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Sorption properties of pavement seam material – an exemplary study with the herbicide glyphosate

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In partly sealed urban areas seam material is the only infiltration pathway and therefore plays an important role concerning the displacement of pollutants into the soil and finally the groundwater. The worldwide frequently used herbicide glyphosate is not only used in agriculture but also for weed control on partly sealed urban areas, e.g. in Berlin. The goal of this study is a risk assessment of leaching for glyphosate into lower layers of the pavement bed or into the ground water.

Therefore the sorption capacity of the seam material for glyphosate was investigated and numerical simulations of the herbicide transport through the pavement were conducted.

For the investigation of the sorption capacity, we separated a darker 0 – 1cm and a brighter 1 – 5cm layer of seam material. Due to continuously accumulation of dust, soot, rubber and organic matter in the urban environment, the upper 0-1cm layer shows 2.5 to 17.5 times higher C_{org} contents than the 1-5cm layer. Also the oxalate extractable Fe and Al contents are significantly higher in the upper layer. That applies as well for the CEC_{eff}. We regarded the 1-5cm layer as original inbuilt sand material in comparison to the modified darker 0-1cm layer in order to find out what components play an important role for the adsorption of glyphosate in seam material.

On the basis of batch experiments the sorption capacity of the darker 0-1 cm layer and the brighter 1-5 cm layer of the seam material for glyphosate was investigated: The isotherms were well fitted by the Freundlich sorption model and the K_f-values ranged from 11.5 to 108.7 l kg^{-1} while the values of 1/n varied between 0.87 and 0.96. These

K_f-values range at the lower end of the values reported for glyphosate in the literature.

According to the composition of the two layers, the K_f values of the 0-1cm (mean 53.9 l kg^{-1}) layer were increased compared to the 1-5cm layer (27.1 l kg^{-1}). However, there was no significant correlation between the K_f-values and the C_{org} content, the CEC or the Fe/Al contents. The surface properties of the seam material are currently determined and the composition of the seam material is analysed by organic petrography to get more information about the main factors influencing the sorption of glyphosate in the seam material.

With the obtained K_f-values first numerical simulations (HYDRUS 2D) under equilibrium conditions were performed: With the chosen parameters (K_f = 25, 1/n = 0,9, 10mm rain event) there seems to be no risk of leaching of glyphosate into deeper layers of the pavement bed respectively the groundwater. Nevertheless leaching under non-equilibrium conditions can't be ruled out and is currently investigated by means of lysimeter and columns experiments. First results of the lysimeter studies indicate leaching of glyphosate within the inbuilt sand.