Preliminary Treatment Processes for Wastewater

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Preliminary Treatment Processes for Wastewater

WWW 5720

7 contact hours
9 CC10 hours

This class will identify and characterize the preliminary treatment processes used in wastewater treatment. These pretreatment processes are all designed to protect the downstream equipment and treatment systems. The processes include screening, grinding, grit removal, flow equalization, odor / corrosion control and flow measurement. The class will review the safety concerns and protective measures related to these processes. Indicators of process efficiencies, math concepts and regulatory issues are also addressed. Participants are encouraged to describe their own experiences in this area, including examples of successful troubleshooting and corrective actions in class discussions.

1. Identify and characterize Pretreatment processes in wastewater.
2. Describe treatment methodologies involved: physical, chemical, biological.
3. Characterize proper operation, process effluent quality and residuals.
4. Present troubleshooting guidance.
5. Cover safety issues and PPE.
6. Work through math concepts involved with each process as applicable.
7. Identify regulatory issues involved with preliminary treatment processes.

Agenda:

8:00 AM to 8:30 AM	Introduction Hand out materials Pre-Test
8:30 AM to 9:00 AM	Pretreatment Process Overview
9:00 AM to 10:00 AM	Screening: Coarse and Fine (bars and drums)
10:00 AM to 11:00 AM	Grinding: Barminuters and Comminutes
11:00 AM to 12:00 PM	Degritting: Grit Chambers (aerated and not);
12:00 PM to 1:00 PM	LUNCH
1:00 PM to 2:00 PM	Flows: Measuring and Equalizing
2:00 PM to 2:45 PM	Prechlorination: Odor Control and Disinfection
2:45 PM to 3:30 PM	Regulatory Issues
3:30 PM to 4:00 PM	Review Final Exam

Wastewater Treatment

Preliminary Treatment

Definitions

Bar Rack - removes coarse solids such as sticks, rags, and other debris in untreated wastewater by interception.

Grit Chamber – removes grit consisting of sand, gravel, cinders, or other heavy solid materials that have subsiding velocities or specific gravities substantially greater than those of organic solids.

Primary Clarifier - removes from 50 to 70 percent of suspended solids and 25 to 40 percent of the **BOD**.

Aeration Tank – Activated sludge is aerated with wastewater stimulating the growth of bacteria. The mixture of activated sludge and wastewater is called mixed liquor suspended solids (MLSS).

Secondary Clarifier – separates MLSS from water and settles the solids to the bottom of the tank. Solids are then either wasted or recycled back to the head of the aeration tank.

Definitions

Disinfection - UV light or chemicals like chlorine are added to the discharge to kill disease-causing organisms.

Lift Station – lifts wastewater from one level to a higher level if wastewater cannot flow by gravity through the plant.

Equalization Tanks/Ponds – evens out flows to or in the wastewater treatment process by shaving peak flows during high flow events and returning stored flows to the process during low flow events. Improves plant process performances.

Tertiary Clarifiers – final clarifiers for chemical addition; for phosphorus removal and enhanced solids removal.

Gravity Filters – final filters remove suspended solids and BOD to less than 5 mg/l. Filter media is typically sand and/or anthracite coal, or sometimes granular activated carbon

Wastewater Collection and Treatment

Pre-treatment Program:

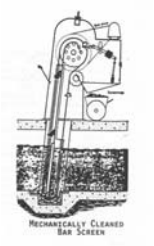
- Certain industries must pre-treat and obtain a permit to discharge into a sewer system
  - Permit issued by sewer system owner
  - Inspected regularly
- Purpose:
  - To prevent toxic chemicals or excess nutrients from being discharged into sewer system

Wastewater Collection and Treatment

Preliminary Treatment

- Flow equalization
- Screening and shredding
- Grit removal
- Disposal of screenings and grit
- Odor control
  - H_2S – rotten egg odor
  - Pre-aeration
  - Chemical addition
    - Chlorine
    - Hydrogen peroxide

Preliminary Treatment



Waterborne Diseases

Bacteria	*Escherichia coli* (gastroenteritis) *Salmonella typhi* (typhoid fever) *Vibrio cholerae* (cholera) *Shigella* (dysentery)
Viruses	Norovirus (gastroenteritis) Rotavirus (gastroenteritis) Hepatitis A virus (infectious hepatitis) Adenovirus (respiratory, gastroenteritis)
Protozoa	*Giardia lamblia* (gastroenteritis) *Cryptosporidium parvum* (cryptosporidiosis)

