ABSTRACT

The purpose of this study was to quantify the occurrence and release of antibiotic resistant genes (ARGs) and antibiotic resistant bacteria (ARB) into the environment through the effluent and biosolids of different wastewater treatment utilities including an MBR (Membrane Biological Reactor) utility, conventional utilities (Activated Sludge, Oxidative Ditch and Rotatory Biological Contactors-RBCs) and multiple sludge treatment processes (Dewatering, Gravity Thickening, Anaerobic Digestion and Lime Stabilization). Samples were monitored for tetracycline resistant genes (tetW and tetO) and sulfonamide resistant gene (sul-1) and tetracycline and sulfonamide resistant bacteria.

RESULTS

ARGs and ARB concentrations in the final effluent were found to be in the range of ND(non-detectable)-2.33x10^6 copies/100mL and 5.00x10^6-6.10x10^7 CFU/100mL respectively. Concentrations of ARGs (tetW and tetO) and 16s rRNA gene in the MBR effluent were observed to be 1-3 log less, compared to conventional treatment utilities. Significantly higher removals of ARGs and ARB were observed in the MBR facility (range of removal: 2.57 to 7.06 logs) compared to that in conventional treatment plants (range of removal: 2.37-4.56 logs) (p<0.05). Disinfection (Chlorination and UV) processes did not contribute in significant reduction of ARGs and ARB (p>0.05). In biosolids, ARGs and ARB concentrations were found to be in the range of 5.61x10^6-4.32x10^7 copies/g and 3.17x10^7-1.85x10^8 CFU/g, respectively. Significant differences (p<0.05) were observed in concentrations of ARGs (except tetW) and ARB between the advanced biosolid treatment methods (i.e., anaerobic digestion and lime stabilization) and the conventional dewatering and gravity thickening methods.

CONCLUSIONS

Wastewater utilities seem to be a potential sources of emerging tetracycline and sulfonamide resistant genes and –bacteria in our environment.

Overall, the trends observed in concentration ranges at different sampling points from all the wastewater treatment plants are: raw influent > pre-disinfected effluent > post-disinfected effluent

Disinfection did not prove to have significant contribution to ARGs and ARB reduction

Concentration of ARGs (tetW and tetO) and 16s rRNA gene in the effluent of an MBR (with a UV disinfection process) utility were 1-3 log less compared to conventional treatment utilities

Significant difference (p<0.05) was observed in concentrations of both tetO and sul1 genes in biosolids samples between the advanced treatment methods (anaerobic digestion and lime stabilization) and the conventional treatment methods (dewatering and gravity thickening)

Daily release loads of ARGs and ARB in the environment were found to be higher through biosolids relative to effluents.

REFERENCES


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