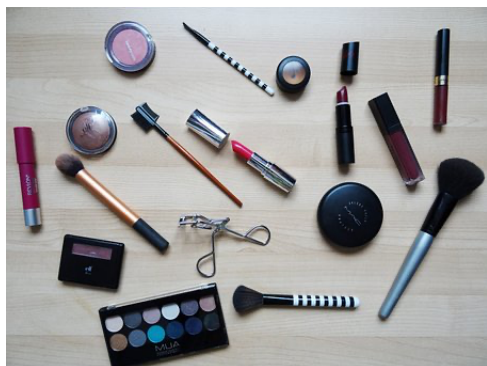


The Chemistry of Cosmetics



Cosmetics are ubiquitous in the modern world.

Cosmetics – makeups, soaps, shampoos, moisturizers, etc. – are ubiquitous in our world today. And they’ve been around a long time. Ancient Egyptians were using a variety of natural products to decorate their skin as long ago as 3000 B.C.E. Kohl, a lead sulfide-containing product, and red ochre (iron oxide) were used as eye shadow and lip color. Cleopatra reportedly bathed herself in milk to maintain soft, smooth skin. It is now known that one of the key components of milk,

lactic acid, supports skin cell turnover. Around the same time, in China, people colored their fingernails to represent their status in society. In 2004, archaeologists discovered a skin lightening cream dating back to around 150 A.D., the time of the Roman Empire. One of the techniques, adding starch to make the cream feel less greasy to the touch, is still used in today’s cosmetic industry.

None of these products, ancient or modern, would exist with chemistry. To create them is to perform chemistry. Cosmetic chemists build new formulas, combine their ingredients, and test their creations before they go on sale. There are thousands of currently approved ingredients that can be combined to make cosmetics. In fact, the United States has a list of at least 12,500 approved chemicals. Each individual product can contain between

15 and 50 different ingredients. However, the most common ingredients are **water**, an **emulsifier**, a **preservative**, a **thickener**, an **emollient**, **pigment**, **fragrance**, and **pH stabilizers**. We will explore each of these ingredients and their contribution to cosmetics below.



Cosmetic creation is a form of chemistry.

Water

Water is often used in cosmetics as a solvent. In chemistry, it is considered the “universal solvent” because more substances dissolve in water than in any other liquid. In cosmetics, it just continues to play the role it’s best at.

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fatty acids from reacting with oxygen by binding to free radicals or undergoing the oxidation reaction themselves. Free radicals are molecules produced when certain substances come into contact with oxygen. They have an odd number of electrons, leaving one unpaired, which means they are highly reactive. An added benefit of antioxidants is that they prevent free radicals from interacting with and damaging the DNA, lipids, and proteins in our skin. This helps slow down the skin aging process.

Antimicrobials protect cosmetics from mold and bacterial growth. They do this by targeting a specific system within the bacteria, virus, or fungus, disrupting its function and killing the organism.



Thickeners are used to achieve the desired consistency.

Thickeners

Thickeners do what you'd expect: thicken a cosmetic product so that it can be easily applied. **Lipid thickeners**, such as wax, are solid at room temperature. When melted and combined with liquid ingredients (e.g. water) in an emulsion, they produce a thick mixture. **Naturally-derived thickeners**, such as cellulose, are hydrophilic, so they take in water and swell, becoming a gel. In a gel, tiny particles are spread throughout a viscous (thick) liquid, in this case arranged in a network. **Mineral thickeners**, such as silica, soak up water or oil and swell to increase the substance's overall viscosity. **Synthetic thickeners**, rather than being naturally-derived, are man-made. They can work in many ways since cosmetic chemists can design them, but the most common is carbomer. Much like cellulose, it swells into a gel network when placed in water. Salt acts as an **ionic thickener**, increasing the viscosity of an anionic (negatively charged) substance.

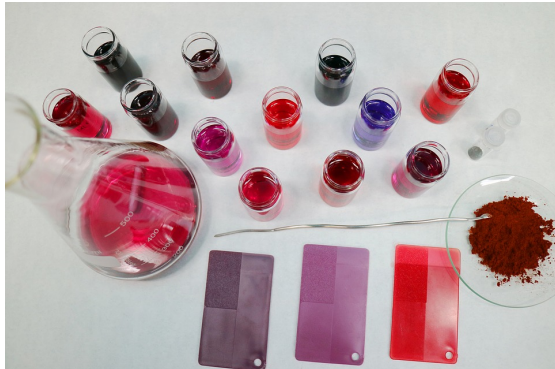
Emollients

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oily while lanolin does not. The best emollients allow products to be easily spread, don't irritate the skin, and are not highly reactive with oxygen. Chemists can also develop synthetic emollients, such as esters, made from an alcohol and a fatty acid. They perform the same tasks as natural emollients and don't leave skin feeling greasy.



Pigments give cosmetics their color.

Pigments

No makeup would be complete without pigments or dyes. They're what give cosmetics their color. There are a wide variety of substances used to color cosmetics, including manganese, coal tar, chromium oxide, mica flakes, iron cyanide, iron oxide, beet powder, cochineal extract (which is made from an insect), lapis lazuli, titanium dioxide, zinc oxide, and zinc stearate. There

are two major categories of pigment, **organic** (carbon-containing) and **inorganic** (usually metal oxides).

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Fragrance

Perfumes and colognes of course have fragrance, as do many soaps and lotions. However, even so-called unscented products have fragrances that conceal the underlying natural scents of the ingredients. The chemical combinations used to generate specific fragrances are closely held

secrets of the companies that make them, but they all come from a list of nearly 4,000 chemicals deemed safe. Included on this list are extracts, such as juniper and lemon pepper, and oils (e.g. jasmine sambac oil), as well as various chemical compounds such as ethyl phenylacetate, benzyl butyrate, dibenzyl ether, and 2-methyl-2,4-pentandiol.



pH must be controlled to ensure the product works as intended.

pH Stabilizers

Finally, pH stabilizers are needed to ensure that the final product works as intended. pH measures how acidic or basic a substance is. It generally ranges between 0 and 14, with lower numbers indicating higher acidity and higher numbers corresponding to greater basicity. Pure water is neutral at pH 7. The pH of a cosmetic needs to be close to that of human skin for it to do its job. Generally, our skin has a slightly acidic pH, between 6 and 4, though this ranges by location.

While neutral products won't work as well on most people, they are appropriate for those with sensitive skin. Therefore, it is essential to both know and be able to control the pH of a cosmetic product during formulation.

Final Thoughts

A lot of planning, research, and testing goes into the production of cosmetics. In addition to the initial formulation, cosmetic chemists need extra of most of these ingredients to tweak each subsequent formula to make sure it matches the approved product.

Reading Comprehension Questions

1. What
2. About how many possible ingredients are approved for use in cosmetics?
3. What
4. What do emulsifiers do? How do they achieve a mixture of oil and water?
5. What are the two main types of preservatives used in cosmetics?
6. How
7. Name
8. What do emollients do? Describe their three components.
9. What
10. About how many possible chemicals are approved for use in fragrance?
11. What

Extension Questions

12. Choose a
13. Parabens

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