

Summary of Swimming Pool Labs

The author gratefully acknowledges the financial support of the National Science Foundation (DUE-9850789) to purchase Calculator Based Lab (CBL) equipment and probes.

Students investigated how a pool's disinfectant capacity, measured by the change in OCl^- concentration, is influenced by:

- 1) UV radiation (type and exposure time),
 - 2) the water's pH at UV wavelengths, and
 - 3) the presence or absence of a non-photosensitive chlorinating agent.
- The labs dealing with UV radiation influences dovetailed nicely with lecture discussions related to stratospheric ozone depletion.

OCl^- concentration is determined by reacting OCl^- with a DPD (N,N-diethyl-p-phenylenediamine) powder pillow or tablet. The resulting colored product is magenta, the intensity of which is linearly proportional to OCl^- concentration. Students generate a Beer's Law linear relationship between absorbance and OCl^- concentration using colorimeters. Of course, benchtop visible spectrophotometers work just as well. The swimming pool chemistry lab activities are conducted over consecutive weeks and are done prior to the week's scheduled lab.

Commercially available portable UV lamps (Model UVGL-25 Multiband UV-254/365nm Mineralight Lamp) or natural sunlight can serve as the UV light source. The descriptions below make reference to UV lamps since the temporal component for exposure to sunlight is latitude dependent. Yuma, AZ ($\sim 32^\circ$ lat. N) is blasted with relentless sunshine and has some of the world's highest solar intensity readings especially when compared to compared to higher northern latitude regions worldwide.

Activities:

- 1) Influence of UV Radiation Type on Photolysis of OCl^- : 250mL of 5ppm OCl^- solutions at pH $\sim 7.0-7.5$ (the typical pH of swimming pools) are placed in separate beakers* and exposed without stirring and at constant temperature to UV wavelength 365nm (and/or 254nm) for three and six hours respectively (or some other workable time frame). Students then add a DPD pillow to a 20mL aliquot of the exposed standard 5ppm OCl^- solution and using the colorimeter measure the absorbance of the magenta colored product at Green LED setting (wavelength = 565nm). The change in concentration of OCl^- is determined from a linear absorbance versus

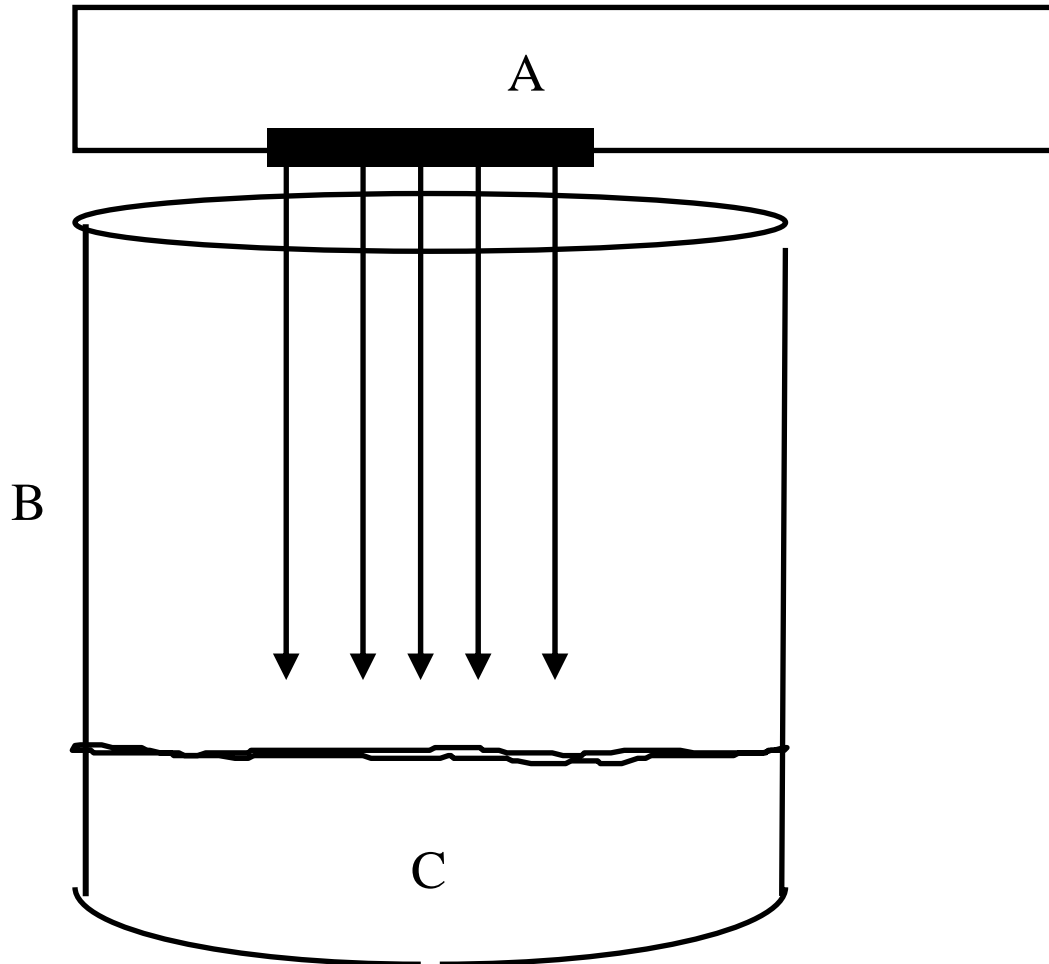
concentration OCl^- standard curve (1.0, 2.0, 3.0, 4.0, and 5.0ppm) generated in an earlier lab by students.

*: test tubes can be used to minimize evaporative losses

2) pH Influence on Photolytic Degradation of OCl^- under UV Exposure Conditions : At $\text{pH} > 9$ hypochlorite exists in monoanionic form, whereas at $\text{pH} < 4$ it exists as hypochlorous acid, HOCl . 250mL of 5ppm OCl^- solutions at $\text{pH} > 9$ and $\text{pH} < 4$ are placed in separate beakers and exposed without stirring and at constant temperature to a UV wavelength of 254nm (and/or 365nm). After ~3-4 hours exposure students add a DPD pillow to a 20mL aliquot of the exposed standard 5ppm OCl^- solution and using the colorimeter measure the absorbance of the magenta colored product at Green LED setting (wavelength = 565nm). The concentration of OCl^- remaining after UV exposure is then determined from a linear absorbance versus concentration OCl^- standard curve generated by students previously.

3) Influence of Photoinsensitive Chlorinating Agent on OCl^- Photolysis Under UV Exposure Conditions : 250mL of 5ppm OCl^- solutions, one with and one without the photoinsensitive chlorinating agent cyanuric acid, at $\text{pH} \sim 7.0-7.5$ (the typical pH of swimming pools) are placed in separate beakers and exposed without stirring, for the same amount of time, and at constant temperature to UV wavelengths 254nm (and/or 365nm). As before students then add a DPD pillow to a 20mL aliquot of the exposed standard 5ppm OCl^- solution and using the colorimeter measure the absorbance of the magenta colored product at Green LED setting (wavelength = 565nm). The change in concentration of OCl^- is determined from a linear absorbance versus concentration OCl^- standard curve generated previously.

Apparati Setup (Very Simple!) for UV Experiments



A: Mineralight[®] Lamp Multiband UV-254-365nm Model UVGL-25

B: beaker

C: 250mL of 5ppm NaOCl stock solution*, unstirred

