EnviroMail No. 59 Re-Release July 2013

Benzo(a)Pyrene Toxic Equivalence Quotient (TEQ) and Aggregate Organochlorine Pesticides Parameters

INTRODUCTION

A toxic equivalence quotient (TEQ) expresses an aggregate measure of toxicity based on a number of contributing compounds. Contributing components are assigned a weighted factor relative to the most toxic component contributing to the aggregate.

PAHs are traditionally determined as individual compounds by the separation of a mixture of components using GC/MS. The sum of PAHs is usually calculated as the sum of the US EPA 16 priority PAHs irrespective of toxicity. A footnote to the table 1A(1) in the 2013 NEPM guideline states that when evaluating the sum of PAHs, consideration of individual HILs/HSLs for Naphthalene and the Benzo(a)pyrene TEQ need to be considered.

The Benzo(a)pyrene TEQ seeks to provide a toxicity-weighted sum of analyte concentrations for a specific list of PAHs in order to provide a single, objective concentration as a Health Investigation Level(HIL). At the same time, a separate HIL for Benzo (a) pyrene is no longer required in the NEPM.

NEPM Table 1A contains additional aggregate values that simply consist of the sum of the concentrations of their individual components. For example, from the Organochlorine pesticides, the sum of DDT+DDE+DDT and the sum of Aldrin and Dieldrin are required.

METHOD INFORMATION

ALS METHOD CODES

Benzo(a)Pyrene TEQ: EP075 and EP132 (ultra-trace).

DDT+DDE+DDD and sum of Aldrin + Dieldrin: EP068, EP131 (ultra-trace) and EP075 (SVOC).

LIMITS OF REPORTING (LOR)

Benzo (a) Pyrene TEQ is equal to the LOR for Benzo(a) Pyrene for each method.

Aggregate Organochlorines: This equates to the individual LOR of DDE or DDD for each method and the LOR of Aldrin or Dieldrin for each method.

REFERENCE

NEPM Schedule B1, Investigation Levels for Soil and Groundwater, 2013.

Excerpt from NEPM 2013 Table 1a (1) showing health investigation levels (Residential A) for Benzo(a)Pyrene TEQ and Organochlorine Pesticide Aggregate Parameters.

cyanide (free)	250
Polycyclic Aromatic Hydrocarbons (PAHs)	
benzo(a)pyreneTEQ	3
PAHs	300
Phenols	
Phenol	3000
pentachlorophenol	100
Cresols	400
Organochlorine Pesticides	
DDT+DDE+DDD	240
aldrin and dieldrin	6
chlordane	50

HOW DOES REPORTING WORK?

The reporting of the Benzo(a)pyrene TEQ follows the same approach used for the reporting of a TEQ for dioxins. Each of the constituent compounds that contribute to the Benzo(a)pyrene TEQ has a specific toxic equivalence factor (TEF) that weights its toxicity relative to that of Benzo(a)pyrene. These may vary from 1 to 0.01 – see the table below.

World Health Organisation Toxic Equivalence Factors for PAHs as per NEPM Schedule B1, Table 1A.

PAH	Toxic Equivalence Factor (TEF)
Benz(a)anthracene	0.1
Benzo(a)pyrene	1
Benzo(b+j)fluoranthene	0.1
Benzo(k)fluoranthene	0.1
Benzo(g,h,i)perylene	0.01
Chrysene	0.01
Dibenz(a,h)anthracene	1
Indeno(1,2,3,cd)pyrene	0.1

REPORTING (CONTINUED)

As this TEQ is essentially a summed parameter, the reporting limit is a matter of convention rather than a statistically based value. The ALS policy on the reporting limit on sums is to use the lowest LOR of contributing parameters to the sum as LOR so that any positive result reported individually is reported in the sum. Since Benzo(a)pyrene generally has the lowest reporting limit of all PAHs, the reporting limit for the Benzo(a)pyrene TEQ will be identical to the reporting limit for Benzo(a)pyrene.

ALS has reported the Benzo(a)pyrene TEQ (TEQ Zero) with all methods that routinely report PAHs for over a year.

Other calculated HIL parameters that have also been reported for a year include:

- Sum of Aldrin and Dieldrin
- Sum of DDD, DDE and DDT.

These will be reported for all soil and water methods, standard and ultra-trace that report the individual compounds required to calculate the summed parameters.

REPORTING OF 'TEQ Zero', 'TEQ LOR' and 'TEQ half LOR'.

With some conjecture over the correct TEQ reporting calculation, and to assist in assessing data, ALS will move to reporting all three TEQ calculation options in July 2013. These follow;

1. The first calculates the TEQ assuming PAHs not detected are actually at the LOR (termed TEQ LOR). This is **most conservative** and can give **false positive TEQs** (not all PAHs undetected will be just below or at LOR). This can give a variance of 1.2 mg/kg TEQ as B(a)P versus an HIL of 3.0 for residential A criteria.
2. The next option uses zero when PAHs are <LOR (termed TEQ Zero). This is **least conservative** and is more prone to **false negative TEQs** when other PAHs are actually found on site or might be in your samples.
3. Lastly, is the 'half LOR' option (termed TEQ half LOR). This is **mid-way** from a risk perspective.

The adjacent table demonstrates the new ALS reporting (three TEQs) from July 2013. The PAHS contributing to the calculated TEQs are shaded light yellow along with the three TEQ reporting options. Another important parameter is total PAHS in bold. The results of the TEQ are demonstrated on the two example samples in orange.

POLYAROMATIC HYDROCARBONS	Standard LOR	TEF	Example 1	Example 2
	mg/kg	*(used for TEQ calculation)*	Sample BH2	Sampe BH3
ALS METHOD CODE:	EP075B (SIM)		0.0 - 0.2m	0.2 - 0.5m
Naphthalene	0.5	N/A	<0.5	<0.5
Acenaphthylene	0.5	N/A	2.5	1.0
Acenaphthene	0.5	N/A	1.0	0.5
Fluorene	0.5	N/A	0.7	<0.5
Phenanthrene	0.5	N/A	4.0	0.5
Anthracene	0.5	N/A	<0.5	<0.5
Fluoranthene	0.5	N/A	3.0	1.0
Pyrene	0.5	N/A	4.0	1.5
Benz(a)anthracene	0.5	0.1	<0.5	4.0
Chrysene	0.5	0.01	<0.5	8.0
Benzo(b) fluoranthene	0.5	0.1	<0.5	0.5
Benzo(k) fluoranthene	0.5	0.1	<0.5	2.0
Benzo(a)pyrene	0.5	1	<0.5	1.7
Indeno(1,2,3-cd)pyrene	0.5	0.1	<0.5	<0.5
Dibenz(a,h)anthracene	0.5	1	1.8	<0.5
Benzo(g,h,i)perylene	0.5	0.01	2.4	<0.5
PAH's (total)^	**0.5**	**N/A**	**19.4**	**20.7**
Benzo(a)pyrene TEQ (Zero)	**0.5**	N/A	**1.8**	**2.4**
Benzo(a)pyrene TEQ (half LOR)	**0.5**	N/A	**2.2**	**2.7**
Benzo(a)pyrene TEQ (LOR)	**0.5**	N/A	**2.5**	**3.0**

SAMPLING REQUIREMENTS and HOLDING TIMES

These aspects remain unchanged relative to standard ALS methods.

For further information please contact your local ALS team.