

Coal tar

Coal tar is a thick dark liquid which is a by-product of the production of coke and coal gas from coal.^{[2][3]} It has both medical and industrial uses.^{[2][4]} As a medication it is used to treat psoriasis and seborrheic dermatitis (dandruff).^[5] It is used by application to the affected area and may be used together with ultraviolet light therapy.^[5] Industrial uses include preservation of railway ties and improving the surface of roads.^[6]

Side effects include skin irritation, sun sensitivity, allergic reactions, and skin discoloration.^[5] It is unclear if use during pregnancy is safe for the baby and use during breastfeeding is not typically recommended.^[7] The exact mechanism of action is unknown.^[8] It is a complex mixture of phenols, polycyclic aromatic hydrocarbons (PAHs), and heterocyclic compounds.^[2] It may have antifungal, anti-inflammatory, anti-itch, and antiparasitic properties.^[8]

Coal tar was discovered around 1665 and used for medical purposes as early as the 1800s.^{[6][9]} It is on the World Health Organization's List of Essential Medicines, the most effective and safe medicines needed in a health system.^[10] Coal tar is available as a generic medication and over the counter.^[4] In the United Kingdom 125 ml of 5% shampoo costs the NHS about £1.89.^[11] In the United States a month of treatment costs less than \$25 USD.^[4] Coal-tar was one of the key starting materials for the early pharmaceutical industry.^[12]

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Coal tar	
Clinical data	
Trade names	Balnetar, Cutar, others
Synonyms	liquor carbonis detergens (LCD) liquor picis carbonis (LPC) ^[1]
AHFS/Drugs.com	Multum Consumer Information
Pregnancy category	<u>US</u> : C (Risk not ruled out)
Routes of administration	Topical
ATC code	D05AA (WHO)
Legal status	
Legal status	<u>US</u> : OTC
Identifiers	
CAS Number	8007-45-2
ChemSpider	none

Uses

Medicine

Coal tar may be used in two forms: crude coal tar (Latin: *pix carbonis*) or a coal tar solution (Latin: *liquor picis carbonis, LPC*) also known as liquor carbonis detegens (LCD).^{[8][13][14]}

Coal tar is used in medicated shampoo, soap and ointment, as a treatment for dandruff and psoriasis, as well as being used to kill and repel head lice. When used as a medication in the U.S., coal tar preparations are considered over-the-counter drug pharmaceuticals and are subject to regulation by the FDA. Named brands include Denorex, Balnetar, Psoriasin, Tegrin, T/Gel, and Neutar. When used in the extemporaneous preparation of topical medications, it is supplied in the form of coal tar topical solution USP, which consists of a 20% w/v solution of coal tar in alcohol, with an additional 5% w/v of polysorbate 80 USP; this must then be diluted in an ointment base such as petrolatum.

Pine tar has historically also been used for this purpose. Though it is frequently cited online as having been banned as a medical product by the FDA due to a "lack of evidence having been submitted for proof of effectiveness", pine tar is included in the Code of Federal Regulations, subchapter D: Drugs for Human Use, as an OTC treatment for "Dandruff/seborrheic dermatitis/psoriasis".^[15]

Various phenolic coal tar derivatives have analgesic (pain-killer) properties. These included acetanilide, phenacetin, and paracetamol (acetaminophen).^[16] Paracetamol is the only coal-tar derived analgesic still in use today, but industrial phenol is now usually synthesized from crude oil rather than coal tar

Construction

Coal tar is incorporated into some parking-lot sealcoat products, which are used to protect and beautify the underlying pavement.^[17] Sealcoat products that are coal-tar based typically contain 20 to 35 percent coal-tar pitch.^[17] Research^[18] shows it is used in United States states from Alaska to Florida, but several areas have banned its use in sealcoat products,^{[19][20][21]} including the District of Columbia; the City of Austin, Texas; Dane County, Wisconsin; Washington State; and several municipalities in Minnesota and others.^{[22][23]}

Coal tar was a component of the first sealed roads. In its original development by Edgar Purnell Hooley, tarmac was tar covered with granite chips. Later the filler used was industrial slag. Today, petroleum derived binders and sealers are more commonly used. These sealers are used to extend the life and reduce maintenance cost associated with asphalt pavements, primarily in asphalt road paving, car parks and walkways.

Industry

Being flammable, coal tar is sometimes used for heating or to fire boilers. Like most heavy oils, it must be heated before it will flow easily.

