

# Removal of heavy metals from a treated effluent in a short retention constructed wetland



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## Introduction

Metal pollution is an environmental problem of great concern, especially because of the contribution of various, different sources which cannot always be efficiently controlled. Important contributions derive from point sources, such as industrial discharge but also domestic sewage, due to the widespread use of metals, but non point sources, including the release from pipes and sewerages, roof and street runoff, agricultural land runoff and cattle sewage.



Figure 1: A traditional wastewater plant

Traditional processes for wastewater treatment remove metals to a great extent just for adsorption on sewage sludge. Input concentrations are in the order of mg/L and output concentrations are normally below 1 mg/L. However, acceptable concentrations in the receptors are in the order of  $\mu\text{g/L}$  or, in some cases, of one order of magnitude higher, as specified in the European Directive 105/2008, now in force. So, further removal is often needed but even advanced treatments are not effective on so low concentrations.

## Results & Discussion

An experimental study was carried out in order to evaluate the efficiency of constructed wetlands in removing metals starting from very low concentrations..



Figure 2: The demonstration scale constructed wetland (CW)

The demonstration CW was installed at Livescia wastewater treatment site (Como, Northern Italy) and fed on the effluent from the plant which treats mixed sewage, including an important contribution from textile dyeing industry and from the runoff of urban areas. It is a horizontal subsurface flow (Figure 3) wetland based on two parallel sectors (15.6 x 4.6 m each) filled with gravel, 20 to 30 mm diameter in sector 1 and 5 to 15 mm diameter in sector 2, except from the inlet and the outlet area where the gravel diameter is larger in both sectors (about 50 mm). Hydraulic conductivity ( $K_f$ ) is  $10^{-3}$  -  $10^{-2}$  m/s. The wetland was cropped with *Phragmites australis* and *Typha latifolia* and run at 2 days HRT for 2 years.

