

Water Circulation Dye Test Procedure

(Words in small caps indicate they can be found in the MAHC Glossary)

Dye testing should be performed to determine and adjust the performance of the RECIRCULATION SYSTEM. Dye studies tend to be qualitative in nature.¹

Some judgment is generally required to determine whether a dye study should be classified as passing or a failing. In general, dead zones *(or areas of poor circulation)* would indicate a failure that could be fixed by adjusting the INLETS or other system hydraulics. If the POOL does not reach a uniform color within 15 minutes, then adjustments are required.

Materials

- Crystal violet ($C_{25}N_3H_{30}Cl$)(20 g/ 50,000 gal)
- Sodium thiosulfate penta-hydrate ($Na_2S_2O_3 \cdot 5H_2O$) (1.2 oz/ 1 PPM free chlorine/ 10,000 gal)
- Sodium hypochlorite (Bleach 5.7% available CHLORINE) (6.64 L/ 50,000 gal)
- Two containers (20 L or 5 gal)
- Video camera
- Photo camera *(optional)*
- Tripod
- CHLORINE detection kit
- Pump *(capable of 700 mL/min or 0.18 gpm)*
- Tubing *(~6.4 mm or 1/4 inch ID)*
- Tubing clamps
- Fittings, adapters, and Teflon tape *(for threaded connections)*
- Scale
- Gloves
- Timer

Procedure

1. Use a scale to weigh out the correct amount of crystal violet needed. Be sure to wear proper safety equipment when handling any chemicals.
2. Make the stock crystal violet solution by mixing the crystal violet and three gallons of non-chlorinated water in a container.
3. If you do not plan to use the POOLS existing DISINFECTION system during the dye removal process, then it will be necessary to prepare a sodium hypochlorite solution. To do this follow the recommend dose of 6.64 liters of bleach *(5.7% available chlorine)* per 50,000 gallons of POOL water. Place the correct amount into a separate container.
4. Two days prior to the dye study, cut off the POOL'S DISINFECTION system, and then measure the CHLORINE concentration of the POOL. On the same day as the DISINFECTION system is turned off, weigh out enough sodium thiosulfate penta-

¹ Alberta. Pool Standards, 2006 for the Swimming Pool, Wading pool, and Water Spray Park Regulation. (Last accessed 1/1/2011).<http://www.health.alberta.ca/documents/Standards-Pools.pdf>.

hydrate to neutralize the CHLORINE that is present and dump it around the perimeter of the POOL. It is necessary to neutralize the CHLORINE because it will react with the dye. Come back the following day to make sure there is no CHLORINE, and likewise on the day of the dye study.

5. Prepare the pump by attaching the tubing to the existing piping and calibrate the flow rate to 700 mL/min. At this flow rate, the stock solution of dye will be injected into the POOL over a 16 minute period. Tube clamps may be used to secure the connection between the tubing and the connectors.
6. Prepare the filter room by laying down a trash bag (*or similar item*) as protection from a potential chemical spill/leak. Then place the pump and containers containing the dye stock solution and sodium hypochlorite solution on the plastic cover.
7. Prepare a location in the pipe network (*preferably after the filter*) to inject the chemicals. If a location does not already exist (*e.g., an existing CHLORINE feed or acid feed point*) then one will need to be made by tapping the pipe and inserting the proper fitting.
8. Attach the tubing from the pump to the existing or newly created injection point. Depending on what fitting is present you might need an adapter for the tubing. The other end of the tubing should be placed in the chemical container holding the dye.
9. Make sure all assistants are in place to record video, take pictures, collect data, and time injection to 15 minute pass/fail observation point.
10. When ready to start, turn on the pump. The dye should begin to flow into the POOL. Start the timer at the same time as the pump is turned on (*pump on, time (t) = 0 min*). The stock dye solution should be depleted in 16 minutes. After 16 minutes, turn the pump off so that air will not be introduced into the system.
11. Record the time when the dye is first observed coming into the POOL.
12. Record the time when the POOL water is completely dyed (*having uniform color*).
 - a. *Most POOLS should be uniformly dyed within 15-20 minutes (and generally no more than 30 minutes) when the RECIRCULATION SYSTEM is hydraulically balanced.*
13. Record any observations or patterns, including dead spots and/or short circuiting, and the corresponding times that they were noticed throughout the test.
 - a. *Adjustments should be made to the RECIRCULATION SYSTEM to correct for any problems observed. Adjustments could include the following:*
 - i. *Direction of INLETS (up and down as well as left and right),*
 - ii. *Velocity of water through the INLETS (when adjustable by INLET modification or TURNOVER time adjustment), and*
 - iii. *Proportion of water from the surface overflow and main drain components of the RECIRCULATION SYSTEM.*
14. Remove the dye by re-chlorinating the POOL. Switch the tubing from the container of dye to the one containing the sodium hypochlorite and turn the pump back on. Another option would be to restart the POOL's current DISINFECTION system.
15. Observe and record what you see as the dye is removed from the POOL through chlorination.