WWF

BRIEFING PAPER

MARCH 2020

How to approach chemical issues within the WFD

The fitness check conclusions of the Water Framework Directive were published in December of last year. While the Water Framework Directive was determined to be fit for purpose, tackling chemical pollution was highlighted as the key area where there is room for improvement and achieving better results, considering their universal use. The following briefing shows how the Water Framework Directive in its current form can be used to fully confront all new chemical issues, including mixture effects and pollutants of emerging concern.

Introduction

The Water Framework Directive (WFD) in its current form can adequately address all present and future chemical aspects of water management. According to the fitness check conclusions, “as for future challenges, this fitness check finds that the Water Framework Directive is sufficiently prescriptive with regard to the pressures to be addressed, and yet flexible enough to reinforce its implementation as necessary with regard to emerging challenges not mentioned in the Directive such as climate change, water scarcity and pollutants of emerging concern (e.g. micro-plastics and pharmaceuticals)”.

This briefing paper looks at two aspects of chemical pollution which have been debated during the evaluation process and are reflected in the fitness check conclusions: mixture toxicity, also referred to as cocktail effect, and emerging pollutants. In agreement with the fitness check conclusions, this briefing provides a roadmap on how those two elements can be addressed within the current WFD framework, and suggests ways for the European Commission and Member States to address them without revising the directive. In order to witness the improvement of status in ecosystems, it is up to the European Commission to provide guidance and make sure the legislative framework is adequate. And it is also up to EU Member State governments to provide the necessary funds and trainings and their political will to implement these measures.

This briefing paper makes the following recommendations.

WWF Asks:

It is important to adequately tackle chemical pollution in our rivers and lakes in order to mitigate the risks for people and the environment. Mixture toxicity and pollutants of emerging concerns can be addressed within the framework of the WFD and we recommend using the Common Implementation Strategy, the daughter directives and the momentum offered by the Zero-Pollution Action Plan on air, water and soil to tackle those issues in the following way:

As regards mixture toxicity:

- Mixture toxicity can be addressed through improved monitoring methods such as effect-based monitoring to gather more information on chemical mixtures as well as give an early warning to identify compounds in future risk assessments. Those methods can be used to complement traditional chemical monitoring. We recommend the European Commission to issue new guidelines in order to spread their use across Member States.
- Mixture toxicity can also be integrated in the water status assessment under the WFD, either in the ecological or chemical status (the latter possibly requiring a review of the Environmental Quality Standards in the Priority Substance Directive).

As regards emerging pollutants:

Waiting for the availability of analytical methods to address those pollutants is not acceptable. Any substance which is identified as priority hazardous substance in the absence of sufficient monitoring data should be put immediately on the Watch List of priority substances, even if there is not an analytical method available yet. The European Commission should introduce a procedure to ensure the timely and cost-efficient development / validation of analytical methods.

MIXTURE TOXICITY

Addressing mixture toxicity within the WFD framework

It is important to adequately address possible mixture toxicity, as it does pose a threat to freshwater ecosystems. This can be done within the framework for monitoring requirements, status assessment, and preparation of measures.

The Joint Research Center (JRC) in their technical report Modes of action of the current priority substances list under the Water Framework Directive and other substances of interest [6] has also already recognized that the WFD allows for the management of mixture toxicity. They state that "the requirement set down in the WFD for water bodies to achieve good ecological status as well as good chemical status entails a focus not only on the risk posed by individual chemicals but also on their effects in combination". We, as well as the JRC, believe that because of the overarching purpose of the WFD to prevent further deterioration of and protect and enhance the status of aquatic ecosystems, there is an inherent need to manage mixture toxicity in the WFD, whether or not it is explicitly stated. Moreover,

the current framework is clearly flexible enough to already implement some measures that can address mixture toxicity, which are described in more detail below.

Monitoring

Using monitoring strategies to manage mixture effects is in line with the WFD's requirements for surveillance monitoring[1] and investigative monitoring[2] (the latter should be established when environmental objectives are not reached for reasons not already known). The fitness check conclusions themselves state that "there seem to be no legal barriers in the WFD that would prevent the uptake of innovate monitoring technologies, should these provide equivalent results in terms of accuracy and reliability".

