

TITL: Update to Wastewater Questions

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NOTE:

'Disinfection

The purpose of disinfection is to

*Destroy or inactivate pathogens to very low levels

Sterilize the water or wastewater

Completely eliminate all pathogens

Meet the requirements of the discharge permit

Chlorine gas is detectable by most people at these concentrations because of its distinctive odor

*0.02 to 0.2 ppm

1.0 to 2.5 ppm

1.0 to 2.5 ppb

5.2 to 7.3 mg/L

Chlorine gas is this color

*Greenish yellow

Clear amber

Bright green

Colorless

Chlorine gas is heavier than air. How much heavier?

*2.5 times

5 times

35 percent

20 percent

The exhaust vents in a chlorine gas room should be located here

*Near the floor

As close to the cylinders as possible

At the ceiling

Wherever they won't be in the way

Chlorine may be safely stored with

[SO]

Organic compounds

Oils and Solvents

Greasy machinery

*None of the above

?Chlorine reacts with many organic compounds, oils, and solvents... sometimes explosively. The only thing that should be stored in the chlorine chemical room is chlorine!

When chlorine gas is added to water, the pH

*Decreases

Increases

Remains the same

Drops 0.5 pH units on average

Liquid chlorine should never be allowed to contact skin for this reason

*Chemical frost bite can occur

Liquid chlorine is extremely corrosive

Chlorine reacts with sweat to form hydrochloric acid

The sudden pH increase can cause chemical burns

A chlorine cylinder is delivered to a treatment plant. The cylinder appears normal and does not have any obvious dents. The operator places his hand on the cylinder and it is hot to the touch. He should

*Reject the cylinder. A hot cylinder could indicate internal moisture contamination

Do nothing. The cylinder is probably hot from riding in the back of the truck all day.

Make a note and notify a supervisor.

Weigh the cylinder to ensure it is full before placing it in the rack.

Liquid chlorine will yeild this many volumes of gas when pressure is released

*456

200

82

728

?One pound of chlorine liquid, or about 300 mL, will expand to fill 5 cubic feet of volume.

A chlorine gas ejector operates on this principal

*Vacuum

Suction

Saturation

Pressure

?The ejector works because water passing through it creates a vacuum which draws additional chlorine gas out of the cylinder.

What is the maximum number of pounds of chlorine that may be safely withdrawn from a 150 pound cylinder in one day?

*40

400

60

200

If chlorine gas is withdrawn from an 150 lb cylinder faster than 40 pounds per day, what is the probable outcome?

*Cylinder will freeze making further withdrawals impossible

Operator will be written up for wasting chlorine

Ejector may be damaged and require replacement

O-rings around outlet area may be degraded

The chlorinator should be kept clean and dry to avoid this potential problem

*Formation of hydrochloric acid

Explosion of gas cylinder

Freezing up of withdrawal mechanism

Backsiphonage of water into the cylinder

?Clean chlorinators with water to remove soluble deposits followed by wood alcohol and air drying. Heat drying can also be used to remove all traces of moisture before reassembly.

A one ton cylinder has this many fusible plugs

*Six, three at each end

Three, spaced at 40 degree intervals on one end

Five, two on each end and one in the middle

One, located at the gas withdrawal line attachment point

Fusible plugs are designed to melt at this temperature to prevent hydrostatic rupture of the cylinder or container

*158 - 164 degrees F

148 - 154 degrees C

90 - 120 degrees C

180 - 212 degrees F

One disadvantage of using sodium hypochlorite for disinfection is that it degrades over time. Sodium hypochlorite solution should be used within this many days to ensure potency.

*60

90
30
120

When sodium hypochlorite is added to water, the pH

*Increases
Decreases
Remains the same
Who cares?

HTH stands for

*High Test Hypochlorite
Hyper Thymine Hypochlorite
High sTrengh Hypochlorite
Hypochlorite Tablet Holder
?HTH is another word for Calcium Hypochlorite which is available in tablet form.

Chloramines are formed when chlorine reacts with this compound

*Ammonia
Amino acids
Amyl Nitrile
Amylase
?Depending on the ratio of chlorine to ammonia, mono-, di-, or tri-chloramines are formed.

