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COMMENT

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Facilitating the market transition away from persistent and mobile substances: a report on tools developed by ChemSec in the ZeroPM project: SIN list, Marketplace and the PFAS guide

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Abstract

Persistent, mobile and toxic (PMT) and very persistent and very mobile (vPvM) substances have gained significant attention in recent years. The substances do not break down in the environment over appreciable time scale, can travel long distances with water bodies and can cause toxic effects on the environment and human health. Hazard classes for these substances were introduced into the Classification, Labelling and Packaging Regulation in March 2023. A key preventative measure to reduce manufacture, use and emissions of PMT/vPvM substances, is a market transition away from these substances to less harmful alternatives. Companies may be unaware of which of their products contain PMT/vPvM substances. The Horizon Europe research project ZeroPM: Zero pollution of persistent, mobile substances is seeking to support this market transition by developing and further extending tools including the Substitute It Now (SIN) List, the Marketplace and a PFAS Guide for companies. These tools will be discussed.

In recent years, the need for a regulatory identification and classification of substances that are persistent (P) and mobile in the aqueous phase (Mobile, M) has been raised [1, 2]. The delegated act introducing new hazard classes for persistent, mobile and toxic (PMT) and very persistent and very mobile(vPvM) substances was adopted on the 31st of March 2023[3] for inclusion in the Regulation on Classification, Labelling and Packaging of substances and mixtures (EC No 1272/2008) [4]. The new hazard classes followed up on commitments by the European Commission detailed in the Chemicals Strategy for Sustainability towards a Toxic Free Environment [5], and built upon previous work by the German Environment Agency (UBA) [1, 2, 6–8].

The introduction of these new hazard classes represents a significant step forward in the regulation of PMT/vPvM substances. However, to complement regulation and reduce the production and use of PMT/vPvM substances, a market transition needs to be catalyzed by providing the right information to the right people to allow companies to act ahead of regulation changes. This can be achieved by providing knowledge, guidance and support for companies as they transition away from harmful PMT/vPvM substances. Many companies are unaware of which of their products contain PMT and vPvM substances. Significant financial and time resource investments are needed by companies to identify, assess, and implement safer and viable alternatives in to supply chains. However, barriers represented by a

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lack of knowledge, time and money can result in poorly informed decisions which may present themselves as regrettable substitutions. A case in point being GenX, the substitute for PFOA, which is now found ubiquitously, and it known to present the same environmental problems as PFOA [9].

In response to this, The International Chemical Secretariat (ChemSec) has developed tools to support companies' transition away from using harmful PMT and vPvM substances in products, processes or services within their supply chain. ChemSec is an independent non-profit organization that advocates for substitution of toxic chemicals to safer alternatives. ChemSec carries out independent research, works in cross-border collaborations and develops practical tools to further the development of more progressive chemicals legislation and push businesses towards the transition to non-toxic alternatives. ChemSec engages the work of chemists, political scientists, business experts and communicators, among others and ensures all tools developed are scientifically sound. ChemSec's financial support comes from the Swedish Government, foundations, private individuals and other non-profit organizations.

Specifically related to PMT/vPvM substances, the SIN (Substitute It Now) List was updated in 2019 to include several PMT/vPvM substances and this served to increased awareness, especially among companies and financial investors, of PMTs/vPvM substances as a group of chemicals needing special attention [10]. Within the ZeroPM project (Zero pollution of persistent, mobile substances), ChemSec will further develop both the SIN List and the Marketplace as well as developing the PFAS guide. These tools (see Fig. 1) will be detailed below.

The SIN List

The SIN List was launched in 2008. At this time the EU Chemicals Regulation Registration, Evaluation, Authorization and Restriction of Chemicals (REACH regulation 1907/2006) [11] had been in place for two years, the concept and criteria for listing Substances of Very High Concern (SVHCs) on a Candidate List was established, but no substances had yet been listed. Prior to this, ChemSec had established a discussion group with progressive downstream users of chemicals, the so called ChemSec Business Group [12]. Based on stakeholder discussions, and a preemptive approach, ChemSec founded the SIN List to provide a list of substances that could be expected on the Candidate List [13, 14].

The SIN List encompasses substances from the categories that are included in REACH Article 57 which are:

- CMR (Carcinogenic, Mutagenic or Toxic to reproduction) substances,
- PBT (Persistent, Bioaccumulative and Toxic) substances and vPvB (very Persistent and very Bioaccumulative) substances,
- "Substances of equivalent concern". This category covers substances that are not covered by the other two categories, but which nonetheless give rise to an equivalent level of concern in terms of potential damage to human health and the environment. This category includes, for example, endocrine-disrupting

Fig. 1 An overview of the tools to be developed by ChemSec to assist in the market transition away from PFAS (an important group of PMT/vPvM substances), including the SIN List, the Marketplace, and the PFAS guide

chemicals as well as sensitizers and chemicals with specific organ toxicity. Several PMT/vPvM substances have been identified under this category [7].

When compiling the SIN List, an advisory committee with representatives from different health and environmental organizations was established to guide development of the concept and the methodology as well as the final substance selection [15]. When adding substances to the SIN List, ChemSec applies the following process [16]:

First, a screening is carried out, using suspect substances lists, scientific publications, biomonitoring databases, model software and by asking scientific experts. This is done to obtain a list of substances that are suspected to meet the criteria in question. Information on production and use is then considered to select the most relevant substances for further evaluation. As the aim of the SIN List is to reduce the use of hazardous substances, only substances that are actually used are listed. Second, the list of substances is given to scientists with expertise related to the endpoints in question. The scientists then identify and scrutinize all available peer reviewed data, evaluate the data and summarize the findings. Computer models with relevant chemical applicability domains and read-across methods used in a weight-of-evidence approach are also used by the experts for PBT/vPvB and PMT/vPvM substances. In the final step, the substances included on the SIN List are selected via discussions with the evaluating scientists, experts from different governments as well as members of the SIN List Advisory Committee.

