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Combination of constructed wetland and extensive green roof that uses growing media with added recycled materials

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As implementation of green roofs can require a large amount of natural resources, such as water and natural components of growing media, the green roof system that uses principles of circular economy was developed and tested. The objective of the study was to verify the performance of the novel concept of combination of constructed wetland and extensive green roof irrigated with pre-treated grey water. Furthermore, the growing medium of the extensive part of the roof contains fractions of recycled crushed brick and pyrolyzed sewage sludge (biochar). In order to design and select a suitable growing medium, 16 variants of substrates were prepared and tested for water holding capacity and water retention curves. Two small test beds were built to test the viability of the novel green roof concept. In order to assess the effect of pyrolyzed sewage sludge, only one experimental bed contained this material (9.5 vol. %), whereas the crushed brick was part of both substrates (37.5 vol. %). The concept of the constructed wetland-extensive green roof was assessed on the basis of water balance measurements, laboratory analyses of water samples taken from various parts of the experimental beds, temperature and water content measurements along the experimental bed´s layers height. Physical properties of the designed substrates such as maximum water capacity, bulk density, grain size, and pH were determined.

After the first six months of performance, the concept of the constructed wetland-extensive green roof seems to be viable. There are relatively low concentrations of nutrients (phosphorus and nitrogen) in the leachate from test beds, namely because the irrigation provides the water directly to the drainage layer, and nutrient-rich substrate enriched with biochar isn't leached by irrigation water. Concentrations of nutrients increase only in response to precipitation. The constructed wetland part of the system proven a high potential to reduce the concentration of the nutrient in pre□treated grey water.

The vegetation formed by Sedum spp. carpets is prospering well on both test beds. Nutrients from biochar are apparently available for the vegetation. Therefore, the vegetation on the bed with biochar amended substrate shows more vigorous growth and higher evapotranspiration. Substrates amended with recycled materials developed in the study had comparable properties

(maximum water capacity, bulk density, pH) with commercial substrates. The monitoring of test beds continues in order to understand better the processes affecting water quantity and quality in long-term perspective.