Waterborne Diseases

- Bacteria -Many types of bacteria are excreted in human feces and some, like *Salmonella* and *E. coli,* have the potential to cause disease.
- Viruses -More than 100 different types of viruses capable of causing disease are excreted by humans.
- Protozoa -Disease-causing protozoa like *Cryptosporidium* and *Giardia* may be found in wastewater

Pathogens and Waterborne Diseases

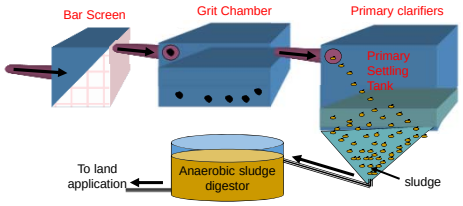
- Enters water sources via:
  - Inadequately treated wastewater
  - Animal waste feedlots
- Causes more human health problems than any other type of water pollution
- Fecal coliform bacteria indicate fecal contamination of water
  - The water can hold other pathogens, such as giardiais, typhoid, hepatitis A

Wastewater Collection and Treatment

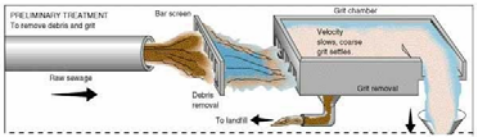
- ***Velocity*** plays a key role in solids and grit travel through a collection system
- Rates range between 2 to 3.5 ft/sec (fps)
- Solids stay mixed while grit concentrations travel like a moving bed along the bottom of the sewer pipe
- At higher velocities, flow becomes turbulent dispersing the grit with the solids; at velocities below 2 fps, grit will begin to settle out

Wastewater Treatment

- Preliminary and Primary treatment
  - Separation of large debris following sedimentation
    - Gravel, sand, twigs. leaves



Preliminary Treatment



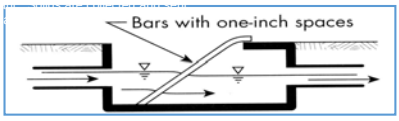
Preliminary Treatment

- Purpose:
  - To remove large objects and non-degradable materials
  - To protect downstream pumps and equipment from damage
  - To reduce odors
- Bar Screens, Grit Chambers, and Degritters
- Odor Control with Air and Chemicals

Screening

Wastewater Treatment (Preliminary)

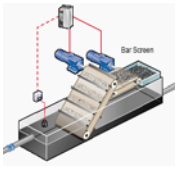
Bar Racks and Screens



Basket Screen/Rack

Ladder Guide
Pull cable

Bar Screens



The Bar Rack or Screen

- A screen composed of parallel bars placed at the plant entrance to catch debris.
- Debris can be removed either manually or mechanically

Preliminary Treatment

- Bar Screens
  - Catches large objects
  - Pieces of wood, heavy rags, plastics, bricks, bottles, e.g. trash
- Approach velocity: < 2.0 fps
- Manually cleaned
- Mechanically cleaned

Screening

- Coarse screens (12 -50 mm) are used to remove large debris like rags, sticks, rocks, and plastic.
- Fine screens (2 -6 mm) capture smaller items such as cigarette butts and some fecal matter
- Screens have to be cleaned often; this can be automated or manual.

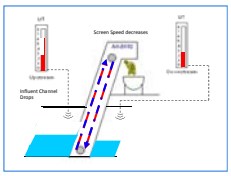
Preliminary Treatment

- Bar Screens
  - Catches large objects
  - Pieces of wood, heavy rags, plastics, bricks, bottles, e.g. trash
- Approach velocity: < 2.0 fps
- Manually cleaned
- Mechanically cleaned

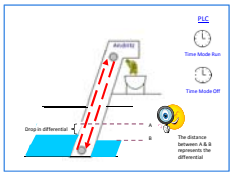
Bar Screens with Screening Compactor

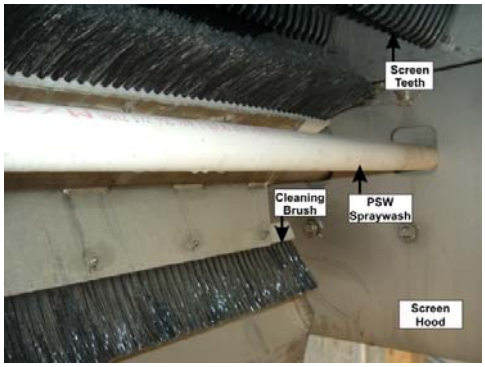
Bar Screens - Control

Differential Level Mode Operational Sequence



Time Differential Mode Operational Sequence





Math Example

- Screenings removed
- Assumptions:
  - Q = 60 mgd
  - Screenings removed daily = 175 ft^3
  - Unknown: Determine screenings removal in **ft^3 per mg**.