In fact, several Commission documents have also already addressed the issue of monitoring mixture toxicity in the past. Already in 2009 the Common Implementation Strategy (CIS) Guidance Document no. 19[3] (on water chemical monitoring) suggested that "passive sampling[4] can also be combined with ecotoxicology, where the extracts from the passive monitors are passed through multiple toxicological tests in a laboratory. This will enable assessment of the effects of a mixture of contaminants from an environmental monitoring point over a period of time. This integration of exposure and effects monitoring will facilitate more cost effective monitoring programmes as well as forming the basis of a risk based pollution control strategy".

Additionally, in a report on effect based monitoring tools the European Commission states that "effect-based tools are especially suitable as part of investigative monitoring programs for which the regulatory requirement are less formally determined" [4]. This is also in line with Article 8 (1) of the WFD where Member States are required to "establish a coherent and comprehensive overview of ecological and chemical surface water status within each river basin district". Using effect-based tools in monitoring is also supported by the European Commission's technical report on aquatic effect-based monitoring (EBM) tools [2].

Using passive sampling together with effect-based tools, which are analytical methods that use the organisms or cellular response to a group of chemicals to determine their effect, in monitoring will help gather more information on chemical mixtures as well as give an early warning to help identify compounds in future risk assessments [2]. The WFD does not prevent but encourages the use of such methods to measure mixture toxicity.

Furthermore, according to CIS guidance document no. 3 (Analysis of Pressures and Impacts) the potential risk of cumulative effects from substances having the same mode of action[5] (MoA) should be taken into account in the pressures and impacts assessment, and according to the WFD, "other pollutants also need to be monitored if they are discharged in significant quantities in the river basin or sub basin."

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[1] Surveillance monitoring: to supplement and validate the impacts analysis, to support the efficient and effective design of future monitoring programmes, to assess long-term changes in natural conditions and changes resulting from anthropogenic activity. The monitoring is performed at least once every management cycle (usually every 6 years).

[2] Investigative monitoring: to determine reasons for exceedances or predicted failure to achieve environmental objectives if the reasons are not already known; and to determine the magnitude and impacts of accidental pollution.

[3] The purpose of guidance documents being "to assist stakeholders to implement the WFD".

[4] As opposed to removing a sample from the sampling location, passive sampling is an environmental monitoring technique which allows for the analyized molecule to freely flow into the sampling cell and then be measured. The result is a time weighted average concentration instead of a concentration from one point in time.

[5] MoA is a functional or anatomical change, at cellular level by which a chemical exerts its biological effects.

What are effect-based methods?

Effect-based methods (also referred to as effect-based tools/monitoring) together with related tools allow for hazards from chemical mixtures to be identified and in a subsequent step for the substances that are causing the biological effect to be pinpointed [3]. EBMs are categorised in three main groups 1) bioassays (in vitro/in vivo), 2) biomarkers, and 3) ecological indicators (see figure below). Each method measures toxicity differently and has advantages and disadvantages. Bioassays measure toxicity samples on cellular or individual level; biomarkers observe biological responses at the cellular or individual levels and ecological methods measure changes observed at higher biological organisation levels [4]. An additional advantage of EBMs together with effect direct analysis (EDA) is that they provide a better picture of the link between chemical pollution in ecosystems and biological effects [11] [12]. Testing responses to a chemical mixture from different organisational levels (e.g molecular, cellular, and individual population) provides more detailed information on links between these substances and the adverse outcome on an individual or population level [13].

