**Polycyclic aromatic hydrocarbons (PAHs)**

***Who is this guidance for?***

This guidance is primarily aimed at employers or individuals with delegated responsibility for managing workplace exposure to substances. Whilst it is not exhaustive, the information presented is intended to demonstrate how biomonitoring can help with this duty. Some simple advice is presented to help non-specialist users to get the most out of biomonitoring covering (1) when to take a sample to ensure reliable and comparable results over time; (2) putting the result into context with respect to background (environmental) levels or what can reasonably be achieved with good exposure control; and (3) some basic technical data that can help to evaluate an analytical service provider. For further information you should consult your chosen analytical service provider who should be happy to discuss your specific requirements and find solutions.

**Hazardous Substances:**

Polycyclic aromatic hydrocarbons

**Workplace Exposure Limits:**

No air limit

**Polycyclic aromatic hydrocarbons (PAHs)**

Monitored by analysis of 1-hydroxypyrene in urine

**BMGV**: 4µmol 1-hydroxypyrene /mol creatinine

***Biological Monitoring Guidance Value (BMGV)***

4µmol 1-hydroxypyrene /mol creatinine

This value is based on the 90th percentile of data from a survey of PAH exposure across a wide range of UK industry.

PAH are a class of chemicals and there are many individual substances. 1-hydroxypyrene is a metabolite of pyrene. It has been extensively used for biological monitoring and found to be a good indicator of general PAH exposure.

***Other Guidance Values***

The ACGIH BEI for 1-hydroxypyrene is 2.5µg/L (approx. 1 µmol/mol creatinine). Analysis of urine samples from individuals with no known occupational exposure to PAHs indicate that general population background levels are less than 0.4 µmol/mol creatinine (this is the basis of the ACGIH BEI). Germany applies a background reference value of 0.3 µg 1-hydroxypyrene /g creatinine (0.16 µmol/mol creatinine) in non-smokers.

***Sample Collection***

Urine samples should be collected at the end of shift, towards the end of the working week into polystyrene universal containers (30mL).

***Sample Transport to Laboratory***

Send samples to the laboratory by first class post (or equivalent) to arrive within 48 hours of collection. If any delay is anticipated, store samples chilled – ideally frozen if suitable facilities are

available. Samples are stable for up to 7 days when stored refrigerated. Packaging must comply with relevant postal regulations for biological samples (UN3373).

**Suggested Method and Analytical Evaluation**

Analytical technique: Liquid chromatography with fluorescence detection following sample treatment to hydrolyse conjugated metabolites.

Detection limit: 5nmol/L (3 x background)

Calibration range: Typically 5-100 nmol/L

Precision:

- within day <8% RSD at 40nmol/L

- day to day <7% RSD at 250μmol/L

Sample stability: 2 days at ambient temperature, >3 months at 20°C

Analytical Interferences: None known

Quality assurance: GEQAS (www.g-equas.de).

***When to take a sample***

Elimination half-life is a measure of the rate of removal of a substance that has been taken into the body. It helps to identify when it is best to take a sample following potential exposure and indicates the potential ‘exposure window’ that will be reflected by a result.

PAHs are a complex mixture of substances that undergo a variety of metabolic reactions to give rise to multiple phenolic metabolites. Urinary elimination of 1 hydroxypyrene is tri-phasic with half-lives of 5.5, 23 and over 300 hours. Consequently, there is some accumulation over consecutive days of exposure. A post-shift sample will reflect that day’s exposure , but will also be influenced by exposure during the previous few days. Hence it is recommended to sample towards the end of the working week or shift pattern.

Skin exposure and subsequent uptake via the dermal route can be a significant route of exposure to PAHs. Absorption through skin is delayed by several hours, often leading to higher levels in next-day pre-work samples.

**Other Information**

***Confounding factors***

PAHs are produced during combustion. Exposure can occur when breathing air contaminated with motor vehicle exhaust, cigarette smoke, wood smoke, or fumes from asphalt roads. Use of coal tar products (e.g. shampoos) can increase 1-hydroxypyrene levels significantly and any use should be noted. Eating smoked, barbecued or heavily charred food can raise 1-hydroxypyrene levels. Smokers will have higher levels than non-smokers.

***Unexposed level***

<0.4 μmol 1-hydroxypyrene/mol creatinine.

**Creatinine correction is advised**

***Interpretation***

Urinary 1-hydroxypyrene results reflect systemic exposure to polycyclic aromatic hydrocarbons that may have entered the body by inhalation or through the skin. If biological monitoring results are greater than the guidance value, it does not necessarily mean that ill health will occur, but it does mean that exposure is not being adequately controlled. An elevated result should be re-tested as soon as possible to help establish whether it represents ongoing workplace exposure or a ‘one-off’ event. If necessary, employers will need to look at current work practices to see how they can be improved to reduce exposure.

***Further information***

EH40 List of Approved Workplace Exposure Limits <http://www.hse.gov.uk/pubns/books/eh40.htm>

Biological Monitoring: A tool for helping to assess workplace exposure (August 2021). Published by British Occupational Hygiene Society (www.bohs.org). [BOHS-Biological-Monitoring-A-tool-for-helping-to-assess-workplace-exposure-rebranded.pdf](https://www.bohs.org/app/uploads/2021/08/BOHS-Biological-Monitoring-A-tool-for-helping-to-assess-workplace-exposure-rebranded.pdf)

Unwin, J., Cocker, J., Scobbie, E. and Chambers, H., 2006. An assessment of occupational exposure to polycyclic aromatic hydrocarbons in the UK. Annals of Occupational Hygiene, 50(4), pp.395-403.

For further advice, please contact us:

Sample Registration, HSE, Harpur Hill, Buxton. SK17 9JN.

registration.sample@hse.gov.uk

0203 028 3383

**Biological Monitoring at HSE**

<https://www.hsl.gov.uk/online-ordering/analytical-services-and-assays/biological-monitoring>