Certification Boulevard

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Test Your Knowledge of Disinfection & Emerging Issues

1. Why should liquid chlorine never be trapped between two closed valves?
   A. Liquid chlorine may turn to gas, contract, and implode the pipe.
   B. Liquid chlorine may turn to gas, expand, and explode the pipe.
   C. The pressure will drop too rapidly.
   D. Trapping liquid chlorine is not a problem.

2. To which position should you rotate a ton container if a leak develops?
   A. With the leak at the bottom.
   B. With the leak at the top.
   C. With the leak on the side.
   D. It does not matter.

3. What chemical is used to identify a chlorine leak?
   A. Ammonia B. Sulfur Dioxide
   C. Sodium Hydroxide D. Sulfuric Acid

4. ***True or False***: Leaking chlorine liquid will tend to collect near the floor of a closed room.

5. Calculate the required capacity of a chlorine contact chamber, given the following data:
   • Plant average daily flow is 5.7 mgd.
   • Plant peak flow is 9.9 mgd.
   • Required detention time at ADF is 30 minutes.
   • Required detention time at peak flow is 15 minutes.
   A. 13,721 cubic feet B. 102,636 gallons
   C. 12,367 cubic feet D. 118,187 gallons

6. What type of chlorine residual is created when ammonia is present and breakpoint has not been accomplished?
   A. Combined B. Free residual
   C. Tri-chloride D. Dioxide

7. What is the weight relationship of chlorine liquid compared to water?
   A. Water and liquid chlorine weigh the same.
   B. Liquid chlorine weighs 2.5 times more than water.
   C. Water weighs 1.5 times more than liquid chlorine.
   D. Liquid chlorine weighs 1.5 times more than water.

8. What are the two types of gaseous poisoning with chlorine called?
   A. Vapor and pellets
   B. Dry and wet
   C. Mild and extreme
   D. Coughing and choking

9. Where is gas chlorine withdrawn in a one-ton container?
   A. From the bottom valve.
   B. From the top valve.
   C. From top or bottom valves.
   D. Gas can not be withdrawn from a one-ton container.

10. What pipe material is used to convey chlorine (liquid or gas) under pressure from one-ton containers to downstream equipment components?
    A. Black iron pipe
    B. PVC pipe
    C. Ductile clay pipe
    D. Pre-stressed concrete pipe

ANSWERS ON PAGE 82

Readers are welcome to submit questions or exercises on water or wastewater treatment plant operations for publication in *Certification Boulevard*. Mail your question (with the answer) or your exercise (with the solution) to Roy Pelletier, City of Orlando Public Works Department, 5100 L.B. McLeod Road, Orlando, FL 32811. Or send it by e-mail to roy.pelletier@cityoforlando.net.

Certification Boulevard Answer Key

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1. **B. Liquid chlorine may turn to gas, expand and explode the pipe.**
   The expansion ratio of liquid chlorine to gas is about 457 times. This is why liquid chlorine should never be trapped in a pipeline between two closed valves ... big bang!

2. **B. With the leak at the top.**
   Because liquid chlorine will expand about 460 times, it is important to locate the leak "gas side up." With the leak located at the top of the container, the least amount of chlorine will escape.

3. **A. Ammonia**
   Ammonia fumes should be used to identify leaks. Do not spray liquid ammonia directly on fittings or valves.

4. **True**
   Chlorine liquid is about 1.5 times heavier than water and, during a leaking condition, will typically remain on the floor. As the liquid evaporates to a gas, the gas will also remain low lying – gas is about 2.5 times heavier than air.

5. **D. 118,187 gallons**
   D.T. @ ADF
   = 5.7 mgd x 92.4 cfm/mgd x 30 minutes
   = 15,800 cu.ft. x 7.48 gal/cu.ft.
   = 118,187 gals
   D.T. @ Peak
   = 9.9 mgd x 92.4 cfm/mgd x 15 minutes
   = 13,721 cu.ft. x 7.48 gal/cu.ft.
   = 102,636 gals
   ADF using 102,636 gallons would only be 26 minutes D.T. Answer is 118,187 gallons capacity to meet both flow/time requirements

6. **A. Combined**
   Combined residual (chloramines) is dominant before the breakpoint.

7. **D. Liquid chlorine weighs 1.5 times more than water.**
   Liquid chlorine is an amber-colored liquid with a pungent and irritating odor. It is 1.5 times heavier than water with 6.7 kgs/cm2 vapor pressure at 20°C and 20 kg/cm2 vapor pressure at 70°C. The maximum solubility in water is 1.0 percent.

8. **B. Dry and wet**
   There are two types of chlorine gassing, known as wet and dry. ***Dry gassing*** *is very irritable and causes choking. If you are exposed, avoid coughing, leave the area immediately, take short breaths, and do not run from the area, since running causes deeper and more rapid breathing.* ***Wet gassing*** *comes from fumes of aqueous solutions. This does not seem as irritable and you may be induced into inhaling larger amounts of molecular chlorine. This can cause pulmonary edema (inner-tissue fluid collects and fills the lungs). Victims of this condition can drown while sleeping.*

9. **B. From the top valve**
   Chlorine ton containers are manufactured with liquid chlorine under pressure. Because of the evaporative temperature of chlorine, some of the liquid is always being converted to gas inside the container. Gas is withdrawn from the top valve and liquid is withdrawn from the bottom valve.

10. **A. Black iron pipe**
    The pipe most compatible for conveying chlorine gas or liquid, at pressures equal to that in the chlorine ton container, is black iron pipe. Liquid chlorine, or gaseous chlorine under pressure, will basically melt PVC pipe; however, PVC pipe is very adequate to convey gaseous chlorine after pressure reduction, and also chlorine solution.