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7th International Conference 2017 on Swimming Pool and Spa Waters, Kos Island, Greece

Microbial quality of swimming pool water with treatment without disinfection, with ultrafiltration, with UV-based treatment and with chlorination

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Aims

Swimming pools are traditionally disinfected with a residual disinfectant such as sodium hypochlorite. Nowadays, swimming water without a residual disinfectant is increasingly popular, as can be seen by the growing number of (natural) swimming ponds (Weilandt 2015), but health risks for bathers do raise concerns for these type of pools, so some form of disinfection is needed (Giampaoli et al. 2014). The combination of ultra-filtration and UV-disinfection for pool water treatment, without a residual disinfectant might be an interesting alternative. The Dutch Innovative Pool project (DIPool) was initiated to explore this new treatment concept, to study its applicability for swimming pools and to verify first system design specifications. The goals of this study were to compare the microbial water quality during treatment without disinfection, treatment with ultra-filtration, treatment with UV-disinfection, treatment with chlorination, and the influence of single treatment steps.

Methods

All treatment concepts were studied in a pilot plant equipped with a pool basin and simulated bathing load, containing only chemical components. Adenosine triphosphate (ATP) and intact cell count measurements were used to monitor the microbial water quality before and after each treatment step at regular intervals in several experiments during 23 days of operation. High pollutant/nutrient conditions without recirculation were used to study the effect of single treatment steps, and recirculation conditions were used to study the effect of accumulation of pollutants/nutrients. A chlorinated pilot plant was used as reference for the alternative disinfection. The influence of a biological activated carbon filtration during chlorinated conditions was also investigated. Both pilot plants were operated at 1 m^3/h, with a turnover time of 30 minutes during the recirculation conditions.

Results

The results showed that the microbial quality of pool water with UV-disinfection was similar to that of chlorinated pool water, while pool water treatment without disinfection resulted in a higher microbial number. After 23 days, most of the results during chlorination and UV-disinfection experiments with recirculation were within 10^3-10^5 intact cells/mL and 0.2-13 ng intracellular ATP /L which is similar to both bottled and tap water. Treatment steps with the highest reduction in microbial quality were ultrafiltration (UF) in the treatment setup with UV-disinfection and chlorination in the treatment setup with chlorination. The largest increase in microbial quality was observed during residence in the pool basin, which was obvious, and during biological activated carbon filtration. Most important conclusions were that i) the microbial water quality of pool water with a UV-based treatment can be similar to that of pool water with chlorination ii) UF plays an important role in maintaining a low number of micro-organisms during UV-based treatment and iii) P-limitation is an additional method to limit microbial growth in swimming pool water.

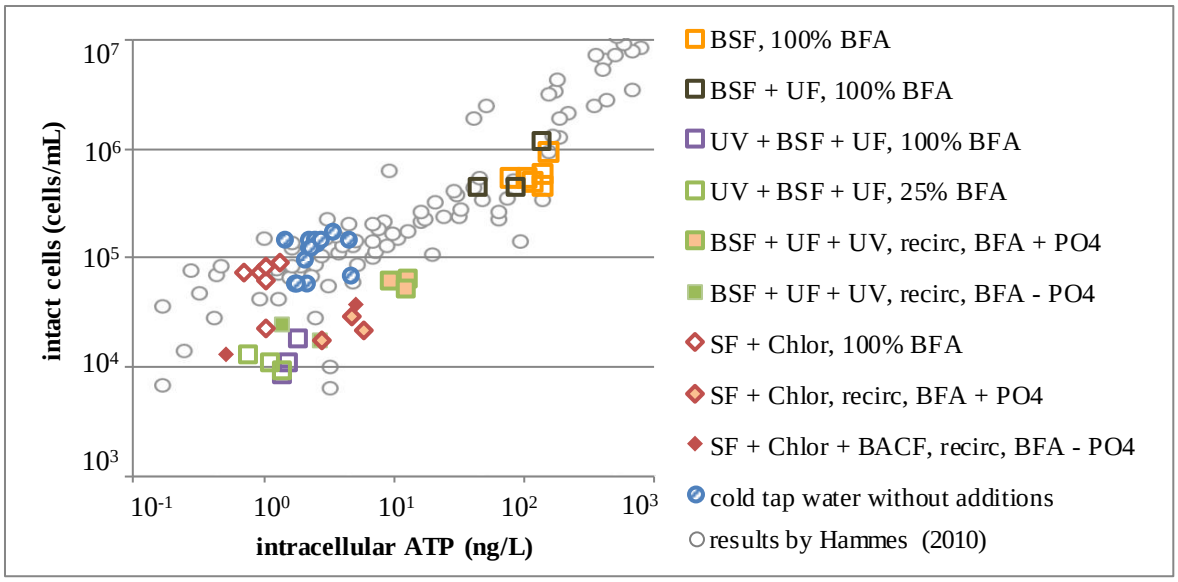

Figure 1 – Microbiological water quality, quantified as concentration intact cells and cATP, during all experiments, with and without recirculation, both with different treatment steps: sand filtration (SF) + chlorination (Chlor), SF + Chlor + biological activated carbon filtration (BACF), biological sand filtration (BSF), BSF + ultra-filtration (UF), UV-treatment (UV) + BSF + UF and with different BFA compositions.

Conclusions

This study showed that pool water treatment based on UV-disinfection consisting of biological filtration, UF and UV-treatment combined with a 30-minute turnover time, is able to maintain the microbiological quality similar to chlorinated pool water during a simulated high occupancy level of a pool without the use of a residual disinfectant.

Key words: microbial quality, disinfection, ultrafiltration, UV-disinfection, chlorination, swimming pool

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