Have you ever think how wastewaters are transformed into clean waters?

Sewage treatment is the process that converts wastewaters (water no longer suitable for other purposes) into a clean effluent that can be reused. The treatment process consists into removing impurities (such as organic matter, pathogens, heavy metals and organic contaminants) from water being treated and concentrated then into a by-product called sewage sludge.

Sludge is mostly water with lesser amounts of solid material removed from liquid sewage. The solid material present, being made of fresh organic matter, became easily putrescent and hazardous for human health and environment so that, it has to be removed through a process called sludge treatment.

Safe and cost-effective management of sewage sludge is still a worldwide environmental challenge. A common goal in sludge treatment is to reduce toxicity, decrease volume, and convert sludge into useful resources for agronomic purposes

Some treatment processes may affect contaminant strength and concentration: depending on the process, the treatment may increase or decrease the bioavailability of contaminants.

After treatment, and dependent upon the quality of sludge produced (for example with regards to heavy metal content), sewage sludge is most commonly either disposed of in landfills, incinerated or applied to land. Sewage sludge, in fact, has fertilizing properties (humus content) that can be reused in agriculture. However, some studies indicated that heavy metals, pharmaceuticals and personal care products, which often adsorb to sludge during wastewater treatment, can persist in agricultural soils following sludges application.

In recent years, Reed Bed Systems (RBSs) have been widely considered as a valid technology for

sludge treatment. However, even though this technology is not widely used in Mediterranean countries, significant experience in the Tuscany region has been gained since 2004.

The RBS is a combination of a traditional sludge drying bed and constructed wetland: *Phragmites australis* (common reed) is directly planted in the drying beds, where sludge is frequently applied. This technology involves low construction costs, minimal daily maintenance, water content reduction, and good stabilization of sludges. RBSs, in fact, stabilize sludges, reducing water, pollutant and pathogen contents; moreover, RBS technology improves the quality of organic matter in sludges.

The stabilization process, resulting from the synergic action of plants (reeds), organic matter and microorganisms (both present in sludges) is a combination of organic matter mineralization (decomposition) and humification (transformation of organic matter into humus) processes.

The organic matter stabilization process occurring in the basins can be successfully studied following parameters usually applied to soil and other environmental matrices. The results showed that stabilization of the sludge over time occurred in all RBSs, as shown by the low level of overall microbial metabolism, and by the re-synthesis of humic-like matter. Results about heavy metal fractionation, an appropriate technique to estimate the heavy metal bioavailability and sludge biotoxicity, showed that the process of sludge stabilization occurring in RBSs retains metals in fractions related to the stabilized organic matter, making metals less bioavailable. Moreover, the concentrations of various toxic organic compounds were below the limit of concentration suggested by the European Union's Working Document on Sludge, for land application. The effectiveness of the stabilization processes in RBs was hence clearly proven by the results that measured mineralization and humification processes, and by the low levels of bioavailable heavy metals and toxic organic compounds in stabilized sludges.

Publication

Reed bed systems for sludge treatment: case studies in Italy.
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