SOILveR
Soil and land research funding platform for Europe

Draft summary PFAS workshop 9th November 2020

Part 1 – Best solution or way forward today/in short term

What are the effects of not accounting (or over-simplifying) for the large number of PFASs in RA and chemical analysis – could we suspect unacceptable risks, due to e.g., mixture toxicity? How to account for uncertainty?

Included in the large 4000 and more substances family so-called PFAS, PFOA and PFOS are currently the main substances of concern in contaminated sites management, when these pollutants are considered. As quantification of PFAS is scarce and incomplete, it is very likely that risk of PFAS-contaminated sites is underestimated and associated to high uncertainty.

However, it is not relevant to focus on all PFAS and there is an urgent need to identify significant/priority compounds to consider according to their occurrence (insignificant quantities are not priorities),
exposure routes and toxicity (long and short chain, including alternative/substitutes for PFOA and PFOS). But the huge knowledge gaps on each of those parameters limit this compounds prioritisation and the fingerprint concept could be relevant.

From policy perspective, the uncertainty affects the ability to determine whether the exposure of people from contaminated sites is significant in comparison with the exposure obtained in general and relevance of costs associated to new obligations. From consultant perspective, the uncertainty leads to liability issues in relation to their responsibility to ensure protective decisions for the future.

Participants mentioned interest for future coordinated actions for example under a PFAS working group umbrella. This group could build on the Total Petroleum Hydrocarbon USEPA working group and should provide operational guidelines at EU level on PFAS-contaminated sites management.

What approaches (chemical analysis & assessment approaches) could be "safe enough" but not too expensive in terms of cost for investigations (e.g., different kinds of analytical methods). In which cases should we analyse both specific compounds and a "total" concentration? When do we have an added value?

Not measuring PFAS leads to inaction and gives birth to lacking knowledge and high analytical prices which leads again to inaction. It is necessary to start measuring PFAS in soil and groundwater to build up (shared) databases and related knowledge (also on the long term) to tackle the PFAS-challenge (fingerprint, risk assessment, remediation) and to lower the analytical prices.

From a policy perspective, the obligation to measure PFAS on suspected risk activities could give an impulse to start measuring. However, not all risk activities have an obligation to be investigated (e.g., fire training grounds). From a political point of view, it is not easy to pinpoint new risk activities. There are also many other emerging contaminants (plastics, …) that also need attention. Policymakers need to balance their guidelines.

Concerning chemical analysis methods, there are a lot of analytical methods for PFAS available, each with his own added value:

1. For the research on contaminated sites with a "known" source and "known" fingerprint of PFAS, specific targeted analysis or a package of e.g., 20 PFAS-parameters (PFAS20) could be used.
2. In case there is a not well known PFAS-fingerprint of the sources on the site, a broad analysis (e.g., non-targeted analysis including precursors using **TOP assay** (Total Oxidizable Precursors)) can be of value as a tool for **determining** whether and which PFASs have been used at the site.
3. Broad analysis can also be of value:
    a. As a tool to **delineate** a pollution distribution, and thereby be a support in the design of the mapping of the pollution picture.
    b. Together with target analysis of PFAS20 a measure of the **uncertainty in the risk assessment** (ratio measures versus non measured parameters)
    c. A tool for **following up** a clean-up action.

It is important to have a good view on the PFAS-contamination before starting to remediate. Costs for extra analysis are far beyond costs for remediation works. More analytical results could help saving costs on the remediation works.

To what extent do we need a policy-based concept of assessment (regarding e.g., thresholds, analysis)? Is it possible to specify specific questions/aspects where policy decisions are needed?

There is enough evidence that PFAS constitute a severe hazard to people and the environment, to call for actions even when knowledge is incomplete for major part of existing PFASs. Hence, there seem to be an agreement that policy-based concepts are needed today and in the foreseeable future. Policy should be considered as temporary and should be expected to be revised as knowledge is developed further, and as risk-based assessments should be strived for. Furthermore, policy-based concepts should as much as possible stand on a scientific basis.

Policy approaches and decisions can be applied both on threshold values, e.g. by basing these on the substance considered most toxic (PFOS usually mentioned, although e.g. the relative potency factors suggested by RIVM[1] for different PFASs indicates that e.g. PFNA could be more toxic than PFOS) or on strategies to consider different groups of PFAS. However, links between threshold values and chemical analysis and/or number of (and which) PFAS to include in the comparison is also needed, and standardization of analytical methods is key. Furthermore, approaches to account for dark matter also needs to be developed and evaluated. An "acceptable ratio" between results from TOPA and the total content of a certain number of quantifiable PFASs (e.g., sum of PFAS-20) could be an approach to add to a threshold value in order to account for potential risks related to variable amounts of "unknowns". Other approaches should also be explored.

Finally, the question is raised whether it is justified that PFAS should be treated differently than other chemical substances or groups. A problem we face with PFASs is that we need to assess the risk of a group consisting of many substances of which we lack sufficient knowledge. This is, however, true also for other groups of substances, for example PAH, PCB and petroleum components. Yet, these are substances that are included in a generic framework for risk assessment in several countries. Lack of knowledge has not been an obstacle and should not be so for PFAS either since management of contaminated sites needs to be dealt with.

