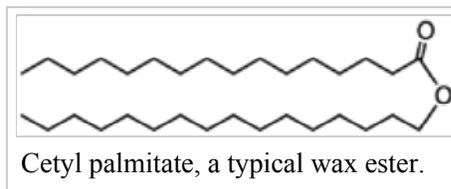


Wax

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Waxes are a diverse class of organic compounds that are hydrophobic, malleable solids near ambient temperatures. They include higher alkanes and lipids, typically with melting points above about 40 °C (104 °F), melting to give low viscosity liquids. Waxes are insoluble in water but soluble in organic, nonpolar solvents. Natural waxes of different types are produced by plants and animals and occur in petroleum.



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Chemistry

Waxes are organic compounds that characteristically consist of long alkyl chains. They may also include various functional groups such as fatty acids, primary and secondary long chain alcohols, unsaturated bonds, aromatics, amides, ketones, and aldehydes. They frequently contain fatty acid esters as well.

Synthetic waxes are often long-chain hydrocarbons (alkanes or paraffins) that lack functional groups.^[1]

Plant and animal waxes

Waxes are synthesized by many plants and animals. Those of animal origin typically consist of wax esters derived from a variety of carboxylic acids and fatty alcohols. In waxes of plant origin characteristic mixtures of unesterified hydrocarbons may predominate over esters.^[2] The composition depends not only on species, but also on geographic location of the organism.

Animal waxes

The most commonly known animal wax is beeswax, but other insects secrete (release) waxes. A major component of the beeswax used in constructing honeycombs is the ester myricyl palmitate which is an ester of triacontanol and palmitic acid. Its melting point is 62-65 °C. Spermaceti occurs in large amounts in the head oil of the sperm whale. One of its main constituents is cetyl palmitate, another ester of a fatty acid and a fatty alcohol. Lanolin is a wax obtained from wool, consisting of esters of sterols.^[1]

Plant waxes

Plants secrete waxes into and on the surface of their cuticles as a way to control evaporation, wettability and hydration.^[3] The epicuticular waxes of plants are mixtures of substituted long-chain aliphatic hydrocarbons, containing alkanes, alkyl esters, fatty acids, primary and secondary alcohols, diols, ketones, aldehydes.^[2] From the commercial perspective, the most important plant wax is carnauba wax, a hard wax obtained from the Brazilian palm *Copernicia prunifera*. Containing the ester myricyl cerotate, it has many applications, such as confectionery and other food coatings, car and furniture polish, floss coating, surfboard wax and other uses. Other more specialized vegetable waxes include candelilla wax and ouricury wax.

Modified plant and animal waxes

Plant and animal based waxes or oils can undergo selective chemical modifications to produce waxes with desirable properties than are available in the unmodified starting material.^[4] This approach has relied on green chemistry approaches including olefin metathesis and enzymatic reactions and can be used to produce waxes from inexpensive starting materials like vegetable oils.^{[5][6]}

Petroleum derived waxes

Although many natural waxes contain esters, paraffin waxes are hydrocarbons, mixtures of alkanes usually in a homologous series of chain lengths. These materials represent a significant fraction of petroleum. They are refined by vacuum distillation. Paraffin waxes are mixtures of saturated n- and iso-



Ceroline brand wax for floors and furniture, first half of 20th century. From the Museo del Objeto del Objeto collection

alkanes, naphthenes, and alkyl- and naphthene-substituted aromatic compounds. A typical alkane paraffin wax chemical composition comprises hydrocarbons with the general formula C_nH_{2n+2} , such as Hentriacontane, $C_{31}H_{64}$. The degree of branching has an important influence on the properties.

Millions of tons of paraffin waxes are produced annually. They are used in foods (such as chewing gum and cheese wrapping), in candles and cosmetics, as non-stick and waterproofing coatings and in polishes.

Montan wax

Montan wax is a fossilized wax extracted from coal and lignite. It is very hard, reflecting the high concentration of saturated fatty acids and alcohols. Although dark brown and odorous, they can be purified and bleached to give commercially useful products.

