Modeling Target Disinfection By-Product Dynamics in Indoor Swimming Pools

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Chlorination is the primary disinfection method for swimming pools in the United States; however, chlorine also reacts with pollutants (e.g., sweat, urine and anthropogenic compounds) to form disinfection by-products (DBPs). Some DBPs are asthma causing (e.g. nitrogen-trichloride) and even carcinogens (e.g., trihalomethanes and nitrosamines). Consequently, exposure to DBPs poses health risks to patrons and staff in pool environments. Furthermore, volatilization of DBPs is enhanced by bather activity, but the relationship between activity and volatilization has yet been quantified such that the dynamic behavior of DBPs can be predicted. Therefore, the objective of this research is to clarify the relationship between bather activities and the behavior of DBPs quantitatively in order to simulate the liquid-phase transportation of target DBPs in indoor pools. An acoustic Doppler velocimeter will monitor the velocity of water over a period of time at various depths below the water surface to measure turbulence, which corresponds to bather activity. Concentration measurements of target DBPs will be taken parallel to the time and depth of the velocity readings, and then correlated to determine the turbulent diffusion coefficients of the target DBPs. The collected data will be used to construct a DBP transport model which predicts the concentration of target DBPs over time under inputted conditions. The result will give a quantitative relationship between physical activities of swimmers and transportation of target DBPs in indoor swimming pools.