

Resin

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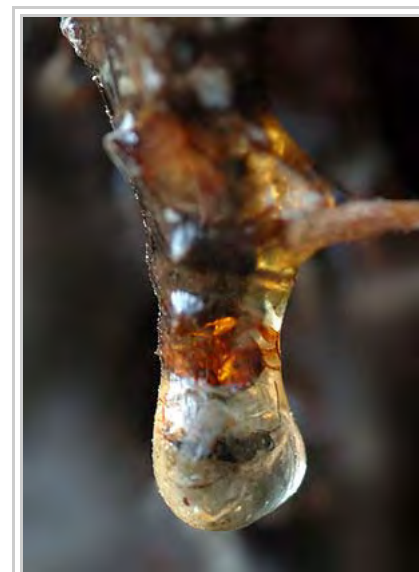
In polymer chemistry and materials science, **resin** is a "solid or highly viscous substance," which is typically convertible into polymers.^[1] Such viscous substances can be plant-derived or synthetic in origin. They are often mixtures of organic compounds. Many plants, particularly woody plants produce resin in response to injury. The resin acts as a bandage protecting the plant from invading insects and pathogens.^[2]

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Cedar of Lebanon cone showing flecks of resin as used in the mummification of Egyptian Pharaohs.



Insect trapped in resin

Examples of natural resins and related materials

Plants secrete resins and rosins for their protective benefits. They confound a wide range of herbivores, insects, and pathogens; while the volatile phenolic compounds may attract benefactors such as parasitoids or predators of the herbivores that attack the plant.^[3]

Resins

The resin produced by most plants is composed mainly of terpenes and derivatives. The most common terpenes in resin are the bicyclic terpenes alpha-pinene, beta-pinene, delta-3 carene, and sabinene, the monocyclic terpenes limonene and terpinolene, and smaller amounts of the tricyclic sesquiterpenes, longifolene, caryophyllene and delta-cadinene. Some resins also contain a high proportion of resin acids. The individual components of resin can be separated by fractional distillation. Rosins on the other hand are less volatile and consist, inter alia, of diterpenes.

Notable examples of plant resins include amber, Balm of Gilead, balsam, Canada balsam, Boswellia, copal from trees of *Protium copal* and *Hymenaea courbaril*, dammar gum from trees of the family Dipterocarpaceae, Dragon's blood from the dragon trees (*Dracaena* species), elemi, frankincense from *Boswellia sacra*, galbanum from *Ferula gummosa*, gum guaiacum from the lignum vitae trees of the genus *Guaiacum*, kauri gum from trees of *Agathis australis*, hashish (Cannabis resin) from *Cannabis indica*, labdanum from mediterranean species of *Cistus*, mastic (plant resin) from the mastic tree *Pistacia lentiscus*, myrrh from shrubs of *Commiphora*, sandarac resin from *Tetraclinis articulata*, the national tree of Malta, styrax (a Benzoin resin from various *Styrax* species), Spinifex resin from Australian *Spinifex* grasses, and turpentine, distilled from pine resin. Amber is fossil resin (also called resinite) from coniferous and other tree species. Copal, kauri gum, dammar and other resins may also be found as subfossil deposits. Subfossil copal can be distinguished from genuine fossil amber because it becomes tacky when a drop of a solvent such as acetone or chloroform is placed on it.^[4]

Fossil resins

Certain resins are obtained in a fossilized condition, amber being the most notable instance of this class. African copal and the kauri gum of New Zealand are also procured in a semi-fossil condition.

Rosin

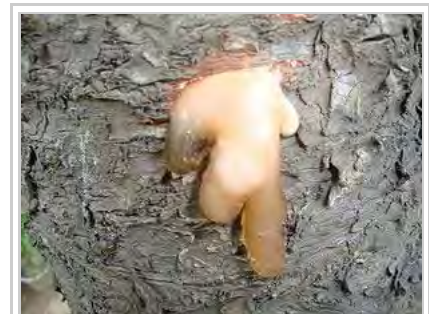
Solidified resin from which the volatile terpene components have been removed by distillation is known as rosin. Typical rosin is a transparent or translucent mass, with a vitreous fracture and a faintly yellow or brown colour, non-odorous or having only a slight turpentine odor and taste. Rosin is insoluble in water, mostly soluble in alcohol, essential oils, ether and hot fatty oils, and softens and melts under the influence of heat, and burns with a bright but smoky flame.

