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6 **Letter to the editor regarding Collard et al. 2023: “Persistence**
7 **and Mobility (defined as organic-carbon partitioning) do not**
8 **correlate to the detection of substances found in surface and**
9 **groundwater: Criticism of the regulatory concept of persistent**
10 **and mobile substances”**

11
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47

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50 Dear Editor,

51

52 We wish to make readers of the recently published article by Collard et al. (2023) aware that
53 it is based on several false claims in relation to the regulatory concept of introducing new
54 hazard classes for persistent, mobile and toxic (PMT) substances and very persistent and very
55 mobile (vPvM) substances. Specifically, these false claims misrepresent the underlying
56 scientific justification and regulatory purpose of the PMT/vPvM criteria. The PMT/vPvM
57 criteria were adopted in the European Union's CLP Regulation on April 20th, 2023, as part of
58 the introduction of the new hazard classes PMT and vPvM. We feel it necessary to highlight
59 these false claims, in view of the potential impacts these claims could have on the ongoing
60 discussions regarding the adaptation of the new hazard classes PMT and vPvM in the
61 Globally Harmonized System of Classification and Labelling of Chemicals of the United
62 Nations (UN GHS).

63

64 **1. Collard et al. (2023) incorrectly claim that surface water monitoring data are relevant**
65 **to the PMT/vPvM criteria.**

66

67 Collard et al. (2023) incorrectly state "*Cut-off criteria for M were derived from a*
68 *benchmarking exercise comprised of a large dataset of surface and groundwater monitoring*
69 *data*". Rather, the PMT/vPvM criteria were developed in relation to subsurface transport, in
70 the context of groundwater and drinking water protection (Arp and Hale, 2022). The
71 PMT/vPvM criteria were not developed to predict water contamination, particularly not
72 surface water contamination. Surface water monitoring data were not considered during the
73 development of the PMT/vPvM criteria (Neumann and Schliebner, 2019). The aim of
74 protecting groundwater and riverbank filtration was a central scientific reason for using the

75 log organic carbon-water partition coefficient ($\log K_{OC}$) as the parameter to base the
76 classification criteria for mobile (M) and very mobile (vM) substances, as stated in the CLP
77 regulation:

78
79 *"The classification criteria for M/vM relate, in particular, to the $\log K_{OC}$ (soil*
80 *adsorption coefficient) value. The K_{OC} value is the organic carbon-water partition*
81 *coefficient and reflects the ability of a substance to be adsorbed on the organic*
82 *fraction of solid environmental compartments such as soil, sludge and sediment, and is*
83 *therefore inversely related to the substances' potential of entering into groundwater. It*
84 *is therefore appropriate to assess the mobility criterion against the $\log K_{OC}$ value of a*
85 *substance, a low K_{OC} implying a high mobility."* (EC, 2023)

86
87 Therefore, any critique of the PMT/vPvM criteria that is based on surface water monitoring
88 data is irrelevant.

89

90

91 **2. Collard et al. (2023) incorrectly imply that the M/vM criteria were derived exclusively**
92 **from benchmarking of monitoring data.**

93

94 The quote from Collard et al. (2023) above is also incorrect in its implication that the cut-off
95 criteria for M and vM were derived exclusively from the benchmarking of monitoring data.

96 The cut-off criteria for M and vM were developed to protect sources of drinking water, such
97 as groundwater and riverbank filtration, from receiving and accumulating persistent (P) and
98 very persistent (vP) substances. The $\log K_{OC}$ cut-off values for this purpose, presented in the
99 CLP delegated act (EC, 2023), were derived through multiple lines of evidence and several

