BIOLOGICAL MONITORING METHODS

Water Soluble Chromium VI Compounds

Maximum Exposure Limit = 0.05 mg m^{-3} 8 hour time weighted average

Biological Monitoring Guidance value:

Benchmark Value - 10 µmol chromium/mol creatinine in urine
Conversion: 1 µmol/mol = 0.46 µg/g

Method for Chromium in Urine

❒ ***Sample Collection***

Time: Urine samples collected at the end of the shift. Care should be taken to avoid contamination of the sample from clothing or hands.

Equipment: polystyrene universal container (30ml)

❒ ***Description of Suggested Method***

Urine (20 µl) is injected into a graphite tube of graphite furnace atomic absorption spectrophotometer. Detection is by absorption of light from a chromium atomic absorption lamp at 357.9 nm with deuterium background correction.

❒ ***Alternative Method***

Methods may be developed based on collision cell ICP-MS techniques

❒ ***Sample Transport to laboratory***

At ambient temperature, should arrive within 48h of collection.
If any delay anticipated, store at –20^{o}C
Samples sent through the postal system must comply with Post Office regulations.

❒ ***Analytical Evaluation***

Precision
- within day <3% RSD at 380 nmol/l
- day to day <7% RSD at 380 nmol/l

Detection limit
- 3 x background - 5 nmol/l

Calibration range
- typically 40 - 800 nmol/l

Sample Stability
-2days at ambient, > 3 months at -20$_{o}$C

Analytical interferences
-None known

❒ ***Other Information***

Elimination half-time
-for chromium in urine is triphasic with half lives of about about 7 hours, 15
- 30 days and 3 - 5 years

Confounding Factors
Exposure to chromium III compounds will also contribute to urinary chrome levels and may confound assessment of exposure to chrome VI. See also the possibility of dietary contributions that may add to chromium and make the assessment of low exposure levels more difficult.

Unexposed Levels
<2 µmol chromium/mol creatintine

Creatinine Correction
Advised

❒ ***Quality Assurance***
- Internal QC must be established.
- External QA - available from TEQAS University of Surrey

Interpretation of Results

General Points

Biological monitoring guidance values are intended to help occupational hygienists and physicians to assess the level of exposure to hazardous substances. They are useful where substances can get into the body through the skin or where control relies on gloves or respiratory protection. Sometimes measuring the level of the substance in the air does not give a complete picture of exposure.

There are currently two types of biological monitoring guidance value in the UK. One is called a 'Health Guidance Value' and as the name implies is the level of a substance or its metabolites in blood, or urine that is not associated with any adverse health effects. The second type of biological monitoring guidance value is called a 'Benchmark Value'. This type of value is set when it would not be appropriate to set a Health Guidance Value – for example for substances that can cause cancer. The Benchmark Value is based on a survey of workplaces that HSE consider to have good control of exposure to the substance and it is the value found in 9 out of 10 samples in those workplaces. This type of guidance value can give no direct guide to the risk of ill-health. The benchmark guidance value just gives an indication of how well exposure is being controlled, and should be used as a trigger for further investigation.

Exposure to hazardous substances should be reduced as far as reasonably practical so the aim should be for biological monitoring results to be below biological monitoring guidance values. If a result is higher than the guidance value then the employer or occupational hygienist and worker should try and find out why – it might be an 'odd' result or it might indicate the exposure controls were not working as well as they should.

Because of the way the benchmark value is defined we might expect 1 sample in 10 from workers in places with good control of exposure to be above the guidance value, but it is likely that two such samples from the same person would indicate a possible deficiency in control and therefore all potential reasons for the elevated levels should be investigated. As with all forms of exposure assessment it is wise to take several measurements and consider the results as a whole before making decisions. Similarly, the frequency of sample collection should be related to the level of exposure. If the results of biological monitoring are well below the guidance value then once or twice a

year may be sufficient. However, if results are above the guidance value monitoring should be more frequent and efforts should be made to reduce exposure.

Chromium VI biological monitoring benchmark value

The biological monitoring benchmark value for chromium VI was set following a survey of workplaces with potential exposure to chromium VI compounds. Twelve different workplaces were visited and the data from 10 used for the guidance value (2 were rejected because their exposure controls were poor). Ninety percent of the results were below the value of 10 µmol/mmol creatinine and this was proposed as the guidance value. Some of the workplace looked at had infrequent exposures to low levels of chromium VI and the values found were well below 10. Other workplaces had more frequent exposures to higher concentrations of chromium VI compounds and although their exposure controls were good, some of the results were above the guidance value of 10. The guidance value was set based on all the results in the range of workplaces not the most exposed or an individual workplace. This means that some workplaces will have more of a challenge to keep biological monitoring results below the guidance value than others but all workplaces should be trying to reduce exposure as far as possible.

Is chromium found in urine from people who are not occupationally exposed?

Yes – Chromium is present in the urine of people who are not occupationally exposed to chromium VI and comes from food (e.g. meat, whole grains, lentils and spices) and water. These 'background' levels are generally below 2 µmol/mmol creatinine. In a recent survey of people not occupationally exposed to chromium 98% of the values were less than 2 µmol/mmol, with 1 sample of the 250 at just under10 µmol/mmol. Because the workplaces looked at in the survey had good control of exposure the guidance value is quite close to these background levels.

Does the UK guidance value compare to international guidance values?

The American Conference of Governmental Industrial Hygienists (ACGIH) have a biological guidance value for chromium of approximately 50 µmol/mmol and this is the average value that might be found in workers who were exposed for 8h a day to the airborne limit (0.05 mg/m^3). The German MAK Commission guidance value is about 40 µmol/mmol after inhalation at 0.05 mg/m^3. Please note that these are biological values that are equivalent to inhalation at an exposure limit. Although the UK exposure limit has the same value (0.05 mg/m^3) this is a maximum value and exposure should be controlled well below this value.

What if a result is higher than the guidance value ?

A series of biological monitoring results are more informative than a single value. If the result is the first from a worker then it is sensible to ask for another sample for confirmation. It is also sensible to look at how the worker may be exposed to chromium and whether the controls are working as intended. It should be noted that because guidance value is based on the value found in 9 out of 10 samples in places with good control it is possible that some measurements will be above the guidance value, even in places with good control.

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