The effect of UV treatment on highly polluted and normal operated swimming pools

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The effect of UV treatment on highly polluted and normal operated swimming pools

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Swimming pools and UV treatment

UV treatment as well as increased chlorine dosing (simulating extended exposure time) increases chlorine consumption. UV treatment appears to accelerate reactions between organic matter and chlorine through the activation of organic matter rate than the light field causing a constant fraction of the organic matter to become chlorine consuming and form THM precursors.

Water samples

Pool water were collected during regular operating hours from two public swimming pools (Denmark) with highly varying TOC and chlorine concentrations.

Water treatment

Water samples were spiked with a radical initiator (Cl2 or NO3- ) and then subjected to irradiation. UV treatment was performed in a quasi-collimated beam apparatus with a doped medium pressure lamp (Fig. 1). The UV dosage was equivalent to UV treatment of full-scale and calculated as in Hansen et al. (2013). The Cl2 dosage was based on Cl2 consumption to achieve a residual Cl2 after 24h at approx. 1 and 3 mg Cl2/L. The total Cl2 consumption in laboratory experiments were determined by ABTS (Pinkem et al., 2000) and TTHMs were quantified by GC-MS (Hansen et al., 2012).

Which is the effect of increased TOC and nitrate on DBP formation?

Effect on chlorine consumption

- High nitrate concentration
  - High nitrate concentrations inhibit the increase in TTHM formation caused by UV treatment.
  - High nitrate doesn’t change the increase of chlorine consumption induced by UV treatment.

- High organic matter concentration
  - Chlorine consumption was unaffected by TOC with or without UV treatment.
  - Only with increased chlorine dosing (simulating extended exposure time) did chlorine consumption increase reflecting more organic matter to be oxidized.

UV treatment

Higher TOC means more organic matter could be altered to more chlorine reactive products by primary photochemical reactions in the UV treatment. Nitrate is known to absorb UV-light and produce hydroxyl radicals which might degrade organic matter to more chlorine reactive compounds in secondary photochemical reactions.

Discussion and Conclusions

- Conversely to our expectations, the high TOC does not contribute notably neither in chlorine consumption nor in DBP formation in post-UV chlorination treatment.
- Results suggested that there might be a saturation in UV ability to penetrate the water inhibiting the further removal of DBPs.
- Possibly repeated post-UV chlorination treatment would have a different effect on DBP removal.
- NO3- spiked UV treated samples stimulated the least TTHM.

NO3- strongly absorbs UV light and apparently this results in shielding the water surface from the UV light and therefore, further reactions are inhibited.