Pulse exposure - delayed responses of Daphnia magna

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**Introduction**

Intermittent discharges of xenobiotic chemicals to the aquatic environment occur frequently e.g. during spraying of pesticides, industrial discharges, and rain events. These pulse exposures lead to short-term high concentrations which may have significant toxic effects on organisms in the receiving waters. However, the effects of this type of exposure is seldom studied. In the present study we propose and evaluate a method for quantification of the effects of pulse exposure (PulseM) using *Daphnia magna* as test organism.

**Materials and methods**

In the PulseM test, new-born daphnids are exposed to high concentrations of chemicals/effluent in pulses ranging from 0.5-6 hours. The test organisms are transferred to clean water and their mobility is observed in a post-exposure period of 48 hours. The method was applied to m-cresol, 3,5 dichlorophenol, potassium dichromate, the pesticides pirimicarb and dimethoate, and two industrial effluents.

### Test procedure

<table>
<thead>
<tr>
<th>Exposure Duration</th>
<th>Post-exposure Mobility</th>
<th>Food uptake and animal sizes</th>
<th>Post-exposure reproduction and sizes of mothers</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 d</td>
<td>1 d</td>
<td>5 d</td>
<td>7 d</td>
</tr>
</tbody>
</table>

### Results

#### Exposure times (hours)

- **Control**
- **Exposed**

#### Concentration (µg/l)

- **Pirimicarb**
- **Potassium dichromate**

#### EC-values

<table>
<thead>
<tr>
<th>Exposure time (hours)</th>
<th>EC10</th>
<th>EC25</th>
<th>EC50</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>64</td>
<td>72</td>
<td>72</td>
</tr>
<tr>
<td>4</td>
<td>30</td>
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<td>24</td>
<td>16</td>
<td>19</td>
<td>26</td>
</tr>
<tr>
<td>48</td>
<td>14</td>
<td>16</td>
<td>24</td>
</tr>
</tbody>
</table>

### Conclusions

#### Results of ISO-test used for:

- Selection of 3-5 test concentrations for pulse test.
- Selection of pulse duration (0.5-6 h).

#### Delayed effects - post-exposure:

**Positive - animals regain mobility**

- Example: Pirimicarb.

**Negative - more immobile animals**

- Example: Potassium dichromate.

#### Delayed positive response:

- Pirimicarb.
- Dimethoate.
- 3,5 Dichlorophenol.
- Industrial wastewater.

#### Delayed negative response:

- Potassium dichromate.
- m-Cresol.
- Industrial stormwater runoff.

#### Pulse exposure to Dimethoate and Pirimicarb:

**Reduced food uptake.**

- Growth of animals affected.
- Time to first offspring increases significantly.

#### Chronic effects of pulse exposure to Dimethoate and Pirimicarb after 21 d in clean water:

- Number of off-spring significantly lowered.
- Weight of offspring reduced.
- Size of exposed mother animals reduced.