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Phyto-dehydration of confined polluted sludge: impacts on C-storage and heavy metal immobilization in plant tissues

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Transpiration of plants can be used to control or remove water in artificial basins containing polluted flooded sediments (phyto-dehydration), with the aim to reduce the risk of environment contamination due to water/sediment spillage. At the same time plants can reduce the risks associated to the pollutants, reducing their mobility by the adsorption in the rhizosphere, uptake and accumulation in tissues, and providing organiccompounds contributing to bind heavy metals.

We tested, at pilot scale, a phytodeydration approach to be applied to a storage pond containing sludge with high zinc and copper concentrations (3200 and 1000 µg/Kg, respectively). The sludge derives from the biodigestion of pig slurries, and for most of the year is covered by a water layer due to rainfall. The phyto-dehydration approach was tested in a two years long mesocosm-scale experiment. Inside the mesocosms we maintained the same sludge/water stratification observed in the pond; the helophyte species *Phragmites australis* was planted over a floating frame inside half of the mesocosms. Mesocosms with *P.australis* and control mesocosms without plants, were monitored during the test to assess the water consumption, CO_2 and CH_4 gas exchanges and plant functioning. At the end of the second year we analysed the changes on the carbon pool of the sludge and the immobilization of heavy metals in the plant tissues.

After two years, the total organic carbon content of the sludge has been reduced in the control mesocosms, while in the *P. australis* mesocosms remain close to the initial values. Zinc and copper immobilization in the plant tissues, was characterised by: a very low concentration of zinc (5 µg/kg) in leaves, intermediates values in culms and rhizomes (49 and 30 µg/kg) and higher values in roots (222 and 114 µg/kg).

In conclusion, in addition to the reduction of the sludge spillage risks, the phyto-dehydration approach based on *P. australis* reduced the carbon loss of the sludge, and triggered at the same time a phytostabilization process that reduce the mobility of zinc and copper, without risk of input of these metals to the food chain.