Personal Care Products

Chem 1020, Ron Robertson, Chemistry Dept.

Detergents

Soaps precipitate with hard water ions calcium, iron and magnesium. Detergents are soap-like molecules which do not tend to from precipitates. A typical syndet molecule has a water soluble sodium sulfonate ($-SO_3$ Na) end and an oil-soluble hydrocarbon group.

A. Types of Detergents

- **Anionic - negatively charged polar head**
- **Cationic - positively charged polar head**
- **Nonionic - uncharged polar head**

B. Components of laundry detergents

1. Surfactant - the detergent itself

Laundry detergents use anionic surfactants
Automatic dishwashers use nonionics
Fabric softeners use cationic sufactants

2. Builders - protect the cleaning efficiency of surfactant by sequestration, precipitation, or ion exchange

Phosphates and citrates sequester Ca, Fe, Mg ions
Carbonates precipitate these ions
Aluminosilicates protect by ion exchange

3. Antiredeposition agents - prevent soil from settling back on fabrics

carboxymethylcellulose

4. Fluorescent whitening agents - convert UV to visible blue

5. Corrosion inhibitor - forms film around metal parts, protection from corrosive effects of water

sodium silicate

6. Processing aid - prevent caking, promote flow properties

sodium sulfate

7. Fragrances

8. Oxygen bleach

sodium perborate

9. Borax - helps maintain alkalinity, aids detergent action

sodium tetraborate

10. Enzymes - break down soils and stains by biological action

Hair Care

A. Hair

1. Root
2. Shaft - keratin (fibrous protein)
3. Sebum secreted as a protective film and composed of fats, cholesterol and inorganic salts

B. Shampoo

a detergent solution with other ingredients added used to remove dirt and excess sebum from the hair

1. Detergent (sodium lauryl sulfate also called sodium dodecyl sulfate)
2. Acidifiers -to neutralize the basicity of detergent (Hair protein decomposes in extreme acid or base)
   a. citric acid
   b. phosphoric acid
3. Foam stabilizer - makes rinsing easier
   a. lauramide diethylamine
   b. cocamide MEA

C. Conditioner

1. mineral oil, lanolin, aloe vera, jojoba oil, dimethicone - added to replace sebum
2. humectant - attracts water, reduces static and makes hair more pliable
   glycerin, propylene glycol, sorbitol, ammonium xylene sulfonate
3. protein fragments - fill in the cracks and dents
   animal hides and hoofs
4. substituted ammonium salts - counteract static electricity that builds up in hair; charged end of salt sticks to the hair and the fatty tail sticks out and helps combing
   tricetylammonium chloride
5. Thickener - adds in combing
   xanthan gum and NaCl, cetyl alcohol

D. Dandruff - flaking of dead skin cells

1. zinc pyrithione - slows flaking of cells
2. salicyclic acid - brakes flakes into small pieces

E. Preservative - retards bacterial growth

methylchloroisothiazolinone and methylisothiazolinone

F. Emulsifier - ingredients stay mixed

glycol distearate

G. Opacifier - makes solution opaque

glycol distearate

"The secret of the shampoo conditioner package is that the conditioner stays inactive until rinsing."

Sunscreens

A. 600,000 people are diagnosed each year with skin cancer (1991)

32,000 people diagnosed with malignant melanoma. This has doubled in the last 10 years.

B. Protection needed for

1. UVB - burning of the skin and cancer risk
2. UVA - causes skin to lose elasticity and promotes wrinkling, interferes with immune system

C. Rating of sunscreens is in SPF (sunscreen protection factor) numbers.

This number tells how many times longer you can stay outside in the sun without burning. Rating applies to UVB only.

D. Active ingredients

1. PABA (para-aminobenzoic acid) protects against UVB
2. Padimate (octyl p-dimethylaminobenzoate) protects against UVB
3. Parsol (avobenzene) protects against UVA
4. Benzophenone - protects against UVA and UVB
5. Cinnamic acid and cinnamate derivatives - UVA and UVB
5. Titanium dioxide - a sunblock, white pigment; protects against UVA and UVB

"Regular use of an SPF 15 sunscreen between the ages of 1 and 18 will reduce the lifetime risk of nonmelanoma skin cancer by roughly 4/5"

Mouthwashes

A. Background

Listerine was invented in 1879 and sold as an antiseptic for treating cuts, scrapes and insect bites. It was name after Sir Joseph Lister, the discoverer of the benefits of antiseptics. In 1921 the company started a marketing campaign for Listerine that emphasized the social problem of halitosis (bad breath) and the mouthwash was born. Sales in 1984 totaled over $350 million was the mouthwash industry.

B. Causes of bad breath

(1) Infection of throat or mouth - mouthwashes not effective

(2) Garlic or onions - these chemical are absorbed into the bloodstream and are gradually released from the blood into the lungs - mouthwashes not effective

(3) Smoker's breath - mouthwashes not effective

(4) Bacterial living on tongue and around the teeth feed on bits of food and cells shed from the mouth to produce sulfur compounds -- "morning mouth".- mouthwashes can be effective

C. Active Ingredients

(1) Antiplaque agents - antimicrobial agents
plant oils (thymol, eucalyptol, menthol, methsalicylate), cetylpyridinium chloride and domiphen bromide

(2) Odor neutralizers
zinc compounds such as zinc chloride or sodium zinc citrate

D. Other ingredients

(1) Anesthetic for sore throat
menthol, phenol or sodium phenolate
glycerin spreads a protective coating and astringents such as zinc chloride encourage protective coatings

(2) Sweetener and flavors
saccharin, cinnamon

(3) Anticavity
sodium fluoride and related fluoride compounds

(4) Solvent
water
ethanol - present in varying amounts as high as 27%, dry out mucous membranes, could function as an antiseptic but not in high enough dose

Toothpaste

A. Tooth enamel

Composed of a calcium phosphate compound

$Ca_{10}(PO_4)_6(OH)_2 \Leftrightarrow 10Ca^{+2} + 6PO_4^{-3} + 2OH^-$

Acids react with the OH- to promote demineralization.

