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Standard Terminology Relating to Pine Chemicals, Including Tall Oil and Related Products[1]

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1. Scope

1.1 Although the pine chemical industry has been a continuing producer of chemical products for many centuries, the nature of the industry, its products, and its terminology have changed. In particular, the original practice of recovering pine chemical through the processing of the exudate from pine trees has been supplemented by their extraction by solvent products of the wood pulping industry. For many years the industry was known as the Naval Stores industry but that term has gradually been replaced by the more descriptive and meaningful term, Pine Chemicals Industry. Thus, this terminology contains some old terms now mostly of historic value, together with the terms of the modern pine chemical industry.[2]

2. Referenced Documents

2.1 *ASTM Standards:*[3]

D6090 Test Method for Softening Point Resins (Mettler Cup and Ball Method)

E28 Test Methods for Softening Point of Resins Derived from Pine Chemicals and Hydrocarbons, by Ring-and-Ball Apparatus

3. Terminology

abietic acid, commercial grade, *n*—a product consisting chiefly of rosin acids in substantially pure form, separated either from rosin or tall oil commercially for specific purposes and in which abietic acid and its isomers are the principal components.

colophony, *n*—a term denoting medium and high grades of rosin.

crude stripper oil, *n*—a by-product of the manufacture of citrus juice, composed largely of d-limonene and containing up to 1.5 % of aldehydes. (See also **d-limonene**.)

dipentene, *n*—chemically defined as the optically inactive form of the monocyclic terpene hydrocarbon limonene.

DISCUSSION—Commercial dipentenes contain substantial portions of other monocyclic and bicyclic, as well as some oxygenated, terpenes having closely related boiling ranges. They are generally obtained by fractional distillation from crude oils recovered in the several commercial methods of utilizing pine wood, also by isomerization during the chemical processing of terpenes. There is no legal requirement under the Naval Stores Act that the source, origin, or kind of dipentene be shown in the commercial designation. Consequently, coined trade names are sometimes used in selling this product. The four kinds of commercial dipentene are:

chemically processed dipentene, n—recovered as a product or a by-product in connection with the chemical treatment and conversion of other terpenes.

destructively distilled dipentene, n—from the lighter portions of the oil recovered during the destructive distillation of pine wood.

steam-distilled dipentene, n—fractionated from the crude oleoresinous extract during the processing of related steam-distilled wood naval stores.

sulfate dipentene, n—from the crude condensate of the vapors generated in the digestion of wood in the sulfate paper pulp process.

ester gum, *n*—a resin made from rosin and a polyhydric alcohol, generally glycerol or pentaerythritol.

gloss oil, *n*—a solution of limed rosin or limed rosin acids in a volatile solvent, used chiefly in surface coatings.

d-limonene, *n*—a purified optically active terpene hydrocarbon recovered from by-products of the citrus industry.

DISCUSSION—It is used as a chemical intermediate and as a monomer in terpene resins.

metallic resinates, *n*—rosin in which part or all of the rosin acids have been chemically reacted with those metals that give soaps or salts which are water insoluble.

DISCUSSION—Limed rosin, zinc-treated rosin, and the resinates of lead, cobalt, copper, and manganese, are of the greatest industrial importance.

[1] This terminology is under the jurisdiction of ASTM Committee D01 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.34 on Pine Chemicals and Hydrocarbon Resins.

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[2] Zinkel, D. F., and Russell, J., eds., *Naval Stores: Production, Chemistry and Utilization*, Pulp Chemicals Association, NY, 1989.

[3] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

modified rosin, *n*—rosin that has been treated with heat or catalysts, or both with or without added chemical substances, so as to cause substantial change in the structure of the rosin acids, as isomerization, hydrogenation, dehydrogenation, or polymerization, usually without substantial effect on the carboxyl group.

DISCUSSION—The following are types of modified rosin:
disproportionated (dehydrogenated) rosin, n—rosin that has been subjected to chemical or physical treatment, or both, so as to cause substantial simultaneous hydrogenation and dehydrogenation of the rosin acids to form their hydrogenated and dehydrogenated counterparts.
heat-treated rosin, n—rosin in which a reduction of acid number and a positive shift in optical rotation has been brought about by controlled heat treatment only, in order to improve its suitability for specific uses.
hydrogenated rosin, n—rosin that has been treated with hydrogen under conditions that cause a partial or complete saturation of the resin acids present, best indicated by a drop in the refractive index. Commercial hydrogenated rosin is usually only partially saturated.