Chlorine dose is always equal to

*Residual plus demand
Demand minus residual
The chlorinator setting less the residual
The measured free chlorine
The measured residual chlorine

For chlorine disinfection to be effective, the minimum contact time should be

*30 minutes
10 minutes
60 minues
90 minues
?In Colorado, the States asks for a minimum of 30 minutes at the maximum monthly average flow OR the peak hourly flow on a normal day, whichever is greater. The Water Environment Federation (WEF) recommends 30 minutes at average flow and 15 minutes at peak flow or the maximum pumping rate.

As water temperature increases, chlorine gas solubility

*Decreases
Increases
Remains the same

As water temperature decreases, the amount of chlorine gas that can be dissolved in the wastewater

*Increases
Decreases
Remains the same

The amount of contact time required for chlorine disinfection _____ as pH increases.

*Increases
Decreases
Remains the same

As temperatures increase, the efficiency of chlorine disinfection

*Increases

Decreases

Remains the same

?At 20°C and a pH of 6.0, at least 38 minutes of contact time are needed to achieve three-log removal of Giardia. At 5 degrees C, the time required to achieve the same level of disinfection increases to 100 minutes.

This sulfite salt is the least expensive and most stable alternative for disinfection

*Sodium metabisulfite

Sodium sulfite

Sodium bisulfite

Sulfur dioxide

What is the Permissible Exposure Limit (PEL) for chlorine gas?

*0.5ppm

1.0 ppm

30 ppm

5 ppm

The Occupational Health and Safety Administration (OSHA) set the PEL for chlorine at 0.5 ppm. This is the concentration

*Safe for AVERAGE exposure concentration during an 8 hour workday

Safe for MAXIMUM exposure concentration for two hours of an 8 hour workday

Requiring Personal Protective Equipment (PPE) such as respirators

Acceptable inside gas cylinder storage rooms

What is the IDLH (Immediately Dangerous to Life or Health) concentration for chlorine?

*30 ppm

500 ppm

1 ppm

200 ppm

The Occupational Safety and Health Administration (OSHA) has set the PEL limit for chlorine at 0.5 ppm as an 8 hour average. OSHA further stipulates that the chlorine concentration may not exceed _____ at any time.

*1 ppm

5 ppm

30 ppm

500 ppm

An operator enters a chlorine gas room. The smell of chlorine is very strong. The operator determines that chlorine gas is leaking from a 1 ton container. Which repair kit will they need?

*B

A

C

D

?Remember that the kit identification types go from small (A - 150 lb cylinder) to large (C - rail car)

Can a chlorine gas cylinder repair kit be used to repair a sulfur dioxide cylinder leak?

*Yes, but different washers will be needed

No, the sulfur dioxide cylinder needs a different repair kit

No, sulfur dioxide is not a gas and doesn't come in cylinders

Yes, of course, the repair kits are interchangeable

If a chlorine leak is suspected, it can be located by using

*A rag soaked in 20 Baume ammonia solution

A certified nose

A chlorine detection monitor

A squirt bottle containing 10 Baume ammonia solution

?As the soaked rag gets close to the source of the leak, white smoke will appear in the air as the ammonia reacts with the chlorine

This law governs reporting requirements for treatment facilities using chlorine gas
SARA Title IIA

Superfund Amendments and Reauthorization Act

*Emergency Planning and Community Right to Know Act

National Fire Protection Act (NFPA) Title 20

?The purpose of the law, which is also known as SARA Title III, is to encourage and support emergency planning efforts at the State and local level.

In 2001, EPA promulgated the Extremely Hazardous Substances (EHS) list under EPCRA (Emergency Planning and Community Right to Know Act). Under this legislation, what is the reportable quantity of chlorine gas?

*100 pounds

500 pounds

10,000 pounds

1,500 pounds

?The list sets a generic quantitative limit for EHSs of 500 pounds OR the Threshold Planning Quantity, whichever is less. Utilities that use or store more than 100 pounds of chlorine gas at a time are required to notify local emergency response professionals.

When opening the valve on a chlorine cylinder, how far should it be turned?

*1/4 turn

1/2 turn

Full open

Until gas reaches the ejector

'Phosphorus Removal

Phosphorus accumulating organisms (PAOs) use readily available substrate in the anaerobic zone to do which of the following?

Grow

Gain energy

*Convert to internal storage products

Reduce phosphorus

Which one of these is an indicator of good enhanced EBPR performance?

*High phosphorus content of mixed liquor

Low BOD concentration in effluent

Increased oxygen consumption in aerobic zone

Negative oxidation-reduction potential readings in anoxic zone

Phosphorus concentrations are highest in the anaerobic zone of an EBPR process.