Answer: 175 ft^3/day ÷ 60 mgd = 2.9 ft^3/mg

Math Example

- Screenings removed
- Assumptions:
  - Q = 40 mgd
  - Screenings removed daily = 90 ft^3
  - Specific gravity of screenings = 0.9
  - Unknown: How many **pounds per day** of screenings were removed?

Answer:

90 ft^3/day x 0.9 x 7.48 gals/ft^3 x 8.34 lbs/gal = 5053 lbs/day

Grit Removal

Preliminary Treatment

- Grit removal
  - Removes rocks, gravel, broken glass
  - Aerated systems
  - Cyclone degritters

Grit Removal

- Grit removal is the forced separation of gritty material (gravel, sand, egg shells, seeds, etc.) from wastewater
- If not removed, this material could accumulate in the treatment system and cause damage to or abrasion of pipes and equipment.

Grit Removal

- ***Grit*** consists of a variety of particles including sand, gravel, cinder, and other heavy, discrete inorganic materials
- ***EPA*** *Fact Sheet* (Screening & Grit Removal) - **defines grit** "as particles larger than 0.21 mm (.008 in.) (65 mesh) and with a specific gravity of greater than 2.65"
- ***Mesh sizing*** is a common way to classify grit particle sizes, particularly for influent grit profiling and performance testing

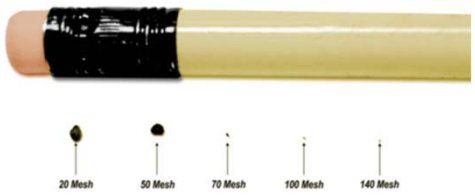
Grit Removal

- ***Velocities*** between 2 - 3.5 ft./sec (fps) keep grit in suspension
- At velocities between 0.7 – 1.4 fps, grit will settle out
  - **1.0 fps is ideal**
  - Lighter organic materials will remain in suspension
  - Organic materials will be removed in primary and secondary treatment

Grit Size

- Grit size is important:
  - Large particles are abrasive
  - Smaller particles are slightly buoyant
- Typical WWTP abrasive grit sizes range from 50 to 100 mesh
- Abrasive grit particles cause the most problems in downstream equipment
- At 140 mesh, particles begin to take on silt-like, buoyant properties

Grit Size



300 Microns 150 Microns

Aerated Grit Chambers

- Air requirements for aerated systems:
  - 3 – 8 ft^3/min per linear foot of tank length
- Detention Time: > 2 minutes
- Grit quantities: 0.5 to 5 ft^3/mg

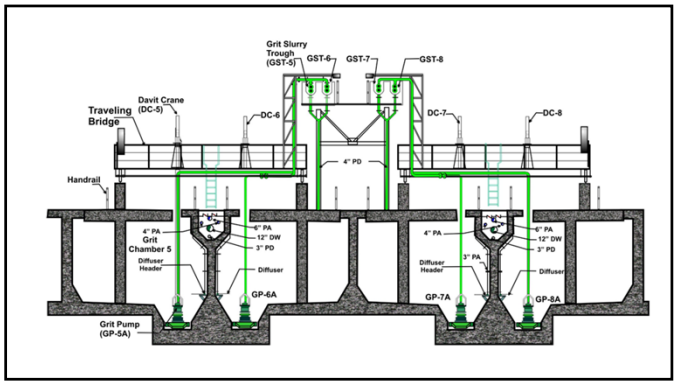
Grit Size

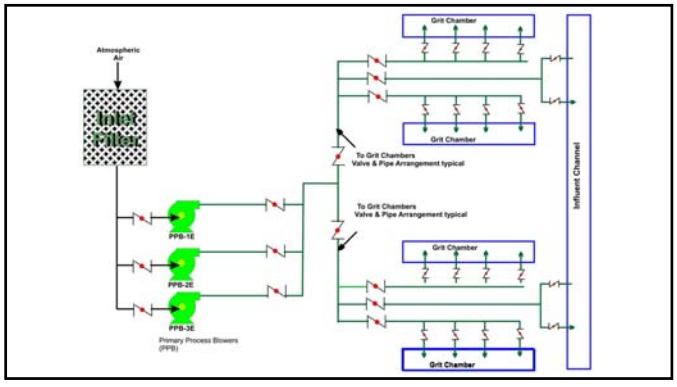
- **Mesh values** correlate to the scale of measuring pan screens that sieve collected grit samples
- Increasing mesh values translates into smaller grit particle diameters
- Another unit of measure applied for grit particle sizing is microns
- Typically 50 mesh particles convert nominally to 300 microns while 100 mesh particles, which are smaller, are nominally 150 microns

