Preliminary laboratory multi-scale investigation on performance of pervious concrete pavements and vegetated elements as storm water bio-filters and retention systems

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Preliminary laboratory multi-scale investigation on performance of pervious concrete pavements and vegetated elements as storm water bio-filters and retention systems

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1. World population in urban areas is still growing causing severe impact on environment and decrement of the life quality of inhabitants.
2. To smoothen the heavy impact of traditional transportation infrastructures, current and future urban facilities must be more environmental friendly and sustainable.
3. One way is to develop new “green transportation infrastructures” (GTI) as part of the urban storm water management system.
4. GTI have been well-investigated around the world, but specifically in Italy there is still a limited experience on their potential and benefits.
5. This work aimed promoting new urban storm water regulation systems through retention, filtration, and restoration of natural soil water content, and involving different expertise and knowledges.
6. A laboratory investigation on porous road pavements, and vegetated boxes, used to filter runoff pollutants from impervious pavements, was carried out to examine their ecological, hydraulic, and mechanical performances.

Three different experimental scales (samples, columns, and boxes) and investigation stages for the two GTI technologies were considered.

Pavement and vegetated systems were saturated for 12 hours with stormwater prepared in laboratory. Water samples were then collected and analysed.

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Input stormwater</th>
<th>Previous column</th>
<th>Vegetated column</th>
</tr>
</thead>
<tbody>
<tr>
<td>Susp. Solids</td>
<td>1127</td>
<td>4</td>
<td>82</td>
</tr>
<tr>
<td>Hydrocarbons</td>
<td>12000</td>
<td>79</td>
<td>67</td>
</tr>
<tr>
<td>Cadmium</td>
<td>0.2</td>
<td>0</td>
<td>0.6</td>
</tr>
<tr>
<td>Chrome</td>
<td>3.8</td>
<td>1.3</td>
<td>8.8</td>
</tr>
<tr>
<td>Nickel</td>
<td>15.0</td>
<td>9.5</td>
<td>125.0</td>
</tr>
<tr>
<td>Lead</td>
<td>10.4</td>
<td>38.0</td>
<td>12.5</td>
</tr>
<tr>
<td>Copper</td>
<td>41.5</td>
<td>7.7</td>
<td>79.5</td>
</tr>
<tr>
<td>Zinc</td>
<td>130.0</td>
<td>2500.0</td>
<td>1050.0</td>
</tr>
</tbody>
</table>

**RESULTS**

- The three scales provided consistent results that were used to develop step by step the three stages of this laboratory investigation.
- Variations of heavy metal contents were found to be dependent on the type of material used in each column/box.
- The two GTI technologies performed very well in case of hydrocarbons treatment, since they reduced it for more than 90%.
- The CDW additions have the positive effect to increase the porosity of the medium using waste material and no negative polluting effects (it is recommended to test in advance the potential release of the different mixtures used).
- The added bacteria bio-film do not increase the pollutants abatement due to the strong environment influence.
- GTI technologies are effective in the reduction of pollution in water runoff, and can improve the performances of urban storm water management systems.

**MOTIVATIONS**

**CONCLUSIONS**

**THIRD STAGE**

**SECOND STAGE**

**FIRST STAGE**

**COLUMN SCALE**

**BOXES SCALE**

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