INTRODUCTION

The region Lorraine shows a high proportion of clay soils, consequently around 20% of agricultural land are drained. This percentage can reach 70% in some watersheds. Water from these drained fields may create a pesticide contamination in rivers.

Within the context of the ‘Zone Atelier Moselle (ZAM)’, in collaboration with the Rhin-Meuse Water Agency, the ANSES Nancy, the ‘Chambre Régionale d’Agriculture de Lorraine and the INRA Mirecourt, remediation zones were implemented in drainage outlet in order to reduce pesticide export towards surface waters.

The objective of this study is to assess the effectiveness of constructed wetlands (CW) on the sorption capacities of the different matrices found in these constructed wetlands.

MATERIAL AND METHODS

Experimental sites and sampling

<table>
<thead>
<tr>
<th>Village</th>
<th>Soil Composition</th>
<th>pH</th>
<th>EC</th>
<th>CEC</th>
<th>SiO₂</th>
<th>Sp. surface</th>
<th>OC</th>
<th>N</th>
<th>CaCO₃</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jallicourt</td>
<td>Soil (L)</td>
<td>7.0</td>
<td>0.4</td>
<td>102</td>
<td>1.3</td>
<td>15.0 g/m²</td>
<td>1.2</td>
<td>0.3</td>
<td>5.2</td>
</tr>
<tr>
<td>Ollainville</td>
<td>Soil (L)</td>
<td>7.0</td>
<td>0.4</td>
<td>102</td>
<td>1.3</td>
<td>15.0 g/m²</td>
<td>1.2</td>
<td>0.3</td>
<td>5.2</td>
</tr>
</tbody>
</table>

Selected pesticides

Nearly 80 pesticides were analysed in waters flowing into and out of these constructed wetlands. Six pesticides were selected for laboratory on the basis of their:

- Frequency of use and detection in waters.
- Physico-chemical properties.

**Physico-chemical properties of pesticides (FootPrint, 2011)**

<table>
<thead>
<tr>
<th>pesticide</th>
<th>Kf</th>
<th>m².g⁻¹.kg⁻¹</th>
<th>Koc</th>
<th>mg.L⁻¹</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCPA</td>
<td>1.0</td>
<td>10</td>
<td>0.5</td>
<td>400</td>
<td>100</td>
</tr>
<tr>
<td>Tebucanazole</td>
<td>1.0</td>
<td>10</td>
<td>0.5</td>
<td>400</td>
<td>100</td>
</tr>
<tr>
<td>Prochloraz</td>
<td>1.0</td>
<td>10</td>
<td>0.5</td>
<td>400</td>
<td>100</td>
</tr>
</tbody>
</table>

RESULTS AND DISCUSSIONS

Adsortion isotherms

- Kf values ranged from 0.74 to 442.6 mg L⁻¹ kg⁻¹ and the n observed ranged from 0.14 to 1.12.

Pesticides:

- adsorption capacities: Prochloraz > MCPA > Isoproturon > Tebucanazole > Boscalid > Naphamid > 2,4-MCPA.

Substrates:

- retention capacity: Straw > 0.25 mg L⁻¹ kg⁻¹ > Sediment > Soil.

Freundlich adsorption and desorption isotherms

Desorption isotherms

- Non significant desorption was observed for 2,4-MCPA.

- No hysteresis can be defined when 0.7 < H < 1; then the adsorption of Boscalid is highly reversible (0.53 < H < 0.89).

- The other H values ranged from 0.59 and 0.30 for Tebuconazole to 0.44 and 0.16 for Prochloraz.

- The straw had the largest amounts of non-desorbable residues, 12.1 mg kg⁻¹ for 0.125 mg L⁻¹ initial concentration.

CONCLUSION

- The results clearly demonstrate the importance of sorption in the effectiveness of a CW, related to physico-chemical properties of pesticides and substrates.

- The retention was greater for pesticides with hydrophobic properties (low solubility and high Kf). In addition, the organic carbon content and nature of the substrate was found to have a strong effect on sorption.

- On the field, sorption alone does not determine the effectiveness of a CW to reduce pollution. Nevertheless, the adsorption reduces pesticide concentrations during the first rainfall events after treatment and the formation of non-desorbable residues increases the residence time of pesticides in the CW.

- Then vegetation and organic matrices (straw, dead leaves,…) should be maintained inside of the CW in order to increase their effectiveness.