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Development of adsorption treatment by iron oxide nanoparticles and biological degradation in mimetic column for managed aquifer recharge

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Use of treated wastewater can be a sustainable water resource management policy. However, high organic matters and pathogen load along with the array of emerging recalcitrant micro-pollutants, that escape the sewage treatment plant, requires expensive advanced oxidation processes (AOPs) before use. Utilization of treated waste water in managed aquifer recharge (MAR), either in the form of riverbank filtration (RBF), lake bank filtration (LBF) and artificial recharge (AR) are cost-effective and have been shown to degrade recalcitrant pharmaceuticals and personal care products (PPCPs). Carbamazepine (CBZ) and diatrizoate (DTZ) are two such persistent pharmaceuticals not degraded in in sewage treatment process. CBZ is an antiepileptic drug prescribed in seizure disorder, bipolar disorder, neuralgia, schizophrenia and depression. DTZ is used as iodinated X-ray contrast agents. Objective of this study was to evaluate removal of CBZ, and DTZ in simulated MAR with functionalized iron oxide nanoparticle and biological treatment. A long cylindrical acrylic column was filled with sand (0.8 ~ 1.2 mm). Hydraulic conductivity, flow rate and retention time were calculated before injecting CBZ and DTZ containing artificial wastewater at estimated load of 7.89 µg/g and 10.62 µg/g, respectively. The effluent concentration at different sampling point on the column during the experimental period was analyzed by SPE-HPLC. When inoculated with a mixed microbial culture, previously known for its metabolic potential, 89.63% of CBZ and 83.66% of DTZ were removed. Because the degradation capacity of pharmaceutical substances was more than 70% in the long-term operation in the soil layer, it will be combined the adsorption and bio-degradation process. This study not only confirmed the ability of MAR to treat the CBZ and DTZ in physicochemical and biological process, but also envisioned the possibility to treat the effluents from sewage plants.

Biography

Soon-Uk Yoon is studying as a PhD candidate at INHA University, Incheon, Korea since 2014. He had a bachelor's and master degree in environmental engineering in 2010 and 2012, respectively from INHA university, Korea. After graduation of academic working, he worked as a researcher at Korea Environmental Institute. He was in the water and environmental strategy research group. His area of interest includes, environmental engineering, water and wastewater treatment, biological treatment of soil/groundwater, and reduction of organic compound or sludge.

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