Multidisciplinary subsurface monitoring for a better understanding of Soil Aquifer Treatment capacity applied on coastal operational wastewater treatment plant (Agon-Coutainville, France)

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ABSTRACT

Unconfined coastal aquifers are potentially subject to both saline intrusion near the seashore and over discharge of treated wastewater in the surficial environment during the tourist season. In Agon-Coutainville (Normandy, France), managed aquifer recharge (MAR) system, combined with Soil Aquifer Treatment (SAT), was integrated as part of the full-scale operational wastewater treatment plant. Such integrated natural/engineered water treatment system ensure the sustainability of the seaside activities (seafood production, beach) and locally supply freshwater for the irrigational needs of the golf course. Concerning the MAR system, the secondary treated wastewater is infiltrated alternatively into three natural reed bed areas before reaching the sand dune aquifer and thus to enhance the quantity of freshwater in the aquifer. Treated wastewater potentially contains various compounds (chemical, virus, pathogen) which can, however, affect the groundwater quality. Nevertheless, some of these compounds are partly removed, during the SAT. To assess performance and efficiency of the integrated system in the natural environment, we have designed and performed an innovating and multidisciplinary monitoring dedicated to 1) spatial evolution of the freshwater generating by the MAR system, 2) mean residence time of water during SAT and 3) potential reactivity occurring during SAT. Spatial field campaigns and tracer tests were conducted by associating classical and innovative approaches including physico-chemical measurements and quantitative analyses, non target analysis for screening organic compounds, ecotoxicological bioassays, online biomonitoring BACTcontrol® system to detect fecal contamination and online system monitoring device dedicated to saline intrusion. Results show that the MAR system provides a freshwater barrier in the aquifer which is seasonally affected by saline intrusion. A part of the aquifer is assessed for freshwater potential production regardless of the natural and anthropogenic recharge. SAT mean residence time is around two weeks that allows SAT reactivity and thus increases quality of the pumped groundwater. This novel subsurface monitoring provides a better understanding of the SAT capacity to enhance the quantity of freshwater and improve its quality.