POP’s Reduction Strategy in Surface Water of Industrialized Regions, Kłodnica River Case Study

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NATO/ CCMS Pilot Study Meeting
Ljubljana, Slovenia, June 17-22, 2007
Water regions in Poland
Mercury in Polish rivers

Mercury concentrations in Polish rivers
monthly monitoring - range of values (2-3 samples)

[Graph showing mercury concentrations in various Polish rivers, with measuring points such as Odra-Choi, Odra-Wro, Nysa Lutynska, Przems, Warta, Wisla, Vistula, Bug, Vistula, Vistula, Narva-Pur, Izn - Co, Parszow, Wisla, Strykow, Reda Woiherowo, and the corresponding max and min values, as well as the EC Directive EQS line.]

[g Hg/l]
Cadmium in Polish rivers

Cadmium concentrations in Polish rivers
monthly monitoring - range of values (2-3 samples)

μg Cd/l

max value, October 2006
min value, October 2006
EC Directive EQS

measuring point

Odra - Chodźko
Odra - Wrocław
Nysa Łużycka ponad Gubą
Warta - Poznań
Włodzica - Bydgoszcz
Wyspa - Węgorzewo
Bug - Wyszyń
Narew - Puń
Inna - Gorzów
Oder - Strzykow
WDA - Strzykow
Reda Węgorzewo
Standardised yearly load of Mercury and Cadmium in Odra and Vistula

<table>
<thead>
<tr>
<th>Measuring Point</th>
<th>Hg (Kg/ha/year)</th>
<th>Cd (Kg/ha/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wisła/Warszaw</td>
<td>0.0045</td>
<td>0.0035</td>
</tr>
<tr>
<td>Wisła/Przemysł</td>
<td>0.004</td>
<td>0.003</td>
</tr>
<tr>
<td>Wisła/Kiszmar</td>
<td>0.002</td>
<td>0.001</td>
</tr>
<tr>
<td>Odra/Chojnów</td>
<td>0.0015</td>
<td>0.0015</td>
</tr>
<tr>
<td>Odra/Wrocław</td>
<td>0.001</td>
<td>0.001</td>
</tr>
<tr>
<td>Odra/Krajków</td>
<td>0.0005</td>
<td>0.0005</td>
</tr>
</tbody>
</table>

Cadmium and Mercury load
Mercury and Cadmium - Odra

Cadmium concentrations Odra - Wroclaw
monthly monitoring - range of values (2-3 samples)

Mercury concentration in Odra - Wroclaw
monthly monitoring - range of values (2-3 samples)
Kłodnica - main features

- Catchment area 1125.8 km² (Odra river basin)
- Population of 1 mln. inhabitants (Upper Silesia region)
- Agriculture (40% cultivated)
- Industry (coal mining, energy sector, metallurgy, metal production, mechanical sector, chemical industry)
- Functions: receptor for anthropogenic water, water retention, recreation and source of water for industry

Substances
- Cadmium
- Mercury
- PAH
### Kłodnica river water quality

<table>
<thead>
<tr>
<th>Priority substances</th>
<th>Kłodnica AA* µg/l</th>
<th>EU Directive AA-EQS µg/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cadmium and its compounds</td>
<td>0.2-0.6</td>
<td>0.15(class 4) 0.25 (class 5)</td>
</tr>
<tr>
<td>Mercury and its compounds</td>
<td>0.5</td>
<td>0.05</td>
</tr>
<tr>
<td>Anthracene</td>
<td>?</td>
<td>0.1</td>
</tr>
<tr>
<td>Benzo(a)pyrene</td>
<td>?</td>
<td>0.05</td>
</tr>
<tr>
<td>Benzo(b)fluoranthene</td>
<td>?</td>
<td>Σ = 0.03</td>
</tr>
<tr>
<td>Benzo(k)fluoranthene</td>
<td></td>
<td>Σ = 0.002</td>
</tr>
<tr>
<td>Benzo(g,h,i)perylene</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>Indeno(1,2,3-cd) pyrene</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Expert assessment based on information from Voivodship Inspectorate for Water protection; *AA – annual average
Conceptual model

- Sediments
  - Contaminated land - groundwater system
  - Direct industrial discharges
  - Indirect industrial discharges
  - Municipal waste water

- Agriculture
  - Air emissions/deposition
  - Product uses
  - Natural sources
Main sources of water contamination:

- Municipal and industrial wastes
- Diffuse pollution sources
- Sediment deposits