*polymerized rosin***,** *n*—rosin that has been treated by chemical or physical means, or both, in a manner so as to cause the formation of dimers (and some trimers) to such an extent that the average molecular weight of such rosin will be measurably greater than that of the original rosin. Also known as "dimerized rosin."

monocyclic terpenes, *n*—a designation sometimes used in the trade to describe a heterogeneous mixture of monocyclic, bicyclic, and other related terpene $C_{10}H_{16}$ hydrocarbons recovered or removed in the fractionation of certain terpenes or other essential oils, or as a by-product in the chemical conversion of pinenes generally sold under trade names.

DISCUSSION—The term "other monocyclic hydrocarbons," used in statistical reports of the U.S. Department of Agriculture, covers this type of material.

naval stores, *n*—the current name for chemically reactive oils, resins, tars, and pitches derived from the oleoresin contained in, exuded by, or extracted from wood chiefly of the pine species (*Genus Pinus*).

DISCUSSION—The term naval stores was derived from the use of these chemical products for the sealing of the hulls of naval vessels in colonial times. The term survived for many years and was also used to describe the products obtained by upgrading oleoresin and crude tall oil. The term Naval Stores is gradually being replaced by the term Pine Chemicals.

naval stores act, *n*—the U. S. Federal regulation (42 Stat 1435.7 USC 91–99 and 7CFR 160) establishing the quality standards fro naval stores products.

DISCUSSION—It was originally passed by Congress in 1923 and amended in 1951 to include tall oil rosin and sulfate turpentine.

neutral content, *n*—the total amount of material contained in pine chemicals, such as rosin, tall oil, and their derivatives that do not contain any acidic functionality.

DISCUSSION—Neutral content includes unsaponifiable matter and any combined acidic material present as derivatives, such as esters, anhydrides, or lactones.

oil of (pine) tar, *n*—certain heavier fractions of the volatile oil recovered by distilling pine-tar oil to convert it into pine tar.

oil of turpentine, *n*—the pharmaceutical name for spirits of turpentine that conforms to the requirements of the National Formulary.

oleoresin, *n*—pine gum, the nonaqueous secretion of resin acids dissolved in a terpene hydrocarbon oil that is produced or exuded from the intercellular resin ducts of a living tree, and is present, together with oxidation products, in the dead wood of weathered limbs and stumps.

pine needle oil, *n*—an essential oil of typical fragrance obtained by steam distillation of the leaves (needles) of certain species of pine.

DISCUSSION—Some imported oils derived from other conifers are classified as pine needle oil.

pinenes, *n*—bicyclic terpene hydrocarbons, the principal constituent of all turpentines and existing therein in two isomeric forms, alpha-pinene and beta-pinene.

pine oil, *n*—a colorless to amber colored volatile oil with characteristic pinaceous odor, consisting principally of isomeric tertiary and secondary cyclic terpene alcohols, with variable quantities of terpene hydrocarbons, ethers, ketones, phenols, and phenolic ethers, the amount and character of which depend on the source and method of manufacture.

DISCUSSION—The four commercial kinds of pine oil are:
destructively distilled pine oil, n—obtained from the lighter distillate from the destructive distillation (carbonization) of pine wood.
steam-distilled pine oil, n—obtained from the crude oleoresinous extract of pinewood during the processing of related steam-distilled wood naval stores . *sulfate pine oil, n*—a high boiling fraction obtained in the refining and fractional distillation of crude sulfate turpentine.
synthetic pine oil, n—obtained by chemical hydration of pinenes to form monocyclic terpene alcohols, mainly alpha-terpineol.

pine tar, *n*—A product of the destructive distillation of pine wood.

pitch—see tall oil pitch.

reclaimed, rosin, *n*—rosin that has been recovered or reclaimed by any means from waste or deteriorated material, provided that the concentration of rosin acids is not below that normal for rosin, and any residual or contaminating component from the waste material itself or from any article used in the recovery process is not in sufficient quantity to cause the physical or chemical properties of the reclaimed product to differ materially from those of rosin.

*resinates, metallic***—**See **metallic resinates**.

rosin, *n*—a specific kind of natural resin obtained as a vitreous water-insoluble material from pine oleoresin by removal of the volatile oils, or from tall oil by the removal of the fatty acid components thereof or by the solvent extraction of macerated pine wood.