100 rounds of consultations with international experts over several years (Arp and Hale, 2022,
101 2019; EC, 2023, 2021; Neumann and Schliebner, 2019). Though some of the technical
102 documents used to develop these criteria referred to groundwater and drinking water
103 monitoring data (Arp and Hale, 2019), it was not the sole consideration. Alternative lines of
104 evidence included: i) the intrinsic ability of PMT/vPvM substances to travel long distances
105 and over long time scales in the subsurface based on groundwater models (e.g. Gustafson,
106 1989), ii) the difficulty in removing PMT/vPvM substances from wastewater, raw water, and
107 drinking water using standard and advanced treatment processes (Gollong et al., 2022;
108 Neuwald et al., 2023), iii) the historic acceptance of similar criteria to protect groundwater in
109 the EU biocide regulation (EU 528/2012), iv) the methodology of the EU groundwater watch
110 group (Lapworth et al., 2019), v) the methodology of the UN FAO (FAO, 2000), vi) the
111 economic impact analyses published by the German Environment Agency (Arp and Hale,
112 2019), and vii) the recent impact assessment performed by the European Commission (EC,
113 2022). Collard et al. (2023), in their critique of the PMT/vPvM criteria, excluded all mentions
114 of these considerations related to subsurface modelling and breakthrough in river bank
115 filtration of PMT/vPvM substances, difficulty in water treatment processes to remove such
116 substances, existing regulations and guidelines using similar criteria, as well as socio-
117 economic impacts of using PMT/vPvM substances, much of which were described by Hale et
118 al. (2022).

119

120 The primary purpose of the PMT/vPvM criteria is not to prevent all water contamination.
121 Rather, it is to prevent emissions of the persistent substances that have the greatest potential to
122 be problematic water pollutants. These water pollutants would have a substantial impact on
123 society, and owing to their intrinsic properties, may also be considered substances of very
124 high concern (SVHC) (Hale et al., 2020). Substances that are not PMT/vPvM substances may

125 also contaminate water but are collectively considered less problematic from a water quality
126 management point of view because they are relatively less likely to reach drinking water
127 resources (Arp and Hale, 2022). They are also easier to remove with conventional technology,
128 including natural attenuation, and easier to detect using traditional methods (Hale et al.,
129 2022).

130

131 The amended CLP regulation summarises this as follows:

132

133 *"PMT and vPvM substances pose concerns as, due to their high persistence together*
134 *with a high mobility that is a consequence of their low adsorption potential, they can*
135 *enter the water cycle, including drinking water, and spread over long distances. Many*
136 *PMT and vPvM substances are only partly removed by wastewater treatment*
137 *processes and can even break through the most advanced purification processes at*
138 *drinking water treatment facilities. Such incomplete removal coupled with new*
139 *emissions mean that the concentration of those PMT and vPvM substances in the*
140 *environment increase over time. Once released into the environment, exposure to PMT*
141 *and vPvM substances is difficult to reverse, which leads to cumulative exposure of*
142 *both animals and humans via the environment. Any effects from this exposure are*
143 *unpredictable in the long-term."* (EC, 2023)

144

145

146 **3. Collard et al. (2023) imply that emission information should be linked to the**
147 **PMT/vPvM criteria.**

148

149 One of the three questions Collard et al. (2023) asks is, "*What could possibly drive the*
150 *presence of these chemicals in these potential sources of drinking water?*". This is answered
151 later in the paper with statements such as "*emissions and vicinity to emissions sources are*
152 *driving the detection rate of chemicals in surface water*". This is an obvious conclusion that is
153 more related to exposure and risk assessment than to the PMT/vPvM criteria, which addresses
154 the potential of a chemical to enter drinking water resources if emitted.

