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Emissions of Organic Pollutants from Traffic and Roads: Priority Pollutants Selection and Substance Flow Analysis

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Introduction

Large quantities of organic pollutants (OPs) are emitted from vehicles, fuels, road and roadside construction materials and they are accumulated on road surfaces. Contaminated road runoff is transported to surface waters, where the OPs may pose a threat to aquatic ecosystems. Therefore, tools that facilitate the prioritization of hazardous compounds for further studies through substance flow analysis (SFA) need to be developed.

Aim and objectives

The specific goals of this research were to:

- Identify sources and quantify uses of OPs present in road environments.
- Propose a list of Priority Pollutants (PPs) with contaminants identified as hazardous and of sufficient concern to warrant further investigations.

Methods

To identify and classify possible sources of OPs from road environments, as well as to perform the selection of PPs to be included in the SFA, the following methodology was implemented (Figure 1).

Selection criteria

Criteria supporting evaluation of collected data and the choice of PPs include:

- Risk of emission/leaching of pollutants from sources into stormwater systems.
- Emission of specific substances or groups of substances from more than one source in road environments.
- Estimation of use and quantities of OPs emitted from vehicles, fuels and construction materials in Sweden and in the EU.
- Hazardous effects on aquatic environments and humans.
- Availability of analysis methods for chosen substances.

RICH

The RICH (Ranking and Identification of Chemical Hazards) tool was used to provide information regarding physico-chemical and biological properties registered for a wide range of substances occurring in stormwater. Figure 2 presents sorting steps in the chemical hazards assessment, performed by RICH.

Results: Selection of PPs

The first screening stage for PPs selection allowed to identify and classify the most important sources of OPs in road environment (Table 1).

Table 1. Sources of OPs emission identified in traffic environment

<table>
<thead>
<tr>
<th>VEHICLES</th>
<th>NUMBER OF GÅRDA</th>
<th>NUMBER OF TUNNELS &amp; CAR WASH</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>200</td>
<td>40</td>
<td>20</td>
</tr>
<tr>
<td>300</td>
<td>60</td>
<td>30</td>
</tr>
</tbody>
</table>

Further analysis and RICH filtration of OPs involved established selection criteria and resulted in PPs presented in Table 2.

Table 2. Examples of identified PPs

<table>
<thead>
<tr>
<th>PNP Type</th>
<th>Identification</th>
<th>Card</th>
<th>Emission</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>Phthalates</td>
<td>4</td>
<td>0.5</td>
<td>Biodegradability</td>
</tr>
<tr>
<td>1</td>
<td>Aldehydes</td>
<td>5</td>
<td>0.2</td>
<td>Bioaccumulation</td>
</tr>
<tr>
<td>2</td>
<td>Amines</td>
<td>6</td>
<td>0.1</td>
<td>Long-term effects</td>
</tr>
</tbody>
</table>

Results: SFA

SFA is an analytical method developed for quantitative assessment of individual substances through a given system, specified in space and time. For this study, system boundaries are defined in Table 3.

Table 3. The system boundaries for SFA

<table>
<thead>
<tr>
<th>SUBJECT</th>
<th>SPACE FRAME</th>
<th>SOURCES</th>
<th>TIME FRAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic pollutants</td>
<td>Road area</td>
<td>Garbage</td>
<td>1 year</td>
</tr>
<tr>
<td>Road area</td>
<td>Vehicles, road surface</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

So far, an SFA for PAHs have been performed. The PAHs are divided into low-, medium- and high-molecular weight compounds. Preliminary results are presented in Figure 4.