



Polycyclic Aromatic Hydrocarbons (PAHs)

Other Names:

CAS Number	Substance
83-32-9	Acenaphthene
208-96-8	Acenaphthylene
120-12-7	Anthracene

List continued in "Additional Information"

May Be Found In:

- Rubber and plastic components
- Footwear outsoles
- Lacquers and coatings
- Recycled materials
- Carbon black pigments/dyestuff
- Extender oils/softeners
- Lubricants
- Printing pastes
- Dye dispersing agents (Naphthalene)
- Textiles (Naphthalene)

Polycyclic Aromatic Hydrocarbons are a group of over 100 chemicals that are mostly colourless, white, or pale-yellow solids. They have low vapour pressure and low aqueous solubility. PAHs are substances occurring naturally in coal, crude oil and gasoline and are composed of multiple carbon and hydrogen aromatic rings. Released from burning coal, oil, gasoline, rubbish, tobacco and wood, PAHs are often formed due to incomplete combustion of organic materials.¹ PAHs generated from these sources can bind to things, or even form small particles. They are therefore considered ubiquitous environmental pollutants. PAHs have a characteristic smell similar to that of car tyres or asphalt. PAHs are typically present in final products as impurities and are not intentionally added.

Uses in the Supply Chain

PAHs are not synthesised chemically for industrial purposes although there are a few commercial uses for many PAHs.¹ They are mostly used as intermediaries in pharmaceuticals, agricultural products, photographic products, thermosetting plastics and other chemical industries.

Oil containing PAHs are added to rubber and plastics as a softener or extender and may be found in rubber, plastics, lacquers, and coatings. Within the footwear producing industry, PAHs are often found in the outsoles of footwear and in printing pastes for screen prints. PAHs can be present as impurities in carbon black dyestuffs. They also may be formed from thermal decomposition of recycled materials during reprocessing. Naphthalene is often present as an impurity from low-quality raw materials used as intermediates in the production of textile dye dispersing agents. It may also be found in textiles.

Why Polycyclic Aromatic Hydrocarbons (PAHs) are Restricted

- Many PAHs have toxic, mutagenic and/or carcinogenic properties. PAHs are highly lipid soluble and thus readily absorbed from the gastrointestinal tract of mammals. They are rapidly distributed in a wide variety of tissues with a marked tendency for localisation in body fat. PAHs have toxic effects on organisms through various actions. 17 PAHs have been identified as being of greatest concern with regard to potential exposure and adverse health effects on humans.¹ The International Agency for Research on Cancer classifies some PAHs as known, possible or carcinogenic to humans. Among those PAHs, the substance benzo(a)pyrene is definitely a known carcinogenic for humans.
- Legislation in major markets around the world restricts the presence of PAHs in final products.
- Some PAHs can be very toxic to aquatic organisms and, above certain exposure levels, may cause long-term adverse effects in the aquatic environment.
- The EU REACH regulation contains provisions on the handling of PAHs. According to REACH it is forbidden to sell carcinogens, mutagens and substances toxic to reproduction (CMR substances) to ultimate consumers. This regulation includes the eight PAHs already classified as CMR substances.
- Above certain levels, long-term exposure to some PAHs may result in the development of particular cancers.
- Some PAHs, above certain exposure levels, may impair human fertility or cause harm to unborn children.
- Chemical hazard information for many chemicals can be found in the following external databases:
 - GESTIS Substance Database: [http://gestis-en.itrust.de/nxt/gateway.dll/gestis_en/000000.xml?f=templates\\$fn=default.htm\\$vid=gestiseng:sdbeng\\$3.0](http://gestis-en.itrust.de/nxt/gateway.dll/gestis_en/000000.xml?f=templates$fn=default.htm$vid=gestiseng:sdbeng$3.0)
 - US National Library of Medicine: <https://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB>
 - USA EPA Occupational Chemical Database: <https://www.osha.gov/chemicaldata/index.html>