There are, however, lessons to be learnt from how we have handled groups of contaminants in a risk assessment historically. In several countries, e.g. Sweden[2], Norway[3] and the Netherlands[4], a risk assessment of a PAH contaminated site focuses on 16 different PAHs. The reason why it is limited to 16 compounds is based on a work that was carried out in the US some 50 years ago. The purpose was to identify a limited number of compounds that need to be monitored in water in the US[5]. From a database of more than 1 200 organic components 129 were classified as Priority Pollutants and became part of the Clean Water Act in 1977. Among these were 16 PAHs. The selection of 129 compounds was based on information about the detection frequency in different types of water in the US[6], manufactured quantities in the US and last, but not least, the possibility to quantify the substance in a chemical analysis. Since then, new knowledge has emerged that shows that other PAHs are of equal or even greater interest from a toxic point of view. In addition, the possibility to detect and quantify contaminants in chemical analysis has evolved significantly since the 1970's. A future with improved knowledge in terms of properties and analysis methods that are developed will most certainly also be the case for PFAS. A lesson learnt from the way the risk of PAH contaminated sites often still is assessed today is that policy decisions may linger for a long time. It is important to be open to the fact that a methodology that is developed for risk assessment of PFAS must not be static, and revisions may be necessary as new knowledge is acquired.

It could also be argued that deriving methods and strategies for PFAS could also provide knowledge on how to *better* assess other contaminants for which we experience (unacceptable?) uncertainties by current approaches. We should probably expect that the issue of risk assessment of chemicals and contaminated sites is far from being fully developed and dealing with PFAS in research and policy will most certainly give valuable experiences for future challenges towards a non-toxic environment.

[1] Zeilmaker et al (2018) "Mixture exposure to PFAS: A Relative Potency Factor approach", RIVM Report 2018-0070, National Institute for Public Health and the Environment

[2] Guidance values for contaminated soil – Model description and guidance, Report 5976, Swedish Environmental Protection Agency, Stockholm, Sweden (in Swedish)

[3] Ruus et al (2016) PAH in contaminated sediments, Report M-436, Miljödirektoratet, Trondheim, Norway (in Norwegian)

[4] RIVM (2012) Environmental risk limits for polycyclic aromatic hydrocarbons (PAHs), RIVM Report 607711007

[5] Keith, L H (2015) The Source of U.S. EPA's Sixteen PAH Priority Pollutants, Polycyclic Aromatic Compounds, 35:2-4, 147-160

[6] Mainly samples of effluents from industries, different types of surface water and drinking water.

Part 2 – Best solutions or ways forward the long term. Looking into the future, what should we aim for? What can we achieve, and does it differ from the short-term solutions?

Which are the more promising analytical methods/techniques, and is it different from short term possibilities?

The question of which analytical methods are more promising and whether they differ from those already in use was met with mixed answers. One shared conclusion is that with current methods, meaning Total Oxidizable Precursor (TOP) assay and extractable organofluorine (EOF), there is development potential. Points for improvement that were mentioned are amongst others: current high reporting values in labs; sensitivity of the analysis (mass spectrometry); the fact that fluor methods measure more parameters than PFAS; extraction within TOP/EOF; liquid chromatography and quantification of more PFASs in the future.

Participants saw a way to learn and improve, despite shortcomings, namely, to describe the functioning of these methods in the circumstances in which they are used. TOP application to soil in the Netherlands still showed that no PFAS are present around the level of PFOA and PFOS. Beyond the question which specific method is promising the challenge was also raised how to interpret all the data. One should consider differences such as the certainty you get from analysing soil or from analysing the waterbed, arising from different behaviour of substances. And if you want to get a good image the time dimension is also important to consider, you want to check on monitoring long term to really understand if you miss substantial substances. More than applying a method it takes an iterative process. Participants also identified missing options with current methods, such as a systematic inclusion of PFAS substitutes in the analytical methods (for ex. GenX).

Regarding other future techniques there was not a lot of input from the national groups, many foresee much the same we are using today. Bio detection Systems (BDS) were mentioned that show *combined effects* in bio solids. In the general discussion the application of BDS was estimated to perhaps be more valuable in an early warning system (BDS wins on time efficiency), not as an alternative method to setting national standards. For standards it is necessary to isolate substances/causes. An obstacle for Particle-induced gamma emission (PIGE) is that this method requires such advanced equipment that a wider spread is unlikely. In conclusion, on methods first focus on improvement today before potential tomorrows.