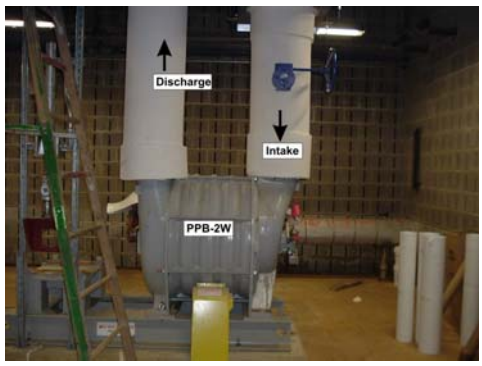
Grit Removal – Pista Grit w/ air lift

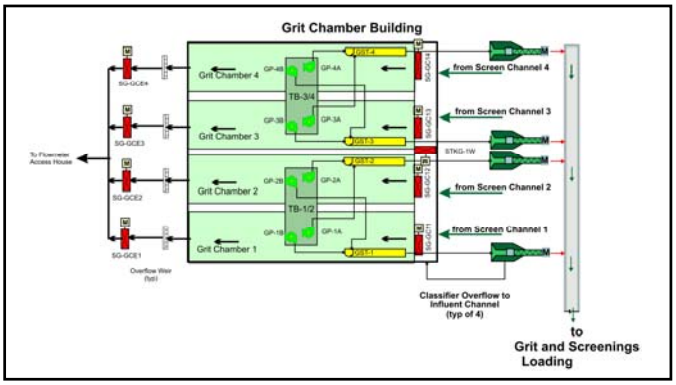
Grit Removal – Traveling Bridge


Grit Pump Discharge
Divot Cranes
Grit Pump Discharge
Traveling Bridge


Grit Slurry Trough (GST-5)
GST-6
GST-7
GST-8
Traveling Bridge
Davit Crane (DC-5)
DC-6
DC-7
DC-8
4" PD
Handrail
4" PA
Grit Chamber 5
6" PA
12" DW
3" PD
Diffuser Header
Diffuser
GP-6A
GP-7A
GP-8A
Grit Pump (GP-5A)

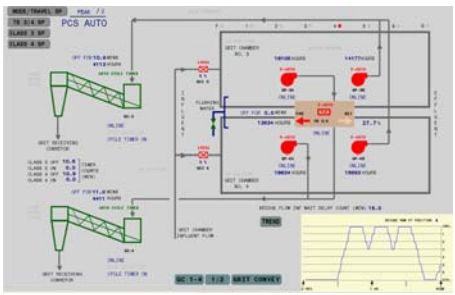

Atmospheric Air
Inlet Filter
PPB-1E
PPB-2E
PPB-3E
Primary Process Blowers (PPB)
Grit Chamber
To Grit Chambers Valve & Pipe Arrangement typical
Influent Channel





Grit Removal – Classifier

Grit Removal – Traveling Bridge – PCS Control



Math Example

- Grit removed
- Assumptions:
  - Q = 45 MGD
  - Grit removed daily = 65 ft^3
  - Unknown: Grit removed in **ft^3 per MG**.

Answer: 65 ft^3/day ÷ 45 MGD = 1.4 ft^3/MG

Math Example

- Grit removed
- Assumptions:
  - Q = 35 mgd
  - Grit removed daily = 55 ft^3
  - Specific gravity of grit = 2.6
  - Unknown: **Pounds per day** of grit removed

Answer:

55 ft^3/day x 2.6 x 8.34 lbs/gal x 7.48 gals/ft^3 = 8,921 lbs/day

Chemicals Applied in Treatment

Application	Chemical Name
Pretreatment - Odor	Granular Activated Carbon
Pretreatment - Oxidation	Chlorine
	Chlorine Dioxide
	Ozone
	Potassium Permanganate
	Sodium Hypochlorite
	Sodium Permanganate

