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Bioenergy residues as novel sorbents to clean up pesticide pollution

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Worldwide, water contamination from agricultural use of pesticides has received increasing attention within the last decades. In general, sources of pesticide water pollution are categorized into diffuse (stemming from treated fields) and point sources (stemming from farmyards and spillages). Research has demonstrated that 40 to 90% of surface water pesticide contamination is due to point source pollution. To reduce point pollution from farm yards, where the spray equipment is washed, biobed or biofilter systems are used to treat the washing water. The organic material usually used in these systems is often not environmentally sustainable (e.g. peat) and incorporated organic material such as straw leads to a highly heterogeneous water flow, with negative effects on the retention and degradation behavior of the pesticides. Therefore, the objective of this study was to assess the suitability of alternative materials based on bioenergy residues (biochar and digestate) for use in biofilters. To this aim the sorption-desorption potential of three contrasting pesticides (bentazone, boscalid, and pyrimethanil) on mixtures of soil with digestate and/or biochar were investigated in laboratory batch equilibrium experiments.
The results indicate that the mixture of digestate and biochar increased pesticide sorption potential, whereby in all cases, the Kd des / Kf des values were lower than the Kd ads / Kf ads values indicating that the retention of the pesticides was weak. Thus, as Kf des were lower than the Kf ads values and H values were below 1, it can be concluded that the biomixtures presented negative desorption (higher hysteresis) in those cases. A higher Kd (>78 L kg-1), Kf (>400 μM1-1/nf L1/nfkg-1) and KL (>40 L kg-1) was obtained for all pesticides for the digestate and biochar based mixtures, which had a higher organic matter content. However, lower sorption of the pesticides was observed in blank soil compared to the other biomixtures, which was attributed to the lower organic carbon content of the blank soil. Our results showed that boscalid and pyrimethanil are highly sorbed to the mixture of digestate and biochar. SUVA254 values justified the aromatic character of digestate (5%) and biochar (5%) mixture which showed highest Koc values among all mixtures for all pesticides. This mixture was found to be the most promising substrate amongst the tested ones for a biobed setup and can be used as an effective and alternative adsorbent for removing pesticides, because of its higher adsorption capacity.