A large part of the binders used in the graphite industry for making "green blocks" are coke oven volatiles (COV), a considerable portion of which are coal tar. During the baking process of the green blocks as a part of commercial graphite production, most of the coal tar binders are vaporised and are generally burned in an incinerator to prevent release into the atmosphere, as COV and coal tar can be injurious to health.

Coal tar is also used to manufacture paints, synthetic dyes (notably tartrazine/Yellow #5), and photographic materials.

In the coal gas era, there were many companies in Britain whose business was to distill coal tar to separate the higher-value fractions, such as naphtha, creosote and pitch. A great many industrial chemicals were first isolated from coal tar during this time. These companies included^[24]

- British Tar Products
- Lancashire Tar Distillers
- Midland Tar Distillers
- Newton, Chambers & Company(owners of Izal brand disinfectant)
- Sadlers Chemicals

Safety

According to the National Psoriasis Foundation, coal tar is a valuable, safe and inexpensive treatment option for millions of people with psoriasis and other scalp or skin conditions.^[25] According to the FDA, coal tar concentrations between 0.5% and 5% are considered safe^[26] and effective for psoriasis.

Cancer

Scientific evidence is inconclusive whether the coal tar in the concentrations seen in non-prescription treatments is carcinogenic, because there are too few studies and insufficient data to make a judgement.^[27] While concerns have been found in animals studies, short-term treatment of humans have shown no significant increase in cancer. It's possible that the skin can repair itself after short-term exposure to PAHs, but not after long-term exposure.^[27]

Working with coal tar such as during the paving of roads or when working on roofs increases the risk of cancer.^[28]

It is believed that their metabolites bind to DNA, damaging it. Long-term skin exposure to these compounds can produce "tar warts", which can progress to squamous cell carcinoma.^[29]

The International Agency for Research on Cancer lists coal tars as Group 1 carcinogens, meaning they directly cause cancer.^{[28][30][31]} Both the U.S. Department of Health and Human Services and the state of California list coal tars as known human carcinogens.^[32]

Other

Coal tar causes increased sensitivity to sunlight,^[33] so skin treated with topical coal tar preparations should be protected from sunlight.

The residue from the distillation of high-temperature coal tar, primarily a complex mixture of three or more membered condensed ring aromatic hydrocarbons was listed on 28 October 2008 as a substance of very high concern by the European Chemicals Agency

Mechanism of action

It is a keratolytic agent, which reduces the growth rate of skin cells and softens the skin's keratin.^{[34][29]}

Composition

Coal tar is produced through thermal destruction (pyrolysis) of coal, and the composition of coal tar varies with the process and type of coal (for example, lignite, bituminous or anthracite) used to make it.^[29]

It contains approximately 10,000 chemicals, of which only about 50% have been identified.^[35] Components include polycyclic aromatic hydrocarbons (4-rings: chrysene, fluoranthene, pyrene, triphenylene, naphthacene, benzanthracene, 5-rings: picene, benzo[a]pyrene, benzo[e]pyrene, benzofluoranthene, perylene, 6-rings: dibenzopyrenes, dibenzofluoranthenes, benzoperylene, 7-rings: coronene), as well as methylated and polymethylated derivatives, mono- and polyhydroxylated derivatives, and heterocyclic compounds.^{[28][36]} Others include benzene, toluene, xylenes, cumenes, coumarone, indene, benzofuran, naphthalene and methyl-naphthalenes, acenaphthene, fluorene, phenol, cresols, pyridine, picolines, phenanthracene, carbazole, quinolines, fluoranthene.^[29] Many of these constituents are known carcinogens.^{[37][38]}

History

It is notable as one of the first chemical substances proven to cause cancer from occupational exposure, during research in 1775 on the cause of chimney sweeps' carcinoma.^[29]

Regulation

People can be exposed to coal tar pitch volatiles in the workplace by breathing them in, skin contact, or eye contact. The Occupational Safety and Health Administration (OSHA) has set the legal limit (permissible exposure limit) for coal tar pitch volatiles exposure in the workplace as 0.2 mg/m³ benzene-soluble fraction over an 8-hour workday. The National Institute for Occupational Safety and Health (NIOSH) has set a recommended exposure limit (REL) of 0.1 mg/m³ cyclohexane-extractable fraction over an 8-hour workday. At levels of 80 mg/m³, coal tar pitch volatiles are immediately dangerous to life and health^[39]

See also

- Creosote
- Cresolene
- Preservative
- Allura Red AC
- Tar
- Sealcoat

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