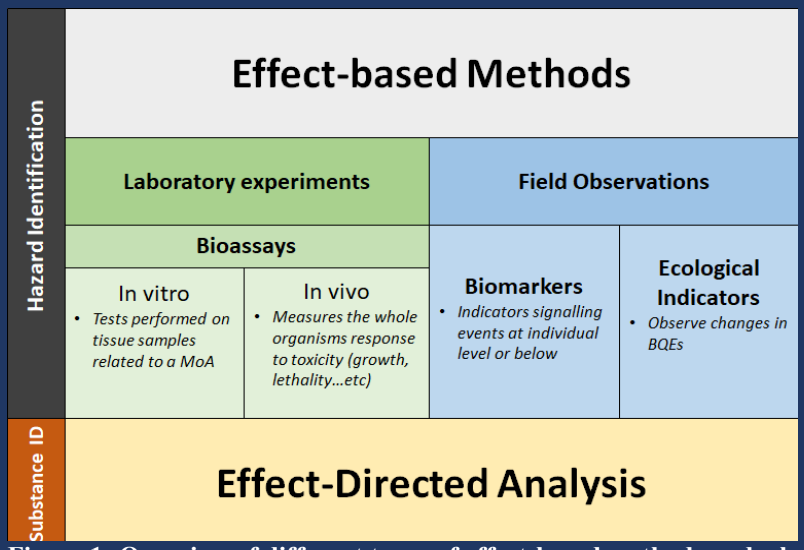

Figure 1: Overview of different types of effect-based methods and what they can be used for.

Over time, effect-based tools have gathered more traction. Member States and academics alike call for the introduction of effect-based methods to manage chemical mixtures in surface waters. EBMs can be an effective tool to address mixture toxicity, however to use these tools it is not necessary to change the WFD. The question is rather to reflect on the best way to disseminate them and to provide the adequate incentives for Member States to use them.

How Status Assessment can Address Mixture Toxicity

Integrating mixture toxicity into status assessment of aquatic ecosystems under the current Water Framework Directive is another way to address mixture toxicity. There are several options for doing it. Two of these options are mentioned in the European Environment Agency (EEA) report Chemicals in European Waters and are described in more detail below.

Option 1 consists of integrating mixture status in aquatic ecosystems into ecological status. **Option 2** consists in integrating integrating mixture status in the chemical status, but that would require using compound-based mixture predictions and establishing the EQS for mixtures of similarly acting compounds additionally, by using EBMs to backtrack these mixture effects to their source substance, the EQS in the Priority Substances (PS) Directive could be updated to reflect mixture effects as well. A third option (**Option 3**) could be to not integrate mixture effects into the status assessment at all but simply include EBMs in monitoring and screening for identification of pressures, which could aid in the prioritisation and de-prioritisation of water bodies for further monitoring but also for identification of

measures to address the pressures; this option was oultlined in the JRCs Draft Report on Effect-Based Methods (2019) presented to the Working Group (WG) chemicals.

Option 1: Whether or not there is a negative effect of mixtures in a water body can be included in the **ecological status** as can also be inferred from EEA's report on Chemicals in European Waters (p.24). This is in line with Annex V outlining the quality elements for the classification of ecological status, specifically the need to address "pollution by other substances identified as being discharged in significant quantities into the body of water." (WFD, Annex V 1.1). This reference is not limited to single substances, but mixtures can/should be regarded as well. Currently, there are a few biological quality element monitoring tools that are sensitive towards chemical hazards [3] [9], giving only a limited picture of how BQEs respond to chemical pollution. However, a change in BQE under ecological status warrants the investigation of cause as well as the implementation of measures to counteract the degradation of quality elements. This would require site-specific effort (water managers first identifying which components of the mixture are the main contributors to harmful effects and then reducing those inputs; this is not an entirely new approach, as BOD (Biological Oxygen Demand) has been used for many years as an integrated measure of water pollution). Moreover, EBMs together with EDAs could also provide additional evidence on the effect of chemical hazards on BQEs as well as be helpful in selecting additional River Basin Specific Pollutants based on ecological relevance [2][15]. New Guidance documents outlining new analytical and risk assessment tools might also be necessary.