Which are the more promising risk assessment methods/strategies for dealing with groups of PFAS (not only PFOS, PFOA). What is needed (data, models…)? Is it different from short term possibilities

It is well known that there is a general lack of data on the various PFAS, physio-chemical data as well as their interactions with different media (transfer/distribution coefficients etc). Other than that, there is a need for classification of PFAS into sub-families according to source / occurrence / toxicity and work on equivalence factors has been pointed out.
The relative potency factor method (RPF) is a method which predicts the combined effect resulting from exposure to a mixture of PFAS taking the toxic potency into account. The toxic potencies of a set of compounds are expressed relative to the toxic potency of the index compound. To do this, they should all have the same toxicological endpoint. The substances that are less potent compared to the index compound receive an RPF smaller than 1; the compounds with a higher

potency than the index compound receive an RPF larger than 1. The risk associated with a mixture can be assessed by comparing the sum of the index compound equivalents to a relevant limit value. A difficulty here is that research about the toxicity of the various PFAS is first not available for all PFAS and secondly, even for well investigated PFAS such as PFOS and PFOA, research is still in progress and new information is therefore continuously available.
Another method could be to assume toxic equipotency, this is something EFSA does for 4 PFAs (PFOS, PFOA, PFNA, PFHxS) and use Relative Exposure Potential. We could look at relative differences in bioavailability such as biological transfer, bioaccumulation potential, biological half-life, etc. So, use exposure instead of toxicity as main parameter for the risk assessment. Adapting existing computer models to calculate these properties for substances with particular behaviour such as PFAS would decrease the uncertainty of the assessment.
To sum up, we could expect to have other ways and strategies for assessing chemical groups and mixtures in the future.

What contributions do you foresee from the EU efforts and other initiatives or networks (Green Deal, Soil Thematic Strategy, Chemical Strategy, PFAS Action Plan, EFSA, NORMAN, JPI Water, WHO, SOILveR) in relation to chemical analysis and risk assessment?

Asked what contributions participants would appreciate from other EU efforts and initiatives, many answers lay in knowledge sharing. One idea mentioned was an exchange on which lists of PFAS substances member states are working with. JRC Soil or the EEA could perhaps function as a portal for PFAS research results. Apart from gathering information participants also welcome generating information and creating ways forward, for ex. through science-based discussions and a pragmatic risk assessment method for PFAS in soil; an EU-wide approach.
Transparency was another wish. What is the key knowledge and position on PFAS from all the separate initiatives? And where are possibilities to connect, based on a willingness to finance research on compounds such as PFAS for a better understanding and knowledge of their behaviour and toxicity.

Next to outcomes from EU-initiatives - how could we (member states/countries) share good practices that we can use when we need to act on little information or knowledge, e.g., without threshold values (in practice we need to act even with limited knowledge)? And how could we interact with the different initiatives as member states/countries or through networks/initiatives?

A lot of information and experience is being built simultaneously in different countries. As we need to act (identify, prioritize, investigate, remediate) in parallel to that knowledge (data, methodology etc) and policy (e.g., thresholds/guidelines) is developed, fast ways of communication should be established. There are already several platforms for interaction that relate to contaminated sites as well as soil and emerging contaminants that could be used. Also, under the COVID-19 circumstances all countries and organizations have improved their possibilities to on short notice join meetings digitally.
At this web conference it was clear that there are benefits of gathering policy makers and PFAS experts in joint discussions, to define state of the arts and define the needs from the policy side to link science to practice. It is also important for policy makers to get an idea of what may be possible in the future, e.g., promising analytical tools or other assessment methods.
Due to the digital possibilities and connections made between countries and between experts within the workshop, it should be possible to appoint a National Contact Point for PFAS in relation to contaminated sites in each country. The idea would be to provide a fast way of communication between “countries”, without starting a working group that. The contact point could e.g., be a policy maker and the participants in the respective “hot spots” in the web conference could

constitute a country expert network in support to the national contact point. This could help us in providing.

- A knowledge hub, for knowledge exchange (new data etc).
- An early warning system (monitoring with same list of parameters in different countries) would be helpful, if one member state notices presence of a new substance
- Common temporary policy frameworks when needed.

One of the existing networks (EmConCoil, Common Forum or other) could initiate a network of contact points, or e.g., be initiated by an administration or organization in an EU country.

Are the risks in using non standardized analytical methods acceptable in relation to urgent need to use methods in practice?

Use the CEN context - arranging more international. NEN process for standardizing is quite slow. Important as well: How reliable can you take samples, regardless of interests? Why do we do something different than Germany? Provide answers on a central level.

What are the most urgent/important re-search questions related to the topic of this workshop? Are PFAS any different? (sea spray or other examples with different behaviour) – tailored approach.

Prioritization of PFAS based on substantial occurrence in soil and screen them for toxicity potential.
Development of an assessment method for PFAS (not for all PFAS toxicity data can be generated)
In vitro testing based on most sensitive toxicity endpoint, once identified. Screening assays for comparative toxicity potency.

Which analytical methods (broad, chemical specific) are used today in each participating country and in what way (e.g., for delineating contamination, chemical forensics, comparing with threshold values) are the results used to assess risk in practice in e.g., a contaminated site?

AGROLAB: "ISO 21675 / DIN 38407-42 / DIN 38414-14"
Use experience from most advanced countries (Germany, The Netherlands, Belgium) according to internal laboratories connections.