**What exactly is my TOPA Assay telling me or not telling me?**

**Introduction**

TOPA is no longer a new concept, it has been widely used in Australia at sites impacted by per and poly fluoro alkyl substances (PFAS) since the publication of the PFAS NEMP in 2018. It is referred to as a tool for estimating the potential amount of non-target precursor mass in a given sample.

**Current Understanding of Application**

The uses of TOPA analysis vary from using it as a line of evidence to mass balance estimations. However, it’s applicability for mass balance estimation is questionable and the outcomes of this use lead to highly uncertain and not representative outcomes which may be used to inform remediation.

**Current Analytical Techniques**

There is currently no standardised method for TOPA analysis, and so the laboratories have each produced a modified version of the Houtz and Sedlack method. Work published by Ventia (2019) indicates that under controlled sample conditions (i.e. known spiked aqueous samples), modifications to each of the laboratory methods were required to achieve the PFAS NEPM requirements for demonstration of complete oxidation. The nature of the modifications varied between the laboratories, but a combination of increased oxidant and multiple heating cycles were required. This outcome highlights the complexities of the oxidation reaction being simulated by the TOPA analysis and uncertainties inherent in this method. The laboratories also identified a hydrolysis reaction that occurred, in addition to the intended oxidation of PFAS, resulting from a change in pH within the samples when excessive oxidant was added producing highly basic (pH~14) conditions in the samples. To further compound the uncertainty in the method and results that are produced:

* it is understood that samples from contaminated sites submitted for TOPA analysis are not subject to such modifications and scrutiny, and
* samples from real world sites will have added complexity of matrix interference and co-competing compounds for oxidation.

When interpreting TOPA results the inherent method uncertainty for the analysis and laboratory variability between samples (looking at laboratory duplicates as indicators) are often overlooked or inadequately considered. Based on information from a number of laboratories the differences between samples prepared on the same day within the same batch usually run on the same instrument in soils is in the range of 12-19% variation. Additional variability in the accuracy of TOPA results is considered likely based on the presence of other factors such as different days of extraction and potentially different instruments adopted for the post TOPA analysis.

**So what do I need to know?**

It is important that any result is considered within a “lines of evidence approach” and with a clear understanding of the uncertainty and limitations of the test being conducted (this applies to all laboratory analysis). Whilst TOPA has a place as a line of evidence, the multiple potential sources of variability would make the use of TOPA results for mass balance determination meaningless.

When considering what TOPA results may mean for your site, it may be useful to consider the following questions and information:

* What is the source of the PFAS? TOPA has been demonstrated to work more effectively with mixtures which are higher in fluorotelomers
* TOPA analysis targets perfluoroalkyl acids precursor oxidation and is not targeted for sulphonates.
* Increased oxidant rates per sample volume can be added to support more complete oxidation of PFAS precursors in line with requirements of the PFAS NEMP, however the increase in pH which may increase hydrolysis of PFOS. But it is important to understand that these highly alkaline conditions are unlikely to be seen in the field.
* We currently have limited understanding of the potential transformation of C4 and below PFAS compounds due to limited analytical standards.
* The test is aggressive and as demonstrated under controlled conditions requires multiple heating and oxidant steps to achieve complete oxidation of pre-cursors. Is this therefore representative of real world conditions?
* Does the increase in PFAS concentrations reported post TOPA fall within laboratory variation inherent in PFAS analysis (noting this is demonstrated to be ±20%)?

**Conclusions**

Like all analytical approaches, the key using the results from TOPA analysis is understanding exactly what the results mean whilst considering the uncertainties underpinning the methods adopted by the laboratory.