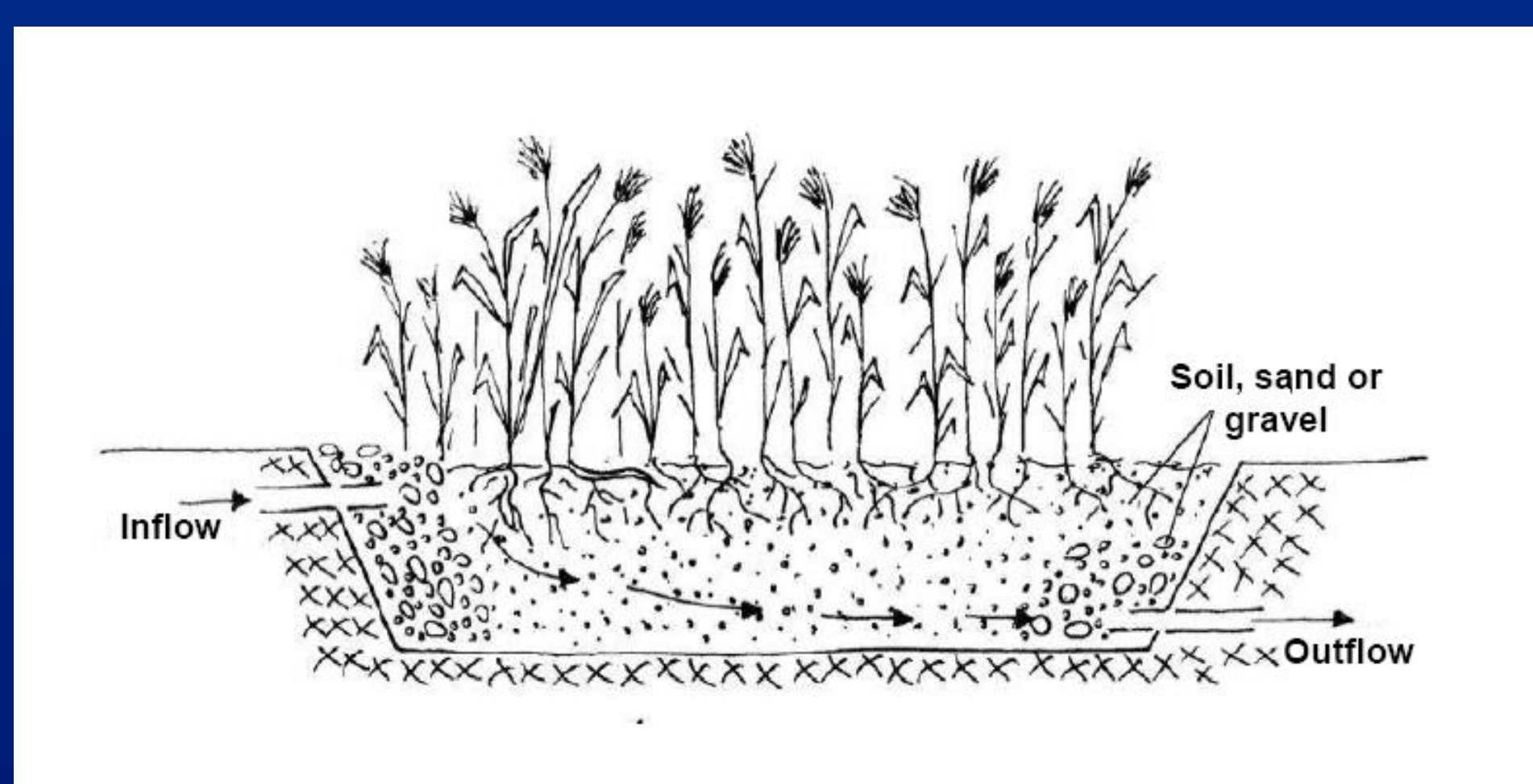


Figure 3 :Scheme of a horizontal sub-surface flow CW

The obtained results show a very high removal of suspended solids (66% and 74% on average for Sector 1 and Sector 2 respectively), which is likely to account for most of the removal of heavy metals, which was quite satisfactory for Zinc, Lead and Copper, in spite of the high variability of the data, as shown in Figure 4.

On the contrary, for nickel, concentrations at the outlet were always higher than at the inlet, for both sectors, with average increases of 45% and 107% which were shown to depend on release from gravel

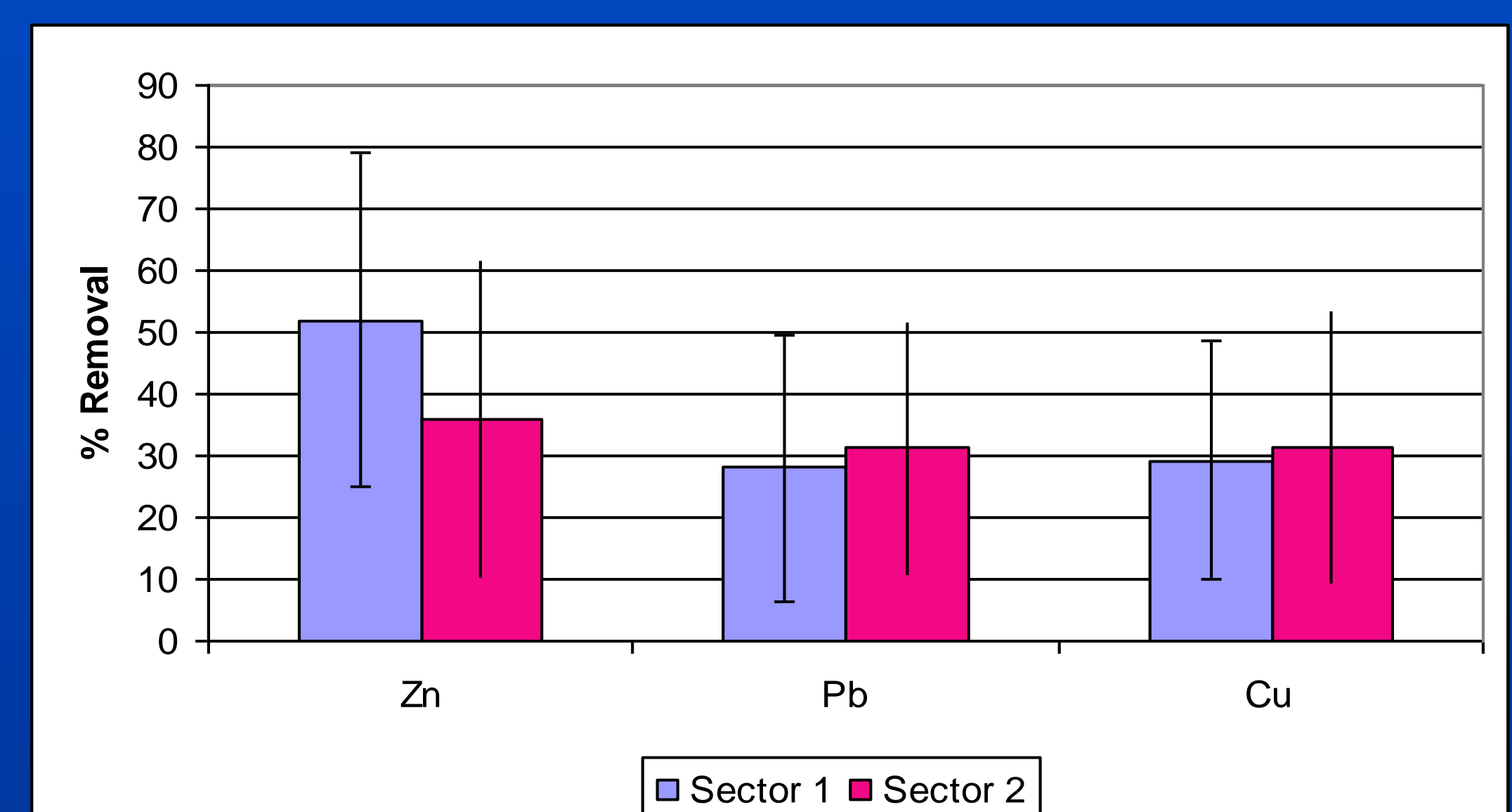


Figure 4: Average % removal of Zn, Pb and Cu in the two sectors of the demonstration CW

The prevailing effect of substrate filtration with respect to plant uptake can be confirmed by comparing the obtained removals in the different periods of the research (Figure 5): the number and size of the plants increased regularly from 2008 to 2010, while metal removal did not.