DISCUSSION—It consists primarily of several diterpenoid isomers of tricyclic monocarboxylic acids having the general empirical formula $C_{20}H_{30}O_2$, with small quantities of compounds saponifiable with boiling alcoholic potassium or sodium hydroxide, and some unsaponifiable matter. The three general classifications or kinds of rosin in commerce are:
gum rosin, n—obtained from the oleoresin collected from living trees.
tall oil rosin, n—obtained by the fractional distillation of tall oil. Such rosin shall have the characteristic form, appearance, and other physical

and chemical properties normal for other kinds of rosin.

wood rosin, n—obtained from the oleoresin contained in dead wood such as stumps and knots.

rosin acids or resin acids, *n*—principally monocarboxylic acids with the empirical formula $C_{19}H_{20}$—COOH.

DISCUSSION—It is generally considered that the term "resin acids" is applicable to all substances having the specified molecular formula whereas the term "rosin acids" is only used when referring to those found in rosins. They are classified into two groups: the abietic type and the pimaric type. Both types and their derivatives are found in wood, gum, and tall oil rosins.

rosin adducts, *n*—the addition product between rosin and an α, β unsaturated carboxylic acid such as fumaric acid, acrylic acid or maleic anhydride.

rosin based resins, *n*—resinous products derived from rosin or rosin adducts through chemical reaction with raw materials such as alcohols (especially polyhydric alcohols), formaldehyde, α,β unsaturated carboxylic acids, phenols etc., or combinations of these materials.

DISCUSSION—Rosin based resins are used extensively in printing inks and adhesives.

rosin crystallization, *n*—the formation of rosin acid crystals within rosin.

DISCUSSION—Solid rosin is a supercooled liquid and is normally transparent. However, when the rosin contains a preponderance of one species of resin acid, crystals of that resin acid can form within the rosin giving it a hazy appearance. These crystals create handling problems as they cause the rosin to become less brittle and more difficult to break up. Further, the rosin has to be heated well above its softening point in order to melt the rosin acid crystals and make the rosin homogeneous again. Non-crystallizing rosin also has far better solubility in many solvents and better compatibility with oils and waxes. The crystallization of rosin can be prevented by changing the rosin acid distribution within the rosin through heat treatment with or without a catalyst.

rosin oil, *n*—the relatively viscous, oily portion of the condensate obtained when rosin is subjected to dry destructive distillation; also used to describe specially compounded oils having a rosin oil base.

rosin spirits, *n*—the relatively light, volatile portion of the condensate obtained in the first stages when rosin is subjected to dry destructive distillation.

rosin standards, *n*—the combinations of assembled colored glasses having the colors designated as representative of the established U.S. grades used in classifying rosin.

DISCUSSION—The recognized official standards are those developed and issued by the U.S. Department of Agriculture, or similar standards made of Lovibond glass, when certified by the same Government agency. The official grades established by or under authority of the Federal Naval Stores Act, for which standards are provided, are as follows in order of increasing color *XC, XB, XA, X, WW, WG, N, M, K, I, H, G, F, E, D*, and *FF* (the latter grade is used only for wood rosin). Rosin darker in color than the standard for Grade D or FF is graded B. The designation *Opaque* with the grade letters OP is used to describe rosin that, because of a turbid, cloudy, or nontransparent condition due to occluded moisture, excessive crystallization, or presence of foreign matter other than dirt, cannot be accurately graded by comparison with any of the described rosin grade standards. The availability and use of these standards is decreasing and being replaced by the use of the Gardner color scale.

rosin type (sample), *n*—a sample of rosin, or a mold of thermosetting plastic material, used as an unofficial standard in grading rosin.

DISCUSSION—Such sample shall be so selected, sized, and surface-finished that it will have the form of an approximate ⅞-in. (22 mm) cube with at least two opposite faces having smooth parallel surfaces, and shall have a color when viewed through these faces which matches within rather narrow tolerances the color of the corresponding official Government standard made of glass.

scrape, *n*—the crystallized pine oleoresin collected from the scarified faces of trees being worked for turpentine.

soap skimmings (tall oil), *n*—the curd, not acidified or otherwise processed, skimmed from the black liquor of the alkaline paper pulp industry, from which tall oil is obtained.

softening point of rosin, *n*—the temperature at which rosin softens sufficiently to flow.

DISCUSSION—Rosin is a glassy-like substance and does not have a sharp melting point and so softening point is often used for rosin characterization. The standard techniques used for measuring the softening point of rosin are the Ring and Ball method and the Cup and Ball method as described in Test Methods E28 and D6090, respectively.

spirits of turpentine, *n*—the volatile oil consisting primarily of a number of terpene hydrocarbons of the general formula $C_{10}H_{16}$.