This is due to:

*Phosphorus release during uptake of VFAs

Cellular breakdown of PAOs in the anaerobic zone

Competition with heterotrophic bacteria stresses PAOs into releasing phosphorus

Phosphorus released in RAS being returned to the anaerobic zone

An operator collects samples for his monthly DMR. The final effluent contains 15 mg/L of TSS and 17 mg/L of BOD. If the MLSS contains 8 percent P, what is the effluent P concentration? Assume no soluble P is present.

*1.20 mg/L

1.36 mg/L

<1.0 mg/L

2.56 mg/L

If the influent wastewater ratio of BOD:P is less than 20, how can phosphorus

removal efficiency be improved?

*Addition of VFAs to anaerobic zone

Addition of phosphorus to anaerobic zone

Increase hydraulic residence time in anaerobic zone

Allow nitrate to bleed into anaerobic zone

If the influent BOD concentration decreases and the influent phosphorus concentration remains the same, what is the expected impact at the final effluent?

*Potentially higher effluent P concentrations

Higher concentration of P in MLSS

Increased oxygen demand in aeration basin

Formation of struvite crystals in anoxic zone

Total phosphate includes these forms:

*Orthophosphate, Organically Bound Phosphate, and Condensed Phosphate

Orthophosphate and Polyphosphate

Polyphosphate, Long-chain Phosphate, and Orthophosphate

Organically Bound Phosphate and Inorganic Phosphate

What is the minimum ratio of BOD:P required to ensure that an Enhanced Biological Phosphorus Removal (EBPR) process removes phosphorus to concentrations less than 1.0 mg/L in the final effluent?

*20

45

100

333

?The minimum ratio ensures that the Phosphorus Accumulating Organisms have enough available phosphorus to thrive.

Final effluent phosphorus concentrations must be reported as PO₄ on the discharge monitoring report. When the lab results come back, they are reported as 2.3 mg/L P.

What concentration should be reported on the DMR?

2.3 mg/L P

2.3 mg/L PO₄

*7.06 mg/L PO₄

6.85 mg/L PO₄

?To convert mg/L P to mg/L PO₄, multiply by 3.07

For enhanced biological phosphorus removal to take place, the phosphate accumulating organisms must be cycled between these conditions

*Anaerobic and aerobic

Anaerobic, anoxic, aerobic

Anoxic and aerobic

Fermentation and Anaerobic

Phosphate accumulating organisms (PAOs) store large quantities of phosphorus for this reason

*Energy storage

Food source

Maintain electrolytic balance

Ion release

?Phosphorus is released in the anaerobic zone to gain energy which allows the PAOs to pick up volatile fatty acids (their favorite food)

During biological phosphorus removal, what takes place in the anaerobic zone?

*Release of phosphorus and uptake of VFAs

Uptake of phosphorus and consumption of glycogen

Release of phosphorus, sodium, and potassium

Release of phosphorus and storage of glycogen

Uptake of phosphorus and consumption of poly-B-hydroxybutarate

During biological phosphorus removal, what takes place in the aerobic zone?

- *Luxury uptake of phosphorus and consumption of poly-B-hydroxybutarate
- Release of phosphorus and uptake of VFAs
- Uptake of phosphorus and consumption of glycogen
- Release of phosphorus, sodium, and potassium
- Release of phosphorus and storage of glycogen

In an enhanced biological phosphorus removal system, where will the liquid phase phosphorus concentration be highest?

- *Anaerobic zone
- Anoxic zone
- Aerobic zone
- Clarifier blanket

An anaerobic zone designed for biological phosphorus removal will typically have a hydraulic retention time of

- *45 minutes or less
- 4 to 6 hours
- 1 to 3 hours
- 20 percent of the total HRT
- ?Longer HRTs are sometimes used to generate VFAs

'Solids Handling

Which mechanical dewatering device consists of a: polymer conditioning zone, gravity drainage zone, low-pressure zone, and high pressure zone?

- Solid bowl centrifuge
- Bowl centrifuge
- Vacuum filter
- *Belt filter press

In a gravity thickener gravitational forces are used to thicken solids. What forces are used by a centrifuge?

- *Centrifugal forces
- Gravitational forces
- Sedimentation forces
- Mechanical pressure forces

For "vector attraction reduction," the new sludge rules require a ___ reduction in volatile solids across a digester process before land application.

