

Test Your Knowledge of Disinfection



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- Given the following data, calculate the chlorine demand:
 - Total daily weight used is 1,350 lbs/day
 - The plant flow is 13.5 mgd
 - The effluent chlorine residual is 2.0 mg/l

A.) 6,305 lbs/day
B.) 1,125 lbs/day
C.) 1,681 lbs/day
D.) 281 lbs/day
- What is the ratio of liquid chlorine when it expands to chlorine gas?

A.) About 8.34 volumes
B.) About 460 volumes
C.) About 7.48 volumes
D.) About 49.3 volumes
- How does the ultraviolet (UV) system function in regard to disinfection of the final effluent?

A.) The ultraviolet reduces the biochemical oxygen demand (BOD₅) level
B.) The ultraviolet radiation is absorbed by microorganisms and damages the genetic makeup of the organisms, preventing their further reproduction.
C.) The UV system promotes high growth rate of microorganisms and causes them to reach the death cycle more quickly.
D.) The UV system increases the carbonaceous biochemical oxygen demand (CBOD₅) value.
- Where is gas chlorine withdrawn from in a 1-ton container?

A.) From the bottom valve.
B.) From the top valve.
C.) From the top or bottom valves.
D.) Gas cannot be withdrawn from a 1-ton container.

- What will happen to combined chlorine residual when ammonia in the effluent goes up?

A.) Chlorine residual will increase if the chlorine feed rate is increased.
B.) Chlorine residual will increase if the chlorine feed rate is decreased.
C.) Chlorine residual will increase if the chlorine feed rate is shut off.
D.) Ammonia does not affect chlorine residual.
- 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.
- What is the chemical formula for sulfur dioxide?

A.) SO₄ B.) O₂
C.) CO₂ D.) SO₂
- What concentration of chlorine can kill in a few short breaths?

A.) 15 parts per million (ppm)
B.) 50 ppm
C.) 100 ppm
D.) 1000 ppm
- What is the chemical formula for ozone?

A.) O₄ B.) O₂
C.) CO₂ D.) O₃
- Into which position should you rotate a 1-ton container of chlorine 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.

Answers on page 72

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1. **B) 1,125 lbs/day**
*Demand = Supply - Residual OR
 Supply - Demand = Residual*
 - Supply is given at 1,350 lbs/day
 - Residual = 13.5 mgd x 2.0 mg/l x 8.34 lbs/gal = 225.18 lbs/day
 - 1,350 lbs/day - 225.2 lbs/day = 1,124.8 lbs/day

2. **B) About 460 volumes**
Upon contact with the air, when liquid converts to gas, it expands about 460 times. This means that one volume of liquid expands to 460 volume of gas. So, a leaking container of chlorine should always be rotated where the leak is gas-side up.

3. **B) The ultraviolet radiation is absorbed by microorganisms and damages the genetic makeup of the organisms, preventing their further reproduction.**
Ultraviolet (UV) lamps are used for germicidal disinfection by producing light at required wavelengths to destroy up to 99.99 percent of all bacteria, protozoa, viruses, molds, algae, and other microbes. This includes such waterborne diseases as: Escherichia coli, hepatitis, cholera, dysentery, and typhoid fever, as well as many others.

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

5. **B) Chlorine residual will increase if the chlorine feed rate is decreased.**
When chlorine reacts with ammonia, it creates chloramines. If the chlorine feed rate is decreased during this reaction, the actual residual will increase, provided there is enough ammonia to maintain the chloramine residual. If the chlorine feed rate is increased during this reaction with ammonia, the actual chlorine residual will decrease. With each increase in feed rate, the residual will decrease until the breakpoint is achieved. Then, 1 ppm of chlorine feed will equal 1 ppm of free chlorine residual.

6. **B) Dry and wet.**
There are two types of chlorine gassing: wet and dry.
Dry gassing is very irritable and causes choking. If exposed, avoid coughing, leave the area immediately, take short breaths, and do not run from the area since this causes deeper and more rapid breathing.
Wet gassing comes from fumes of aqueous solutions. This does not seem as irritable and you may inhale large amounts of molecular chlorine. This can cause pulmonary edema (inner-tissue fluid collecting in and filling the lungs) and you can drown while sleeping.

7. **D) SO₂**
Sulfur dioxide (SO₂) is a colorless, non-flammable gas, with strong, pungent, suffocating odor. Its vapor density is 2.26 times that of air at atmospheric pressure. Sulfur dioxide, typically used for dechlorination of chlorinated effluent, is normally supplied under pressure in containers. Both liquid and gaseous phases are present in the repressurized container.
Caution: Sulfur dioxide gas is intensely irritating to the eyes, throat, and upper respiratory system. Liquid sulfur dioxide may cause skin burns, which results from the freezing effect of the liquid on tissue.

8. **D) 1000 ppm**
1000 ppm is a deadly concentration in just a few short breaths.

9. **D) O₃**
Ozone (O₃) is formed primarily through a reaction between the common oxygen molecule (O₂) and radiation from the sun. When high-energy ultraviolet radiation strikes an oxygen molecule, it splits the molecule into separate atoms. Each atom quickly joins an O₂ molecule, producing O₃ - ozone. This occurs primarily in the stratosphere.

10. **B) With the leak at the top.**
Because liquid chlorine will convert to gas at a rate of 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.