155

156 Risk is defined as hazard (i.e. the toxic effect) combined with exposure, whereas the
157 PMT/vPvM criteria describe a combination of problematic intrinsic properties of the
158 substance related to hazard and exposure that are independent of emissions or use. The
159 PMT/vPvM criteria, thereby, indicate that continuous emissions will lead to increasing
160 exposure and risk over time, and that an effects threshold will eventually be exceeded
161 (Cousins et al., 2019). This is similar to the case of persistent, bioaccumulative and toxic/very
162 persistent bioaccumulative (PBT/vPvB) substances, in that given continuous release there will
163 be increasing exposure and risk in the food chain (Hale et al., 2020). PMT/vPvM criteria
164 alone do not provide an indication of the level of exposure, only the potential. For a risk
165 assessment, one needs the substance property data used in the PMT/vPvM assessment, along
166 with emission and scenario parameters. For instance, in the case of a river bank filtration or
167 groundwater pollution scenario from a source to a drinking water well, the concentration of
168 the substance in the well water will depend on the substance properties determined in the
169 PMT/vPvM assessment (degradation half-life – persistency, adsorption potential – mobility,
170 and toxicity), as well as the exposure parameters (emission volumes, vicinity to well, aquifer
171 depth, groundwater flow rate, hydraulic conductivity, time since emissions). A substance that
172 degrades quickly or has a high adsorption potential would need to be emitted in larger
173 quantities or emitted in closer proximity in order to contaminate a specific site, relative to a

174 substance that does not degrade or has a low adsorption potential. Therefore, non PMT/vPvM
175 substances can contaminate wells, but would require more emissions or shorter travel
176 distances from the source to the well relative to PMT/vPvM substances. It is also worth
177 mentioning that it is difficult to measure well contamination of many PMT/vPvM substances,
178 as traditional analytical approaches are not always suitable for many mobile substances (Hale
179 et al., 2022; Reemtsma et al., 2016).

180

181 Requiring an emission characterization to be part of the PMT/vPvM criteria would be the
182 equivalent of requiring information on the proximity to a flame as part of a flammable
183 substance hazard assessment. As it is essential for users of flammable substances to know
184 they should avoid emissions near combustion sources; it is also essential for users of
185 PMT/vPvM substances or PBT/vPvB substances to know that any emissions will lead to
186 environmental accumulation leading to the contamination of drinking water resources or in
187 food-chains, respectively. These accumulation processes are difficult and near impossible to
188 reverse (Cousins et al., 2019; Hale et al., 2020). The PMT/vPvM criteria, therefore, allow for
189 precaution in the use and emissions of PMT/vPvM substances.

190

191

192 **4. Concluding remarks**

193 Collard et al. (2023) is not the first study co-authored by scientists affiliated with chemical
194 manufacturers that have made similar false premises regarding the PMT/vPvM criteria;
195 similar claims can be found Pawlowski et al., (2023). The hazard classes for PMT and vPvM
196 are relatively new, and therefore some misconceptions about their purpose or justification can
197 occur.. However, it is important to recognize that these misconceptions are being put forward
198 by those that may be affiliated with companies that may produce PMT/vPvM substances. The

199 introduction of the new hazard classes PMT and vPvM supports the precautionary principle,
200 so that the use of these substances on the market is compatible with the protection of water
201 resources.

202
203 One section in the paper by Collard et al. (2023) that is worthy of further consideration is the
204 in-depth reassessment of P and vP conclusions for several substances. Many of the persistence
205 assessments in the cited literature were based on a weight-of-evidence assessment using the
206 best available data; however, the weight-of-evidence was often not of sufficient quality to
207 definitively conclude P or vP. The type of statistical analysis conducted by Collard et al.
208 (2023) could only be done correctly if harmonised, high-quality P and vP assessments based
209 on the CLP criteria, were available. For P and vP assessments, this would require half-life
210 data from simulation tests (OECD 307 for soils (OECD, 2002a), OECD 308 for sediments
211 (OECD, 2002b) and OECD 309 for water (OECD, 2004)), as well as batch sorption
212 experiments for mobility following OECD 106 (OECD, 2000). More high-quality data on
213 this front is encouraged, particularly since the PMT/vPvM criteria are fit for purpose to
214 protect drinking water resources.

215

216

217 **Declaration of competing interest**

218 The authors declare that they have no known competing financial interests or personal
219 relationships that could have appeared to influence the work reported in this paper.

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