Polyethylene and related derivatives

Some waxes are synthesized by cracking polyethylene at 400 °C. The products have the formula $(CH_2)_nH_2$, where n ranges between about 50 and 100. As of 1995, about 200 million kilograms/y were consumed.^[3]

Uses

Waxes are mainly consumed industrially as components of complex formulations, often for coatings.^[3] The main use of polyethylene and polypropylene waxes is in the formulation of colourants for plastics. Waxes confer matting effects and wear resistance to paints. Polyethylene waxes are incorporated into inks in the form of dispersions to decrease friction. They are employed as release agents. They are also used as slip agents, e.g. in furniture, and corrosion resistance.



Wax candle.

Candles

Waxes and hard fats such as tallow are used to make candles, used for lighting and decoration.

Wax products

Waxes are used as finishes and coatings for wood products.^[7] Beeswax is frequently used as a lubricant on drawer slides where wood to wood contact occurs.

Other uses

Sealing wax was used to close important documents in the Middle Ages. Wax tablets were used as writing surfaces. There were different types of wax in the Middle Ages, namely four kinds of wax (Ragusan, Montenegro, Byzantine, and Bulgarian), "ordinary" waxes from Spain, Poland, and Riga, unrefined waxes and colored waxes (red, white, and green).^{[8][9]} Waxes are used to make wax paper, impregnating and coating paper and card to waterproof it or make it resistant to staining, or to modify its surface properties. Waxes are also used in shoe polishes, wood polishes, and automotive polishes, as mold release agents in mold making, as a coating for many cheeses, and to waterproof leather and fabric. Wax has been used since antiquity as a temporary, removable model in lost-wax casting of gold, silver and other materials.

Wax with colorful pigments added has been used as a medium in encaustic painting, and is used today in the manufacture of crayons, china markers and colored pencils. Carbon paper, used for making duplicate typewritten documents was coated with carbon black suspended in wax, typically montan wax, but has largely been superseded by photocopiers and computer printers. In another context, lipstick and mascara are blends of various fats and waxes colored with pigments, and both beeswax and lanolin are used in other cosmetics. Ski wax is used in skiing and snowboarding. Also, the sports of surfing and skateboarding often use wax to enhance the performance.

Some waxes are considered food-safe and are used to coat wooden cutting boards and other items that come into contact with food. Beeswax or coloured synthetic wax is used to decorate Easter eggs in Romania, Ukraine, Poland, and the Czech Republic. Paraffin wax is used in making chocolate covered bon-bons. Wax is also used in wax bullets, which are used as simulation aids.

Specific examples

Animal waxes

- Beeswax - produced by honey bees
- Chinese wax - produced by the scale insect *Ceroplastes ceriferus*
- Lanolin (wool wax) - from the sebaceous glands of sheep
- Shellac wax - from the lac insect *Kerria lacca*
- Spermaceti - from the head cavities and blubber of the sperm whale



A typical modern wax sculpture of Cecilia Cheung at Madame Tussauds Hong Kong.



Wax-decorated Easter eggs as made in the Ukraine and the Czech Republic.

Vegetable waxes

- Bayberry wax - from the surface wax of the fruits of the bayberry shrub, *Myrica faya*
- Candelilla wax - from the Mexican shrubs *Euphorbia cerifera* and *Euphorbia antisiphilitica*
- Carnauba wax - from the leaves of the Carnauba palm, *Copernicia cerifera*
- Castor wax - catalytically hydrogenated castor oil
- Esparto wax - a byproduct of making paper from esparto grass, (*Macrochloa tenacissima*)
- Japan wax - a vegetable triglyceride (not a true wax), from the berries of *Rhus* and *Toxicodendron* species
- Ouricury wax - from the Brazilian feather palm, *Syagrus coronata*.
- Rice bran wax - obtained from rice bran (*Oryza sativa*)
- Soy wax - from soybean oil
- Tallow Tree wax - from the seeds of the tallow tree *Triadica sebifera*.

Mineral waxes

- Ceresin waxes
- Montan wax - extracted from lignite and brown coal
- Ozocerite - found in lignite beds
- Peat waxes

Petroleum waxes

- Paraffin wax - made of long-chain alkane hydrocarbons
- Microcrystalline wax - with very fine crystalline structure

See also

- Slip melting point
- Wax argument or the "ball of wax example", is a thought experiment originally articulated by René Descartes.

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External links

- Waxes (<http://www.cyberlipid.org/wax/wax0001.htm>)



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