic containers with applicator***

Loose powder and cream type eyeshadows are packed into plastic bottles that sometimes also include an applicator. Metallic and plastic tubes along with applicators attached to cap of the tube are also available.

### ***6.6. Glass jar***

Gel and cream eyeliners are marketed in small glass jars and a brush is used for application.