Stream Czarniawka discharging to Kłodnicy

Bielszowicki stream – Ruda Śląska

Ruda Śląska Bielszowice
### Potential Sources of Hg, Cd, PAH emissions to water

<table>
<thead>
<tr>
<th>Potential source category</th>
<th>Hg</th>
<th>Cd</th>
<th>PAH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combustion of fossil fuels</td>
<td>high</td>
<td>low</td>
<td>high</td>
</tr>
<tr>
<td>Manufacturing processes</td>
<td>high</td>
<td>high</td>
<td>medium</td>
</tr>
<tr>
<td>Atmospheric deposition</td>
<td>high</td>
<td>high</td>
<td>high</td>
</tr>
<tr>
<td>Domestic Waste disposal – waste water treatment plants</td>
<td>medium</td>
<td>high</td>
<td>low</td>
</tr>
<tr>
<td>Base metal mining and dressing</td>
<td>low</td>
<td>low</td>
<td>low</td>
</tr>
<tr>
<td>Primary non-ferrous metal production</td>
<td>low</td>
<td>high</td>
<td>high</td>
</tr>
<tr>
<td>Iron and steel production</td>
<td>low</td>
<td>low</td>
<td>low</td>
</tr>
<tr>
<td>Mineral oil and gas refineries</td>
<td>medium</td>
<td>none</td>
<td>medium</td>
</tr>
<tr>
<td>Basic organic chemicals</td>
<td>low</td>
<td>none</td>
<td>low</td>
</tr>
<tr>
<td>Major uses</td>
<td>low</td>
<td>low</td>
<td>low</td>
</tr>
<tr>
<td>Road transport and Other mobile sources and machinery</td>
<td>very low</td>
<td>very low</td>
<td>low</td>
</tr>
<tr>
<td>Agriculture related sources</td>
<td>very low</td>
<td>very low</td>
<td>low</td>
</tr>
<tr>
<td>Sediment re-suspension</td>
<td>low</td>
<td>low</td>
<td>low</td>
</tr>
</tbody>
</table>

Direct and indirect impact
Benzo(a)Pyrene emissions to air

B(a)P emissions in Europe - prognosis 2010 [Mg]

- Small sources, coal: 18%
- Small sources wood: 70%
- Other Small sources: 4%
- Aluminium: 1%
- Coke: 2%
- Road transport, Diesel: 5%

70%
PAH emissions to water - IPPC

IPPC installations PAH emissions to water [%]

- Combustion of fossil fuels: 35%
- Metal industry: 2%
- Mineral oil and gas refineries: 13%
- Plants for pre-treatment of fibres or textiles: 2%
- Basic organic chemical: 12%
PAH emissions trends in Europe

Decrease of PAH emissions between 1990-2003

- Benzo(a)pyrene 30%
- Benzo(b)fluoranthene 28%
- Benzo(k)fluoranthene 33%
- Indeno(1,2,3-cd)pyrene 18%

Wastewater discharges and treatment plants
Landfills and industrial sites
Further investigation

- Revision of the point sources environmental performance (incl IPPC)
- Identification and assessment of the diffuse sources including rainwater run off
- Investigation and assessment of contaminated land
- Studies on the river sediments – analyses and modeling
- Verification of the flow model of Kłodnica river for mercury, cadmium, and PAH
- Determination of the contaminants balance in the catchment
Management activities

- Water Catchement Management Plan prepared by Regional Water Management Board
- Development of infrastructure including wastewater treatment plants
- Industry technological changes
- Regional initiatives e.g. „Przyjazna Kłodnica”
Source control measures

- Improved technologies: BAT required by the IPPC Directive
- Industry profile changes and product substitutions
- Wastewater management – improvement in the drainage system and wastewater treatment
- Improvement in industrial and municipal waste management
- Implementation of measures for diffuse sources including contaminated soil and rainwater run-off
Example

- Sedimentation pond to be constructed on the base of existing pond

- Reduction of suspended matter as to achieve clarity

- Reduction of organic matter, BOD and COD 30 – 50%

- Reduction of Nitrogen and Phosphorous compounds
Engineering concept for the proposed sedimentation pond

1 – inflow
2 - sedimentation
3 - biological treatment (plants)
4- central part (recreation)
5- outflow
Strategic approach

- Improved understanding of the water system
- Revision of the results of current management
- Identification, assessment and targeting potential sources which are not covered by the current management
Thank you for your attention