Rosin consists of a complex mixture of different substances including organic acids named the resin acids. These are closely related to the terpenes, and derive from them through partial oxidation. Resin acids can be dissolved in alkalis to form resin soaps, from which the purified resin acids are regenerated by treatment with acids. Examples of resin acids are abietic acid (sylvic acid), $C_{20}H_{30}O_2$, plicatic acid contained in cedar, and pimaric acid, $C_{20}H_{30}O_2$, a constituent of galipot resin. Abietic acid can also be extracted from rosin by means of hot alcohol; it crystallizes in leaflets, and on oxidation yields trimellitic acid, isophthalic acid and terebic acid. Pimaric acid closely resembles abietic acid into which it passes when distilled in a vacuum; it has been supposed to consist of three isomers.

Rosin is obtained from pines and some other plants, mostly conifers.^[5] Plant resins are generally produced as stem secretions, but in some Central and South American species such as *Euphorbia dalechampia* and *Clusia* species they are produced as pollination rewards, and used by some stingless bee species to construct their nests.^{[6][7]} Propolis, consisting largely of resins collected from plants such as poplars and conifers, is used by honey bees to seal gaps in their hives.^[8]

Petroleum- and insect-derived resins

Shellac and lacquer are examples of insect-derived resins.



Extremely viscous resin extruding from the trunk of a mature *Araucaria columnaris*.

Asphaltite and Utah resin are petroleum bitumens, not a product secreted by plants, although it was ultimately derived from plants.

History and etymology

Plant resins have a very long history that was documented in ancient Greece by Theophrastus, in ancient Rome by Pliny the Elder, and especially in the resins known as frankincense and myrrh, prized in ancient Egypt.^[9] These were highly prized substances, and required as incense in some religious rites.

The word *resin* comes from French *resine*, from Latin *resina* "resin", which either derives from or is a cognate of the Greek ῥητίνη *rhētínē* "resin of the pine", of unknown earlier origin, though probably non-Indo-European.^{[10][11]}

The word "resin" has been applied in the modern world to nearly any component of a liquid that will set into a hard lacquer or enamel-like finish. An example is nail polish. Certain "casting resins" and synthetic resins (such as epoxy resin) have also been given the name "resin."

Some resins when soft are known as 'oleoresins', and when containing benzoic acid or cinnamic acid they are called balsams. Oleoresins are naturally occurring mixtures of an oil and a resin; they can be extracted from various plants. Other resinous products in their natural condition are a mix with gum or mucilaginous substances and known as gum resins. Several natural resins are used as ingredients in perfumes, e.g., balsams of Peru and tolu, elemi, styrax, and certain turpentine.^[5]

Non-resinous exudates

Other liquid compounds found inside plants or exuded by plants, such as sap, latex, or mucilage, are sometimes confused with resin, but are not the same. Saps, in particular, serve a nutritive function that resins do not.

Uses

Plant resins

Plant resins are valued for the production of varnishes, adhesives, and food glazing agents. They are also prized as raw materials for the synthesis of other organic compounds and provide constituents of incense and perfume.

The hard transparent resins, such as the copals, dammars, mastic, and sandarac, are principally used for varnishes and adhesives, while the softer odoriferous oleo-resins (frankincense, elemi, turpentine, copaiba), and gum resins containing essential oils (ammoniacum, asafoetida, gamboge, myrrh, and scammony) are more used for therapeutic purposes and incense. The resin of the Aleppo Pine is used to flavour retsina, a Greek resinated wine.^[12]

Synthetic resins

Many materials are produced via the conversion of synthetic resins to solids. Important examples are bisphenol A diglycidyl ether, which is a resin converted to epoxy glue upon the

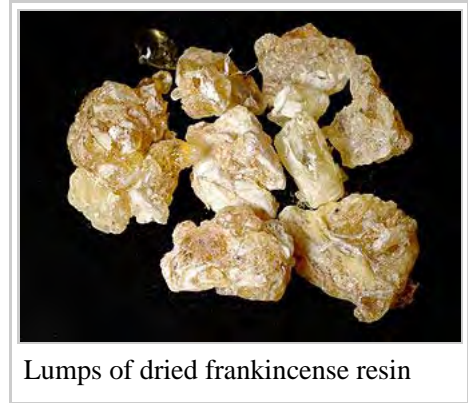


Resin of a pine

addition of a hardener. Silicones are often prepared from silicone resins via room temperature vulcanization.

See also

- Resin extraction – method of harvesting resin from trees
- Balsam of Peru – a balsam used in food and drink for flavoring, in perfumes and toiletries for fragrance, and in medicine and pharmaceutical items.
- Mastic (plant resin) – resin from the *Pistacia lentiscus* tree
- Pitch (resin)
- Kino (gum) – a plant gum similar to resin
- Biodegradable – plant resins are naturally biodegradable in many circumstances.
- Resin casting – casting with a resin, usually using a synthetic not a natural resin.
- Polyresin – a hard, synthetic resin for casting in molds



Lumps of dried frankincense resin

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