- 32%
- 35%
- *38%
- 40%

A well established anaerobic digester has a total alkalinity of

- 3000 - 4000mg/L
- *2000 - 5000mg/L
- 50 - 700mg/l
- 50 - 300mg/L

Typical volatile acids concentrations in a anaerobic digester range from:

- *50-300mg/L
- 50-700mg/l
- 2000-5000mg/L
- 3000-4000mg/L

For healthy methane forming micro-organisms in an anaerobic digester, the pH should be maintained between:

- 7-8
- *6-8
- 7-9

The 3 types of digester covers are:

- *Fixed
- *Floating
- *Gas holding
- Gas releasing
- Bolted
- Open

A digester operated in a temperature range of 115-125 degrees F is in the _____ range

- Phsycrophilic
- Mesophilic
- *Thermophilic
- Homeopathic

Two criteria determine a digester's capacity: the hydraulic detention time and the _____ loading rate

- Biological Oxygen Demand (BOD)
- *Volatile suspended solids (VSS)
- Polymer
- Total solids (TS)

The devices that set the minimum operating level on a floating cover are called _____.

- *Corbels
- Lift Brackets
- Level indicators
- Stress pins

Digester heat requirements include: heat required to _____ the temperature of incoming feed sludge to the operating temperature, and heat required to _____ the digester operating temperature.

- *Raise, maintain
- Maintain, raise
- Lower, maintain
- Maintain, mix

Precipitation of magnesium ammonium phosphate in a digester is called _____.

- *Struvite
- Calcite
- Bauxite
- Stalactite

In an anaerobic digester, gas production should be in the vicinity of ___ cu.ft per of gas/day per lb. of volatile matter destroyed.

- 8
- 10
- *12
- 15

The two major gasses found in digester gas are _____ and _____.

- *Methane and Carbon dioxide
- Methane and Carbon monoxide
- Nitrogen and Methane
- Nitrogen and Carbon dioxide

What is affected first when the anaerobic digestion process is starting to deteriorate?

- Supernatant quality
- Temperature

*Volatile acid:alkalinity ratio
Volatile solids concentration

The liquid between the sludge on the bottom and the scum on the top of a non-mixed digester is called _____.

*Supernatant
Subnatant
Interstitial layer
Decant

What is the typical organic loading rate for a well mixed and heated anaerobic digester in pounds of volatile solids per cubic foot per day?

*0.1 - 0.4
0.05 - 0.10
0.4 - 0.8
0.8 - 1.2

In lime stabilization of sludge the goal is to raise the pH to what level and hold it there for 2 hours?

*pH 12
pH 10
pH 8
pH 5

Which of the following is not an example of a sludge stabilization method?

Composting
Digestion
*Drying beds
Lime
Heat drying

One reason that air should be excluded from anaerobic digesters is because [SO]

Gas storage capacity is reduced
*Air mixed with gas produced in the digester could create an explosive combination
Air interferes with aerobic bacteria action
Harmful or pathogenic bacteria may be introduced with air
None of these answers are correct
?Operations Forum February 1999

Solids stabilization in the anaerobic digestion process is accomplished during which stage?

Acid formation
*Volatile acid reduction
Solids draw off
Supernatant removal
Time on drying beds
?Operations Forum October 1998

Which polymer has an ionic charge that may vary with the pH of the solids being conditioned?

Polyelectrolyte
*Nonionic
Cationic
Anionic
?Operations Forum May 1998

What is the most important factor when conditioning solids for dewatering?

*Particle size
Sludge temperature
Filamentous bacteria

Nitrification

?Operations Forum May 1998

Anaerobic digesters are generally operated at a temperature of about ___deg. C. The bacteria that prefer this temperature are referred to as _____.

95, thermophilic

95, facultative

35, thermophilic

*35, mesophilic

?Operations Forum September 1997

Which gas produced in anaerobic digesters can be used as fuel?

Propane

*Methane

Ethane

Carbon dioxide

?Operations Forum June 1997

The mechanism used to remove dewatered sludge from the belt of a belt filter press is commonly referred to as a(n)

Pressure belt

Edge sensor

*Doctor blade

Scum collector

?WEF/ABC 2002 Guide

The standard percent efficiency equation cannot be used to calculate volatile suspended solids reduction in a digester. Why not?

*Inert materials pass through the digester unchanged. The VSS reduction equation accounts for this phenomenon.

Biosolids are converted to carbon dioxide gas which can't be measured.

The hazardous atmosphere in an anaerobic digester makes obtaining the samples needed for the percent efficiency equation too dangerous

Because we've always done it this way