Sourcing Compliant Materials from Your Suppliers

- Explain that you require materials to be compliant with current AFIRM RSL limits.³
- Especially for the use of rubber, ensure your supplier is not adding oils or lubricants that might contain PAHs.
- Request suppliers to submit a confirmation of material compliance and/or a test report from a third-party laboratory. When materials are received, consider performing random, risk-based testing to ensure current AFIRM RSL limits are met.
- Share this guidance sheet with your material suppliers. Using the guidance in the next section, instruct them to work with their chemical suppliers to source chemical formulations that comply with these requirements. If needed, highlight the existence of harmful substances in materials via chemical management trainings from the ZDHC Academy, existing guidelines, and laws.
- Pay special attention to:
 - Rubber and plastic materials used for outsoles in footwear production, as well as rubber and plastic components. They widely use extender oils, which may contain or degrade to PAH substances.
 - Recycled plastic and rubber materials may have a greater risk of containing PAHs due to thermal decomposition during reprocessing. Ensure any recycled materials used meet existing regulations.
 - Black coloured materials might contain carbon black-based pigments or dyestuffs. Carbon black, if of low quality, may contain high concentrations of PAHs as impurities.
 - Naphthalene may be found in textile materials because it is a residual impurity in dye dispersing agents composed of naphthalene-sulfonic acid polycondensation products.
- If your supplier uses a thermal process for the manufacturing of your product, there is a potential risk of PAH formation from thermal decomposition.
- Lubricants used in textile processing may be contaminated with PAHs, so materials could fail to meet PAH limits.
- Make sure all your suppliers have a solid chemical management system in place.

Sourcing Compliant Formulations from Your Chemical Formulators

- Explain to chemicals suppliers that you require chemical formulations to comply with current ZDHC MRSL limits.
 - Search for formulations on the ZDHC Gateway Chemical Module. If your preferred formulations are not listed, encourage providers to register their formulations.
 - Ask for a ZDHC ChemCheck report.
- For all formulations, request SDS documentation to ensure none of the CAS Numbers above are listed as ingredients.
- Pay special attention to:
 - Suppliers of oils used as extenders or softeners in plastic and rubber materials.
 - Recycled oils can carry the greatest risk of PAH contamination.
 - Carbon black based pigments and dyestuffs may contain high residual concentrations of PAHs.
 - Dispersing agents for textile dyes may contain high residual naphthalene concentrations if they are based on low-quality naphthalene-sulfonic acid polycondensation products. Make sure only certified and approved chemicals are used in manufacturing processes.
 - Recycled or low-quality lubricants used for textile processing may contain PAHs. Make sure chemical formulations are only being sourced from nominated and approved suppliers.

Safer Alternatives

As PAHs are not considered chemical substances for the production of textile, garment and footwear products, they are generally impurities in low-grade raw materials. To ensure materials, and consequently final products, are not contaminated by PAHs, it's vital to implement due diligence via chemical formulation testing management systems.

Additional Information

Continued list of CAS Numbers and substance names from first page:

CAS Number	Substance
191-24-2	Benzo(g,h,i)perylene
86-73-7	Fluorene
206-44-0	Fluoranthene
193-39-5	Indeno(1,2,3-cd) pyrene
91-20-3	Naphthalene
85-01-8	Phenanthrene
129-00-0	Pyrene
56-55-3	Benzo(a)anthracene
50-32-8	Benzo(a)pyrene
205-99-2	Benzo(b)fluoranthene
192-97-2	Benzo[e]pyrene
205-82-3	Benzo[j]fluoranthene
207-08-9	Benzo(k)fluoranthene
218-01-9	Chrysene
53-70-3	Dibenzo(a,h)anthracene

References

1 Hussein I. Abdel-Shafy, Mona S.M. Mansour, A Review on Polycyclic Aromatic Hydrocarbons: Source, Environmental Impact, Effect on Human Health and Remediation, Egyptian Journal of Petroleum, Vol. 25, Issue 1, March 2016, pp 10-123.

2 Center for Disease Control and Prevention. (2016, December 23). Factsheet: Polycyclic Aromatic Hydrocarbons (PAHs). Retrieved April 4, 2017, from https://www.cdc.gov/biomonitoring/PAHs_FactSheet.html.

3 Apparel and Footwear International RSL Management Group (Ed.). (2018, January 31). Restricted Substances List (Rep.). Retrieved <http://afirm-group.com/afirm-rsl/>.

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