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Sorption of lead by settling pond soils after reclamation treatments

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The reclamation of degraded soils adding waste amendments can add significant concentrations of Pb. Because of this, it is important to know the sorption capacity of Pb by the soils where wastes with high concentrations of this metal are applied.
To determine the sorption capacity of Pb by mine soils, before and after reclamation treatments, four different sites were selected at a settling pond mine zone: an untreated one as the control sample (B1), a vegetated one with pines for 21 years (B2v), a vegetated with eucalyptus for 6 years (B3v) and an amended with sewage sludges and paper mill residues for 5 months (B4w). All soils had one horizon except B4w, where twice were sampled (B4Aw and B4Bw). The B4Bw is considered analogous of the control soil. To evaluate the sorption capacity by the soils, sorption isotherms were constructed using single-metal solutions of Pb2+ nitrates (0.03, 0.05, 0.08, 0.1 and 0.5 mmol L-1) containing 0.01 M $NaNO_3$ as background electrolyte (Vega et al., 2009). The overall capacity of the soil to sorb Pb was evaluated as the slope Kr (Vega et al., 2008).
The obtained results show that the sorption isotherm of Pb by control soil (B1) and its analogous (B4Bw) are of L-type curve, whereas the sorption isotherms of the treated soils (B2v, B3v and B4Aw) are of H-type curve (Giles et al., 1974). The most of the obtained isotherms do not fit with the models of Langmuir or Freundlich, therefore sorption capacity was evaluated by Kr parameter. According to the obtained Kr parameter, B1 and B4Bw have the lowest Pb sorption capacity (Kr = 0.480 and 0.556, respectively), which increased two times after recently waste amending (B4Aw; Kr = 0.998). The vegetated sites (B2v and B3v) also have higher sorption capacity than B1, but lower than B4Aw (Kr = 0.692 and 0.725, respectively). The highest sorption capacity of Pb by the amended soil is due to its characteristics such as high pH and organic carbon content. This is corroborated by the significantly positive correlation of Kr for Pb and the soil pH, effective cation exchange capacity (CECe), the different forms of C (inorganic, humin, fulvic and humic acids), the percentage of clay fraction and the percentage of crystalline minerals in that fraction ($P < 0.01$). Therefore, the best treatment to increase the sorption capacity of Pb by mine soils is the amendment with organic wastes.

References
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