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Study of Innovative Treatment on Reclaimed Water

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Objectives:
To investigate current and emerging tertiary and advanced treatment technologies for reclaimed water disinfection and chemical constituent destruction. To identify and determine the relative low cost technology (or technologies) that are capable of the simultaneous destruction of both pathogens and chemical constituents.

Results/Findings:

- Chlorination and chloramination performance was mixed. Free chlorine provided substantial virus and bacteria destruction and had mixed results for destruction of chemical constituents. Chloramination provided substantial destruction of bacteria but did not show similar performance for virus and chemical constituents.
- PAA may be a good substitute for chlorine if coliform bacteria are the primary target; otherwise, its poor performance against spores and viruses, high cost, and slow reactivity with EDCs compared to free chlorine, limit its applicability.
- Ultrafiltration (UF) and microfiltration (MF) are proven barriers to most of the microorganisms tested in this study, and sorption of hydrophobic micropollutants to particulate matter aided their removal by UF and MF.
- UV and O_3 are robust disinfectants, with particularly high effectiveness against parasitic protozoa in the former case and viruses in the latter. The combination of H_2O_2 and these base technologies in advanced oxidation processes had no consistent synergistic or antagonistic effect on disinfection. Human enteric and respiratory virus disinfection by the candidate technologies was unchanged by the addition of H_2O_2, indicating the primary role of UV light or ozone in these processes.
- Ozonation quickly mitigates the overall estrogenic effect of EDCs, but its selectivity also means that it reacts slowly with NDMA, TCEP, and other compounds with electron-withdrawing characteristics. In these cases, the addition of H_2O_2, which promotes the formation of hydroxyl radicals, improves the degradation of such compounds.
- UV photolysis is an especially important component of UV/ H_2O_2 advanced oxidation when target compounds are photoliable, such as NDMA and triclosan. When direct photodegradation is not a feasible option, indirect photolysis via hydroxyl radicals can destroy target compounds. At UV doses relevant to disinfection in wastewater reuse, with the addition of H_2O_2, measurable destruction of chemical constituents and hormonal activity was documented.