B. Plaque

A sticky film of bacteria and food form on the teeth after eating - plaque. These bacteria act on carbohydrates and convert them to organic acids like lactic acid. This promotes demineralization.

C. Tartar

Plaque combines with calcium and phosphate in saliva to form tartar - mainly calcium phosphate and calcium carbonate. This is a hard substance that is difficult to remove.

D. Functions of toothpaste

(1) Remove plaque and stains from teeth

(2) Freshening of breath

(3) Give teeth added resistance to decay

E. Ingredients of toothpaste

(1) Abrasives - scour plaque and stains
hydrated silica (SiO_2), chalk ($CaCO_3$), calcium monohydrogen phosphate ($CaHPO_4$), calcium pyrophosphate ($Ca_2P_2O_7$) and other minerals (baking soda very mild)

(2) Detergents - clean away plaque
sodium lauryl sulfate

(3) Fluoride - strengthens enamel, reduces acid production by plaque
sodium monofluorophosphate, sodium fluoride, stannous fluoride

(4) Anti tartar agents
sodium pyrophosphate ($Na_4P_2O_7$)

(4) Binders - keep solid and liquid together
carrageenan from seaweed

Ingredients of toothpastes (continued)

(5) Flavors - pleasant taste
spearmint, peppermint, wintergreen, cinnamon

(6) Humectants - keep water in the product
sorbitol and glycerin

(7) Colors - cosmetic appeal

(8) Preservatives - retard growth of bacteria in product
methylparaben and propylparaben

(9) Sweeteners
saccharin and sorbitol

(10) Breath odor control
sodium n-lauryl sarcosinate

Cosmetics

A. Definition - a chemical preparation intended to be rubbed, poured, sprinkled, or sprayed on the human body to cleanse, beautify, promote attractiveness or alter appearance

B. Deodorants and antiperspirants

1. Sweat composition differs by heredity and diet but an average would be 99% water, 0.5% salt, small amounts of urea, uric acid, glucose, lactic acid, amino acids and fatty acids. Bacterial action causes "body odor"

2. Deodorants kill odor-causing bacteria, may also contain fragrances
   - benzethonium chloride
   - zinc phenosulfonate
   - other zinc compounds like zinc peroxide remove odors by oxidizing the amines an fatty acids

3. Antiperspirants stop or retard the operation of sweat glands and lower the amount of perspiration
   - aluminum chlorhydrates $Al_2(OH)_5Cl$
     The aluminum ion is an astringent - a chemical species that acts by constricting the opening of sweat glands

C. Skin Care Products

1. Moisture content of epidermal keratin (dead skin cells) is about 10%. pH is about 4

2. Sebum from oil glands helps to prevent moisture loss.

3. Emollients prevent moisture loss through the formation of a waterproof coating.
   - lanolin (grease from wool)
   - avocado, soybean, safflower oils

4. Creams and lotions are emulsions (mostly oil in water but some are water in oil) of emollients and humectants (chemicals that attract water)

- mineral oil - emollient
- stearic acid - emollient
- sorbitol - humectant
- propylene glycol - humectant
- petrolatum - emollient

5. hyaluronic acid supposedly is the moisture binding chemical in infant's skin; retinoic acid is said to reduce wrinkle formation

D. Lipstick

1. Common components
   - dye (dibromofluorescein {yellow/red} and tetrabromofluorescein {purple}) with a metal ion (iron, nickel or cobalt) to form a "lake"

     Aside: a "lake" is a coloring agent made of an organic dye adhering to an inorganic substance called a mordant.
   - Castor oil and alkanes to dissolve the dye
   - Lanolin as an emollient
   - Waxes to cause stiffness
   - Perfume

E. Perfumes, Colognes and Aftershave

1. A cologne is a dilute perfume

2. Perfumes
   - top note - most volatile - extracts from crushed flowers, citrus oils
   - middle note - less volatile - extracts from flowers such as rose, lily, jasmine
   - end note - resins of waxy polymers derived from wood, musk, amber, balsam - ties top and middle notes together and makes scent less sweet, also functions as a sex attractant {unquantified in humans}
   - 75 to 90% ethanol

3. Seven kinds of odors have been identified to match the seven types of olfactory receptors in the nose (camphorous, musky, floral, pepperminty, ethereal, pungent, putrid)
4. Aftershave

- chemical formulation designed to refresh the skin and smooth minor irritations
- composition is about 40 to 60% alcohol, perfume, menthol (0.2%) for a cooling effect, small amounts of weak acids to restore skin pH after shaving with basic soap, aluminum or zinc astringent, and emollient such as glycerin or sorbital.
  Aside: Menthol is a differential anesthetic which anesthetizes most skin sensations except cold. It is widely used as an antipruritic (anti-itch)