Option 2: Using compound-based mixture prediction of mixture effects could be included in **chemical status**. EQS for mixtures of similarly acting compounds could be established by establishing the sum of the ratios of the single substance concentrations in a mixture, over their individual EQS values. If this calculated sum exceeds 'one', then the EQS of a certain priority substance group is exceeded. A review of the priority substances list may be necessary to include the aforementioned mixture EQS. However this approach does have the disadvantage that it doesn't take into account the occurrence of antagonistic[6] and synergistic[7] effects (explained below) and where the mixture is composed of compounds/substances with different modes of action. Additionally using effect direct analysis (EDA) together with effect-based methods, the cause effect relationship between a mixture and the reaction biological indicators can be established allowing the identification of the substances responsible for the effect. Site specific efforts might also be needed to provide a more conclusive evidence on the substances responsible. If these substances are PS then EQSs can be adapted to take into account mixture effects; moreover, new substances can be listed.

We are convinced that both above mentioned solutions are possible under the current framework and would effectively address mixture toxicity as regards status assessment/classification. For this the CIS would be a possible format for discussing the most applicable method for Member States to integrate these options into their management plans.

How Measures can be developed

Usually prior to the impact assessment and status classification of a body of water an analysis of pressures should be done. In this case pressures would already be known before EBMs were used to assess hazards. If this is the case there should already be a pretty good idea of what pressures are causing the impact. If necessary, additional EBMs and EDAs can be used to narrow down the chemical suspects. Once pressures are identified appropriate measures can be put in place such as source control, EQS, etc. If however the pressures are not identified prior to a mixture effect being observed using EBMs in monitoring, the process of identifying pressure is more complicated. More information about the impact needs to be collected in order to narrow down pressures. Determining the geographic scale, and testing other taxonomic groups can give insight into the extent of the problem and provide clues about the reason for the impact.

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[6] **Antagonistic Effect:** An effect is said to be antagonistic when the effect of the two chemicals is lower than the summed effect of each chemical alone. (JRC Modes of Action of the current priority substances list under the WFD and other substances of interest, 2018, p.155)

[7] **Synergistic effects:** Are said to have occurred when the combined effect of two chemicals is greater than the sum of the effect of each chemical alone. (JRC Modes of Action of the current priority substances list under the WFD and other substances of interest, 2018, p.155)

Further investigative monitoring and source tracking will also likely be needed. Once all additional information is collected and a better picture of pressures is formed, measures can be implemented. Further information on the above examples can also be found in the Draft Report to the CIS WG Chemicals on the outcome of the work performed in the CIS subgroup on effect-based methods (EBMs) agreed to by Water Directors of Member States [15].

Advantages of the current analysis method and limitations of EBMs

It is important to note that the above mentioned measures should not replace the setting of the EQS for individual substances at the EU level but act as a complementary method to traditional chemical analysis. While stakeholders and Member States suggest the single chemical approach is outdated, environmental standards developed for priority substances were designed to adequately protect human health and the aquatic environment, and we believe they are still needed to ensure that. Moreover, while EBMs can be used to monitor mixture effects it is unclear how EBMs can capture effects that can occur in humans following long term exposure to pollutants [6]. EBMs have additional limitations that make the priority substances list a crucial tool. EBMs will not be able to detect either metals or contaminants bound to particles [7] and EBMs also do not always provide conclusive evidence of the substances responsible for the toxic effect and even the use of effect-directed analysis can sometimes only narrow the suspects down to a few substances responsible.

Researchers agree that EBMs should only be used to support substance by substance chemical methods. Especially because the analyte-by-analyte approach has a high degree of specificity in targeting specific contaminants and contaminant groups. The priority substance approach (single substances, or groups of substances with similar MoA) also permits continuity of implementation, and provide a basis for comparison [8]. It is therefore important to keep this approach to limit the concentration of substances that have been identified as causing harm to human health and the aquatic environment (priority substances). Especially because for a number of priority substances listed under the Water Framework Directive, like cadmium, lead and nickel, and pesticides such as chlorfenvinphos and simazine, European measures towards preventing releases to the environment have been effective in significantly reducing their presence in water bodies [7].