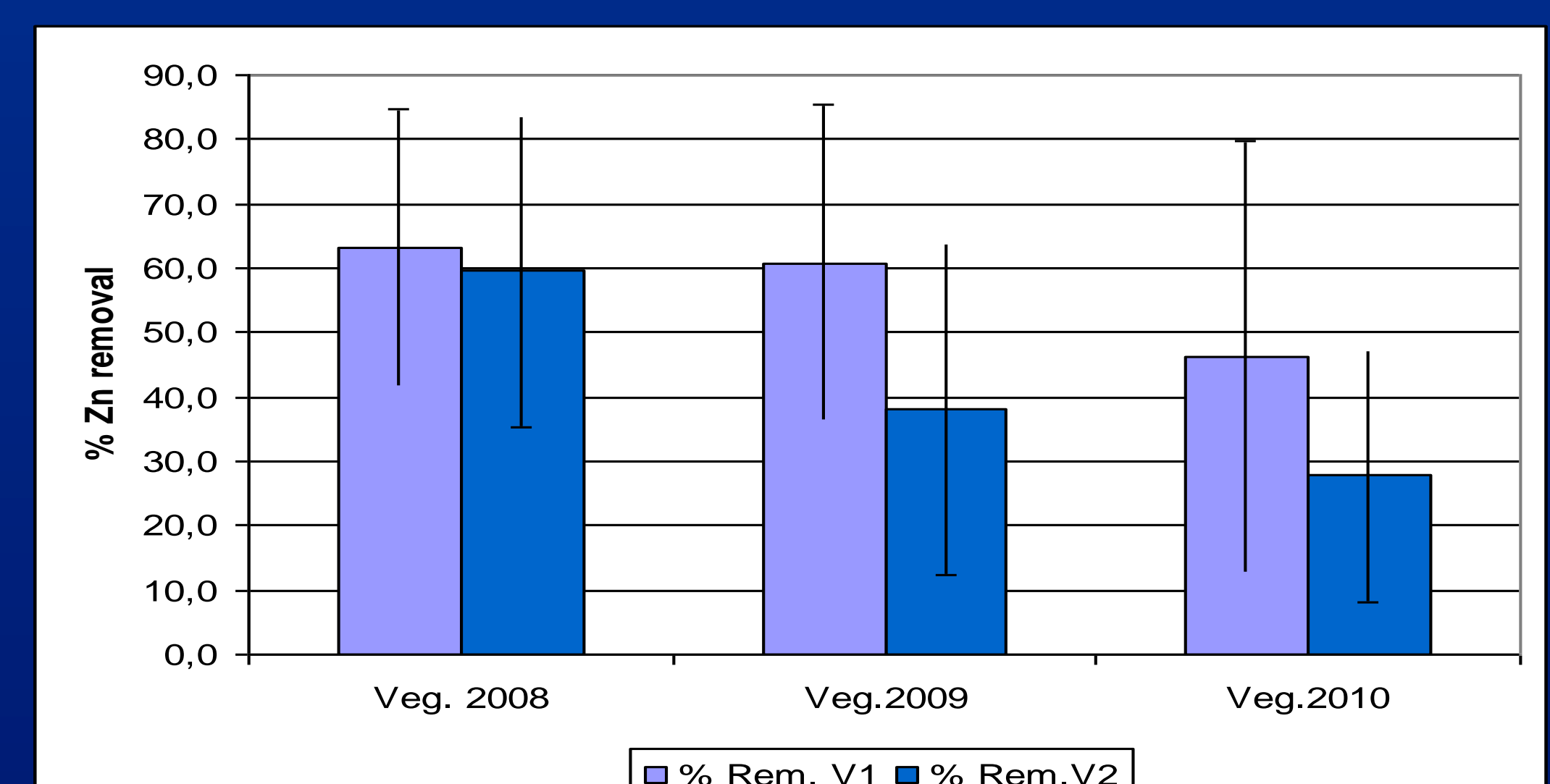


Figure 5: Average % removal of Zinc in three vegetative seasons

## Conclusions

CW can provide removal not only of traditional pollution parameters, but also of heavy metals from treated effluents at low concentrations. In the present case, metal concentrations were already below the EC standard before entering the CW. However, a 30% removal can be interesting where this is not the case. However, the prevailing removal mechanism by soil adsorption and filtration involves the need for careful consideration of the time for soil to be saturated along with the need for disposal and replacement of saturated soil. Another point which could be of some concern is the release of metals from gravel..

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