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Novel Organic Matter Removal Method Using Natural Wastewater Treatment Systems

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Introduction

Natural wastewater treatment methods allow us to not only minimise sewage pollution but also utilise water. This research describes nearly 2.5 years of operation of an NTSW pilot plant, the goal of which was to purify household sewage from the Institute of Applied Ecology building to drinking water quality. The NTSW is made up of a septic tank, compost beds and denitrification, phosphorus and active carbon beds. The NTSW, with an active area of 3 m^2 per person and a hydraulic residence period of 6 days, allowed for a mean reduction of 99 percent, 95 percent and 98 percent in biological oxygen demand, chemical oxygen demand (COD) and total suspended solids (TSSs), respectively.

Description

The reuse of water recovered from wastewater after treatment and adequate preparation is becoming increasingly important as the global water deficit worsens and the demand for more sustainable water management grows. Furthermore, the growing relevance is being pushed by the continual development of new and increasingly effective natural technologies that allow for the treatment of wastewater to the quality of clean water. Natural water purification methods, such as built wetland (CW), various forms of wastewater pond systems and combinations of these treatment facilities, are one of the directions in the creation of new solutions. Furthermore, there has lately been a large rise in the number of scholarly articles linked to engineered wetlands, water reuse and water rejuvenation [1].

So far, water recovered from sewage has mostly been utilised for irrigation in farmland. One example is the recently proposed European Parliament Regulation on the Minimum Requirements for Water Reuse. The restrictions in this text exclusively apply to the use of water in agriculture. Israel has made the most progress in the subject of wastewater reuse, using 85 percent of treated wastewater as an extra supply of irrigation water in agriculture. Water reuse in the United States, on the other hand, differs considerably from state to state. In California, the leading state in this regard, 46 percent of the water recovered from wastewater is used for agricultural reasons [2].

The stated scenario of sewage water reuse mostly concerns big municipal sewage treatment plants, from which the effluent is generally diverted to irrigation without extra cleaning operations. Where better quality water is required, such as agricultural irrigation or watering urban vegetation, the sewage treatment plant outflow is exposed to additional procedures such as aeration, coagulation, filtering and disinfection. The adoption of extra water purification techniques in this situation greatly raises the expense of generating high-quality water. This is the primary obstacle restricting the reuse of sewage-recovered water, particularly high-quality water.

The utilisation of natural wastewater treatment systems opens up new opportunities for the reuse of water recovered from wastewater. Such treatment technologies utilise little energy and enable for the reuse of high-quality wastewater water. Furthermore, they are distinguished by a wide range of other environmental services, including biomass generation, air purification, the enhancement of local microclimate factors and biodiversity. They can also be used for entertainment. NTSW has demonstrated excellent efficiency in the treatment of home, agricultural and industrial wastewater during the last many decades. The upgraded wetland system was created and implemented in Poland at the beginning of the twenty-first century, based on the benefits of the NTSW [3].

Another phase in the water treatment and reuse process may be to recycle the water and use it to flush toilets. The purpose of this research is to characterise the performance of an NTSW pilot plant located at the Institute of Applied Ecology building in western Poland. Because there are currently no uniform requirements for the quality of water intended for flushing toilets in Poland and other European Union countries, we decided that the newly developed and implemented technology must purify water to the point where the outflow meets the criteria for drinking water quality [4].

The septic tank is where the wastewater treatment process, including the removal of organic debris, begins. Here, wastewater is treated mechanically and somewhat biologically. The outflow of sewage from the septic tank to the compost beds, on the other hand, occurs cyclically every hour and amounts to 300 l each day. The surplus sewage generated during the week is collected in the septic tank and supplied the pilot plant during the weekend (when no employees are present). If, on average, the hydraulic residence period in a septic tank is 8 days [5].

Conclusion

This research summarises the findings of a nearly 2.5-year operation of a natural wastewater treatment system built by the Institute of Applied Ecology in Western Poland, which housed three permanent residents and up to five staff. The pilot plant included a septic tank, compost beds and denitrification, phosphorus and activated carbon beds. The active area of the pilot plant was just 3 m^2 per person and the HRT was 6 days. Wastewater treatment was done in compost beds, while water renewal was done in the remaining beds. The collected data indicate that the pilot plant has a very high removal efficiency (99 percent, 96 percent and 98 percent for BOD, COD and TSS, respectively).

Acknowledgement

None.

Conflict of Interest

No potential conflict of interest was reported by the authors.

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