As regards monitoring, due to the limitations of EBMs and the still prevalent advantages of traditional chemical monitoring we would advise **not to replace** current monitoring obligations under the WFD with EBMs but instead use them side by side. We fully support using EBMs and other methods, as we understand that mixture toxicity poses a significant threat to aquatic environments, therefore EBMs and other mixture toxicity analysis should be used to complement for example monitoring requirements (under investigative monitoring). As outlined above this is already possible under the current framework as a complementary approach to achieving the objectives set forth in the WFD. No additional amendments are needed. New guidance could be nevertheless be issued by the European Commission in order to help build Member States capacity to embrace EBMs. The topic of these guidance document could lay out how these new monitoring methods and EBMs in general can be integrated into the current system. This could be done either under the Common Implementation Strategy – with the advantage that the Working Group on chemicals already provides an adequate platform for expert discussions. Another and possibly complementary option could be to address this point as part of the Zero Pollution Action Plan. The advantage of using the Zero Pollution Action Plan would be to have higher visibility for these methods to be used as a novel approach to increase implementation in Member States.

EMERGING POLLUTANTS

The method set in the WFD to manage pollutants of emerging concern is the Priority Substance Directive, and more specifically the Watch List established in 2015. The Watch List was specifically established to have pollutants of emerging concern carefully monitored by EU Member States to determine the risk they pose to the aquatic environment and whether EU Environmental Quality Standards (EQS) should be set for them.

The EQS Directive determined the Watch List should be reviewed every 2 years, and so far the Watch List has been reviewed twice. However due to a failure to regularly review the list of priority substances, opportunities for moving Watch List substances to the priority substances list have been missed (this failure is due to the European Commission's inaction as they failed to comply with the requirement to propose a revision on the priority substances list, and Member States who accepted that).

No further delay in the regulation of prioritized substances should be tolerated. The last review of the priority substances list was in 2013 (Directive 2013/39/EU) and at that time, the requirement in the WFD for a regular review of the Priority Substance Directive was changed to require a review of the list at least every 6 years. A list with proposed additional priority substances including fact sheets and EQS is available since 2016, but because of the ongoing fitness check, they have not been taken forward.

The low ambition of Member States in actually tackling emerging (and well known) pollutants can also be demonstrated by the following fact. Member States have argued that the availability of analytical methods is a prerequisite for listing an emerging pollutant on the Watch List; they have at the same time opposed listing well known hazardous substances with known impacts on aquatic environment, arguing that sufficient monitoring data is not available. For example as regards pyrethroids – used in commercial insecticides - it is clear since more than 10 years that they should be prioritised, however this hasn't happened due to non-availability of monitoring data (e.g. Deltamethrin, Permethrin, Esfenvalerate). Moreover, pyrethroids have not even been introduced into the last revision of the Watch List because Member States have argued that the analytical method is still not available. Pharmaceuticals were also not listed as priority substances in the last review of the Priority Substance Directive (2012-2013) due to strong opposition of Member States, despite being proposed to be listed by the EC. At that time, Member States argued that sufficient monitoring data was not yet available.

The main reason for such cases is a strong resistance of industry to stricter regulation of chemicals. We think that it is not acceptable to wait for the availability of analytical methods – if a substance is identified as priority hazardous substance in the absence of sufficient monitoring data, it has to be put immediately on the Watch List, even if no analytical method is available yet. The European Commission should introduce a procedure to ensure the timely and cost-efficient development / validation of analytical methods.

Effect-based tools described above can also be used in the context of pollutants of emerging concern as an early warning system for substances not currently under monitoring obligations [14]. The new monitoring approach of using EBMs and passive sampling, as well as the prioritisation process and Watch List, together with the strategy on pharmaceuticals in the environment provide a robust framework for dealing with pollutants of emerging concern in the aquatic environment. However, the consequent implementation of these methods, and thus the successfulness in reducing these contaminants will largely depend on the political willingness of Member States to address them through listing them on the Watch List and priority substances list and adopting effective measures to tackle their pressure [14].

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