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Backwash Optimization for Drinking Water Treatment Biological Filters

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Abstract : Natural organic matter (NOM) removal efficiency using drinking water treatment biological filters can be highly influenced by backwashing conditions. Backwashing has the ability to remove the accumulated biomass and particles in order to regenerate the biological filters' removal capacity and prevent excessive headloss buildup. A lab scale system consisting of 3 biological filters was used in this study to examine the implications of different backwash strategies on biological filtration performance. The backwash procedures were evaluated based on their impacts on dissolved organic carbon (DOC) removals, biological filters' biomass, backwash water volume usage, and particle removal. Results showed that under nutrient limited conditions, the simultaneous use of air and water under collapse pulsing conditions lead to a DOC removal of 22% which was significantly higher ($p>0.05$) than the 12% removal observed under water only backwash conditions. Employing a bed expansion of 20% under nutrient supplemented conditions compared to a 30% reference bed expansion while using the same amount of water volume lead to similar DOC removals. On the other hand, utilizing a higher bed expansion (40%) lead to significantly lower DOC removals (23%). Also, a backwash strategy that reduced the backwash water volume usage by about 20% resulted in similar DOC removals observed with the reference backwash. The backwash procedures investigated in this study showed no consistent impact on biological filters' biomass concentrations as measured by the phospholipids and the adenosine tri-phosphate (ATP) methods. Moreover, none of these two analyses showed a direct correlation with DOC removal. On the other hand, dissolved oxygen (DO) uptake showed a direct correlation with DOC removals. The addition of the extended terminal subfluidization wash (ETSW) demonstrated no apparent impact on DOC removals. ETSW also successfully eliminated the filter ripening sequence (FRS). As a result, the additional water usage resulting from implementing ETSW was compensated by water savings after restart. Results from this study provide insight to researchers and water treatment utilities on how to better optimize the backwashing procedure for the goal of optimizing the overall biological filtration process.

Keywords : biological filtration, backwashing, collapse pulsing, ETSW
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