Appendix

Appendix A: Contamination of Pools from Accidental Fecal Release (AFR) and Vomit

Pool and spa operators should be aware that fecal matter (stool) or vomit in the pool poses a serious health risk for all pool users. If contamination should occur, the following is a general guideline developed for pool operators by the Centers for Disease Control (Updated August 1, 2008).

Step 1: Evacuation and Evaluation

Request that all bathers leave the pool. If the filtration system services more than one pool, all affected pools must be closed until the evaluation is completed. If the person who contaminated the pool is available, determine if he or she is ill with stomach cramps, fever, or flu like symptoms. If so, or if the stool is loose, go to step 2B.

Step 2A: Person is not sick, material easily picked up

If a pool has been contaminated by "formed" stool which may be easily picked up, OR if it can be determined that the person vomited due to gulping water or over exertion;

1. Remove as much of the feces or vomit as possible (using a net or bucket) and dispose of it in a sanitary manner.
2. Vacuum remaining visible material only if it cannot be removed by other means.
3. Small material that is floating on the surface that cannot be picked up should be pushed toward the overflow or skimmers until all visible material is removed.
4. Spot disinfect the area of contamination with a small quantity of disinfectant. A solution of 5.25 percent sodium hypochlorite (household bleach) diluted 1:10 with water may be used for disinfection.
5. Raise the free chlorine level to 4 ppm for the entire pool, including any associated surge or balancing tanks. Use a non-organic chlorine such as calcium hypochlorite. Ensure pH is 7.5 or less, and water temperature is 77ºF (25ºC) or higher.
6. Brush the walls and bottom of the pool in the contaminated area.
7. Maintain free chlorine concentration at 4 ppm and pH 7.5 for at least 25 minutes before reopening the pool. Ensure that the filtration system is operating during the entire disinfection process.
8. Document AFR or vomit in a **Contamination Incident Log**. Record date, time of event, and whether it involved formed stool or diarrhea. Also include free chlorine levels and pH before and after the event.

Step 2B: Person is ill or illness is suspected

1. Follow all procedures in Step 2A , bullets #1, 2, and 3.
2. Use additional chlorine and time to achieve a **Time and Chlorine Concentration (CT)** value of at least 15,300. Multiply the chlorine concentration in parts per million (ppm) by the time in minutes at that concentration to determine the CT value. A CT value of 15,300 will destroy 99.9% of Cryptosporidium and other pathogens that may be present in feces. The following example will achieve a CT of 15,300:
   - Raise the free chlorine concentration to 20 ppm;
   - Maintain pH at 7.5 or less;
   - Maintain water temperature at 77ºF (25ºC) or higher;
   - Assure that free chlorine remains at these levels for at least 12.75 hours (12.75 hours = 765 minutes. 765 minutes X 20 ppm chlorine = 15,300 CT). See **Time and Chlorine Concentration Calculation** later in this section.
3. Brush the walls and the bottom of the pool in the contamination area.
4. Ensure filtration system is operating during the entire disinfection process.
5. Back wash filter to waste. Due to the resistance of Cryptosporidium (an intestinal parasite) oocysts to chlorine, it is also recommended that you add a filter enhancement product (i.e. flocculants and clarifiers) to physically trap more parasites in the filter media prior to backwashing to waste.
6. Ensure that free chlorine levels drop below 10 ppm, and meet regulatory levels for the specific type of pool facility (i.e. 3.5 ppm for spas and wade pools using stabilized chlorine).
7. Document AFR or vomit in a **Contamination Incident Log**. Record date, time of event and whether it involved formed stool or diarrhea. Also include free chlorine levels and pH before and after the event.

Step 3: Recordkeeping

WA State Rules for Water Recreational Facilities require pool operators to maintain records for injuries, illness, and for incidents of "visible pool water contamination". The following is an example of what should be contained in an incident report form:

CONTAMINATION INCIDENT REPORT

Date of Incident: _____ / _____ / _____

Material in Pool was: ☐ Stool (loose) ☐ Stool (firm) ☐ Vomit ☐ Blood

Person responsible was: ☐ Ill ☐ Not Ill ☐ Don't know ☐ Not found

Free Chlorine Level at time of incident was : _____ PPM **pH was: _____**

Pool was closed for _____ hours From ____ ☐am ☐pm to ____ ☐am ☐pm

Pool was not closed ☐

Flocculant added to Pool: ☐ Y ☐ N (strongly recommended if pool closed)

Disinfectant Levels were maintained at _____ PPM for _____ Hours

Time & Concentration Sample Calculations:
T = Time in Minutes
C = Concentration in PPM
15,300 = CT Value for Inactivation of Parasite (i.e. Cryptosporidium)

