

Assessment of human viruses in municipal waste water in Calgary, Canada

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Abstract

Water shortage is an increasing problem worldwide. Effective treatment of waste water for reuse has attracted interests for public and scientific community. Currently, most of the studies related to the quality of reclaimed waste water focus on the bacteriological indicators such as *E. coli* and total coliform. There is limited data of human viruses in waste water. In fact, human enteric viruses are present at high levels in waste water, which poses a potential risk to public health and hinders application of reuse. The objective of this study is to assess the effect of UV treatment on the virus removal at two municipal waste water treatment plants in Calgary, Canada. Ten liters of pre and post-UV treatment waste water samples were collected in duplicate monthly for 12 months. Viruses were concentrated by filtration, elution and flocculation followed by nucleic acid extraction. A real-time quantitative PCR viral panel was used for detection and quantification of eight viruses including Norovirus (NoV), Rotavirus (RV), Sapovirus (SaV), Astrovirus (AsV), Adenovirus (AdV), Enterovirus (EV), JC virus (JCV) and Reovirus (ReoV). Viral infectivity was assessed using both cell culture and integrated cell culture and qPCR (ICC-qPCR). NoV, RV, AsV and AdV were detected in all 24, EV and JCV in 23 and SaV in 22 of pre-UV samples, respectively.

The mean viral load (except ReoV) ranged from 3.06 (JCV) to 5.77 (RV) log₁₀ DNA copies/Lin pre-UV samples and 3.23 (JCV) to 5.68 (RV) log₁₀ DNA copies/Lin post-UV samples.

The average virus removal by UV treatment ranged from -0.42 (JCV) to 0.52 (NoV) log as assessed by qPCR which may be due to the sample variation and the limitation of qPCR in detection of live viruses. Further studies on developing a qPCR method to differentiate the infectious and non-infectious viruses are of interests. Cell culture and ICC-qPCR detected infectious viruses in all 24 pre-UV and 19 out of 24 post-UV samples. Approximately 1.8 log reductions of infectious viruses could be achieved by current industrial standard UV treatment. The results indicate a moderate effect of UV treatment on virus inactivation in municipal waste water which urges further studies to increase the understanding of the effect of UV treatment on human viruses in waste water to improve the waste water reuse and public safety as treated waste water is discharged into river and could become source water for downstream users.

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