DISCUSSION—Four kinds of turpentine are now recognized:

destructively distilled wood turpentine, n—obtained by fractionation of certain oils recovered by condensing the vapors formed during the destructive distillation of pine wood.

gum turpentine or gum spirits, n—obtained by distilling the crude exuded gum or oleoresin collected from living pine trees.

steam-distilled wood turpentine, n—obtained from the oleoresin within the wood of pine stumps or cuttings, either by direct steaming of the mechanically disintegrated wood or after solvent extraction of the oleoresin from the wood.

sulfate turpentine, n—volatile material recovered during the conversion of wood to paper pulp by the sulfate process. Refined turpentine is the name for a commercially available grade that is produced by removing primarily sulfur compounds from sulfate wood turpentine.

tall oil, *n*—a generic name for a number of products obtained from the manufacture of wood pulp by the alkali (sulfate) process or more popularly known as the kraft process.

DISCUSSION—To provide some distinction between the various products, designations are often applied in accordance with the process or composition, some of which are crude tall oil, acid refined tall oil, distilled tall oil, tall oil fatty acids, and tall oil rosin. The following designations for tall oil shall be considered obsolete:

Crude resinous liquid	Swedish pine oil
Finn oil	Swedish resin
Liquid resin	Swedish rosin
Liquid rosin	Swedish rosin oil
Resin oil	Syulvic oil
Sulfate pitch	Talloel
Sulfate resin	Tallol
Sulfate rosin	

acid refined tall oil, n—the product obtained by treating crude tall oil in solvent solution with sulfuric acid under controlled conditions to remove dark color bodies and odoriferous materials. Removal of the solvent yields a product with lighter color and higher viscosity than crude tall oil with approximately the same fatty acids-to-rosin ratio.

crude tall oil, n—a dark brown substance composed of the mixture of fatty acids, rosin, and neutral materials liberated by the acidification of soap skimmings. The fatty acids are a mixture of oleic acid and linoleic acid with lesser amounts of saturated and other unsaturated fatty acids. The rosin is composed of resin acids similar to those found in gum and wood rosin. The neutral materials are composed mostly of esters, polycyclic hydrocarbons, sterols, and other high-molecular weight alcohols.

distilled tall oil, n—the class of products obtained by distilling crude tall oil in fractionating equipment under reduced pressure under such conditions that the ratio of rosin acids to fatty acids is varied over a wide range. The products that generally contain less than 90 % of fatty acids, are known as distilled tall oils.

tall oil fatty acids, *n*—the class of products containing 90 % or more fatty acids obtained by fractionation of crude tall oil.

DISCUSSION—The fatty acids are primarily oleic and linoleic acids with lesser amounts of saturated and other unsaturated fatty acids. The remainder consists of rosin and neutral materials.

tall oil, distilled—See *distilled tall oil* under **tall oil**.

tall oil rosin—See **rosin**.

tall oil heads (light ends), *n*—the low-boiling fractions obtained by the fractional distillation of crude tall oil under reduced pressure.

DISCUSSION—The composition of these products varies over a wide range but includes palmitic, oleic, linoleic, and stearic acids with lesser amounts of other saturated and unsaturated acids. The neutral materials content is normally high.

tall oil pitch, *n*—the residue from the distillation of crude tall oil. It is generally recognized that tall oil pitches contain some high-boiling esters and neutral materials with lesser amounts of rosin and fatty acids.

tall oil soap, *n*—the product formed by the saponification or neutralization of tall oil with organic or inorganic bases.

terpenes, *n*—a class of unsaturated organic compounds having primarily the empirical formula $C_{10}H_{16}$ occurring in most essential oils and oleoresinous plants.

DISCUSSION—Structurally the important terpenes and their derivatives are classified as monocyclic (dipentene), bicyclic (pinene), and acyclic (myrcene).

terpene alcohol, *n*—an alcohol directly related to or derived from a terpene hydrocarbon.

DISCUSSION—The following are common examples: terpineol (tertiary cyclic), borneol (secondary cyclic), geraniol (primary, acyclic), linalool (tertiary, acyclic).

terpene resins, *n*—the products formed by polymerization of β -pinene, α-pinene, limonene and other terpene hydrocarbons.

turpentine, oil of—See **oil of turpentine**.

turpentine, spirits of—See **spirits of turpentine**.

unsaponifiable matter, *n*—the total amount of non-acidic organic material, both free and combined, present in naval stores products such as rosin, tall oil, and their derivatives after saponification. Unsaponifiable matter is composed primarily of alcohols, sterols, aldehydes, and hydrocarbons. For example, it is material that will not form a soluble soap when refluxed with alcoholic potassium hydroxide.