There have been three main updates since the launch of the SIN List in 2008. In 2011, the SIN List was updated with Endocrine Disrupting Chemicals (EDCs) [17]. At this time there were no official criteria in place for EDCs and the SIN List showed it was possible to identify EDCs on a case-by-case basis under Article 57f of REACH. This is also how EDCs have later been identified for the Candidate List. In 2014 there was an update with the theme "regrettable substitution" [18]. Again, a number of EDCs were added and also a number of PBT substances and vPvB substances. Many of the substances added are replacements for well-known hazardous compounds, that themselves have later been shown to be equally problematic. Examples are Bisphenol S and Bisphenol F [19], a number of brominated flame retardants [20] and benzotriazole UV-filters [21]. In 2019, the SIN List was expanded under the theme "persistence" to include 16 PMT and vPvM substances. They included melamine, some chlorinated solvents and some PFAS. At the same time additional PBT and vPvB substances were added to the SIN List. In addition, a nanomaterial—carbon nanotubes—was added to the SIN List, based on it being persistent, carcinogenic and probably toxic to reproduction [22–24].

The ChemSec Marketplace

The online business to business (B2B) platform ChemSec Marketplace [25] was launched in 2017 as a tool to boost substitution of harmful chemicals by industry, where it allows chemical producers of safer alternatives to advertise their products free of charge. In addition, companies looking for safer alternatives can post requests for new solutions. As of January 2023, the platform has published over 600 adverts, has approximately 2000 users per month, and on average, two new contacts are made between companies every day. The ChemSec Marketplace has a unique setup in that providers of alternatives can advertise these free of charge. For an alternative to be placed on the Marketplace it must not contain any chemicals that fulfil the criteria of being Substances of Very High Concern (SVHC). ChemSec also screens the alternatives (using materials safety data sheets and other documentation) and reserves the right to deny publication of an alternative if it is suspected that the alternative may not be a safer alternative. Alternatives that have third party verification, ecolabel or fulfil certain environmental standards will be prioritized first in the results when searching for an alternative.

The ChemSec Marketplace is being used by governmental agencies such as ECHA who have posted requests on the Marketplace seeking information on alternatives to the chemicals that are currently included in the REACH authorization processes. In the future, the ChemSec Marketplace will expand the availability of alternatives to persistent and mobile substances to facilitate the market transition away from harmful substances and show policymakers which alternative products are currently available on the market.

PFAS guide for companies

Per- and polyfluorinated alkyl substances (PFAS) are a group of many thousands of similar substances [26] with the common property that they do not degrade in the environment, but accumulate over the time they are emitted. They are often referred to as forever chemicals and are ubiquitous in the environment having many known negative effects. Recent work has postulated that the planetary boundaries for a safe operating space for humanity when it comes to PFAS has been exceeded based on levels of PFAS in rainwater in remote areas being above proposed safe thresholds for drinking water [27]. Regulation in the EU and other regions is becoming increasingly stringent, the most ambitious of all being the proposal for a universal restriction of PFAS in the EU [28].

To phase out PFAS from products and processes, companies need to understand potential PFAS uses and functions that are relevant to their business position. Due to the complexity and broad array of many PFAS uses and functions [29], it can be challenging for companies to know if and why they have PFAS in their products. In combination with extensive supply chains that may suffer a lack of transparency, phasing out PFAS is a considerable task. The PFAS guide [26] was developed to fill this gap and was launched in February 2023. The PFAS guide builds on existing inventories, reports and publications on PFAS uses from experts. These resources have been developed into a format that is more easily accessible and understandable for non-scientists and people working more hands on with the PFAS issue in companies. The PFAS guide contains one part with basic guidance and related to PFAS, including information such as what typical PFAS uses are, methods for chemical analyses of PFAS and how to communicate about PFAS in the supply chain. There is also information on regulation and links to a number of sector-specific resources and reports. The PFAS guide also includes a database where users can search for sectors, products, uses and functions to understand if they have "PFAS hotspots" in their business. The PFAS Guide includes links to the SIN List and the ChemSec Marketplace for alternatives as well as to other sources of information.

In conclusion, preventing the production, use and emissions of persistent and mobile substances requires a conducive policy framework and a move towards safer chemistry. Steps have been made towards this (for example through the introduction of new hazard classes for PMT/vPvM substances), though potential barriers such as organizational inertia or techniques used in certain cases to avoid moving away from harmful substances still exist. The implementation and enforcement of regulations is cemented, enhanced and fast tracked if there is a market readiness to shift towards safer chemistry. The online tools developed by ChemSec in the ZeroPM project will enhance companies' capacity to identify PMT/vPvM substances, including PFAS, and provide them with safer alternatives to catalyze the transition to safer alternatives.

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Availability of data and materials
The datasets generated and/or analyzed during the current study are available online: sinlist.org, marketplace.org and pfas.chemsec.org. Further datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

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Not applicable.

Consent for publication
Not applicable.

Competing interests
Anna Lennquist and Jonatan Kleimark work for ChemSec, which is the organization that hosts the tools the SIN List, Marketplace and the PFAS Guide.

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