15,300 / T = C i.e. 15,300 / 600 minutes (10 hours) = 26 PPM for 10 hours
15,300 / 960 minutes (16 hours) = 16 PPM for 16 hours
*****pH must not rise above 7.5 during entire superchlorination*****

Free Chlorine disinfectant Level Prior to re-opening: _____ PPM (cannot exceed 10 ppm)
pH Level prior to opening _____

Note: If the fecal accident is a "formed stool" you may re-open pool after:
Remove fecal material, spot disinfect the immediate area and ensure the pool remains closed for 25 minutes at a minimum chlorine concentration of 4.0 ppm and pH of 7.5 or below

Comments: _____
Pool Operator: _____

High chlorine dosage

Anyone attempting to use a higher than recommended chlorine dosage in an effort to reduce the time the pool is closed should be aware of the following precautions:

- You are using the dosage because it has been determined that a pool user has contaminated the pool and:
    1. The person has symptoms of illness, such as fever, diarrhea, vomiting, etc.; or
    2. Loose stool or vomit was found in the pool.
- High concentrations of chlorine can damage pool equipment and pool surfaces.

- You must determine how much chemical sanitizer yields the desired results for your pool facility.
- You must use appropriate test kits to accurately monitor chlorine residual and pH.
- Pools need to remain closed long enough to allow for free chlorine to drop below 10 ppm prior to opening.
- Remember that some chlorine test kits will give low readings or zero readings when chlorine level is very high.

Time and Chlorine concentration calculation (CT Inactivation Value)

The CT inactivation value is a formula that provides information for concentration of free chlorine (C) and length of time in minutes (T) to kill 99.9% of Cryptosporidium (the pathogen most resistant to Chlorine) in your pool or spa.

The formula can be used as follows:

C x T = 15,300:
15,300/T = C
15,300/C = T

For example, suppose your disinfection equipment can only maintain a maximum 15 ppm chlorine concentration. The formula requires that you divide 15,300 by the known concentration (C), 15 ppm.

The net result will be 15,300 / 15 or (T) =1020 minutes. Dividing minutes by 60 gives you the number of hours, or in this case, 1020 / 60 = 17 hours.
So, 15 ppm free chlorine for 17 hours provides the same disinfection effect as 20 ppm for 12.75 hours.

Another example, suppose you wish to re-open your pool 24 hours after beginning the disinfection process.
24 hours x 60 (minutes/hour) equals 1,440 minutes (T). Dividing 15,300 by 1,440 (T) give us a concentration (C) of 10.6 ppm, or rounded up to 11 ppm.

So, 24 hours at 11 ppm provides the same effect as 12.75 hours at 20 ppm.

Remember when disinfecting for accidental fecal releases **always use non-organic chlorine products** such as calcium hypochlorite, lithium hypochlorite or liquid chlorine (sodium hypochlorite). Organic chlorine products like Trichlor, and Dichlor are not considered adequate to remove the Cryptosporidia microrganism.

The decision making process and the calculations required for emergency disinfection are complex. Remember that you can contact your local public health department to obtain advice.

Amount of chlorine needed

The amount of chlorine needed to achieve your desired result depends on the volume of water in your pool and the concentration of chlorine you are using. In many instances the label instruction will provide amounts of chemicals per 10,000 gallons of water. Read product information carefully and do not hesitate to contact your local pool equipment supplier, or local health department for more help. Please remember to always add high levels of chlorine **only after the pool has been closed and all bathers have left the pool**. Also, to minimize risks of chemical burns, wear appropriate protective gear including gloves, glasses and protective clothing. Always add powdered chemicals such as calcium hypochlorite to water to avoid violent reaction.

Remember to clean and sanitize any equipment such as a bucket, net or brush after it is used for removal of fecal matter or vomit.

Bromine pools

Use non-organic chlorine products to obtain the required high dosage for pools, spas, and wading pools that use Bromine as a primary disinfectant.

Appendix B: Preventing Corrosion or Scale in the Pool

Damage occurs at pools relatively quickly when certain characteristics of the pool chemistry get out of balance. If these get too far one way, they can begin corroding parts of the facility, usually the heater and any metal components in the recirculation system. Conversely, if the balance goes too far the other way, it can create a condition that will create scale which can clog lines (which restricts water flow) or coat heater coils (costing more energy for heating the water). There are numerous types of measuring scales for evaluating water corrosion as there may be different factors creating problems in particular waters. The one shown on the following page is an abbreviated version of a common formula developed by W. L. Langlier. The formula works as follows:

pH (actual reading) + TF + CF + AF - 12.1 = degree of corrosivity or scaling.
(TF = Temperature factor; CF = Calcium Factor; AF = Alkalinity Factor)

Ideally, keep range of tests between -0.3 to +0.3.