Gases

- Chlorine
  - Gas (Cl_2) or liquid bleach
  - Extremely toxic
  - Very irritating to skin, eyes, and mucous membranes
  - Cl_2 gas can cause death by asphyxiation
  - Breathing equipment should be readily available

Gases

- H_2S – Hydrogen sulfide
  - Gaseous
  - Rotten egg odor – old or septic sewage
  - Can dull your senses (olfactory fatigue)
  - Combines with oxygen to form sulfuric acid, which can dissolve concrete
  - Too much can cause respiratory irritation

Gases

- Carbon Dioxide (CO_2)
  - Odorless, tasteless
  - Heavy concentrations can cause death due to oxygen deprivation
- Gasoline vapors
  - Can cause fires and explosions in lift stations
  - Lift stations require proper ventalation

Flow Equalization

Flow Equalization

What are other options or measures to use for Flow Equalization?

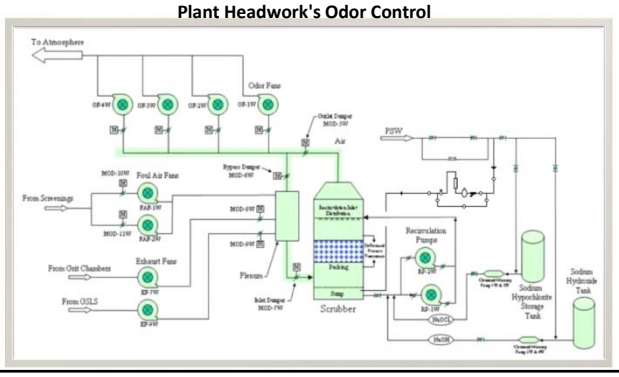
Odor Control

Odor Control

- Minimize release of hydrogen sulfide (H_2S) from channels and tanks
- Remove screenings, grit, sludge, and scum daily
- Hose down/clean/flush channels and tanks when taken out of service
- Wash down all spills and grease coatings
- Check odor scrubbers for malfunctions
- If wastewater is septic, add chemicals
  - Chlorine
  - Permanganate

Plant Headwork's Odor Control – Single Stage

Plant Headwork's Odor Control

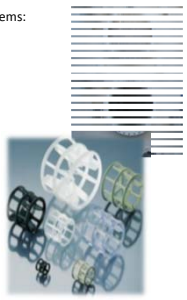


Plant Headwork's Odor Control

SYSTEM COMPONENTS

The odor control system is comprised of the following subsystems:

- Foul Air Supply
- Scrubber & Instrumentation
- Recirculation & Makeup Water System
- Chemical Storage
- Chemical Feed
- Portable Sump Pump (used only to remove chemicals accumulated in containment area)
- Acid Wash Pump (*used for cleaning media*)
- Chemical/Electrical Room HVAC
- Power Supply
- Emergency Eyewash/Showers



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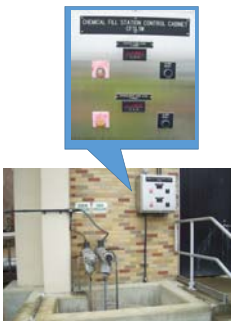
Plant Headwork's Odor Control

Chemical Unloading Station



Plant Headwork's Odor Control

Chemical Safety for Sodium Hydroxide

OVERVIEW

Sodium Hydroxide (NaOH), also known as caustic soda, is used to raise the pH of the scrubbing liquid which cause hydrogen sulfide to exist in soluble state, dissolved sulfides.

Sodium hydroxide is a corrosive nonflammable clear odorous liquid that has a pH of 14. It is rated to be completely soluble in water and has a specific gravity of 1.275.1

This product reacts violently with water, generating a large amount of heat. If the chemical is added to fast it can accumulate at the bottom of the tank, where excess heat may be generated and boiling occurs with splattering results. This chemical can react explosively with acids, aldehydes and organic compounds.

Sodium Hydroxide NFPA Chemical Hazard Label

Plant Headwork's Odor Control

Chemical Safety for Sodium Hypochlorite

OVERVIEW

Sodium Hypochlorite (NaOCl) is used as an oxidizing agent, which assists in removal of sulfides.

The ORP measurement provides an indication that enough hypochlorite has been added.

Sodium hypochlorite is a nonflammable yellow-green corrosive liquid that has a pH between 12.5 to 13.5. It is rated to be completely soluble in water and has a specific gravity of 1.224.1

Sodium Hypochlorite NFPA Chemical Hazard Label

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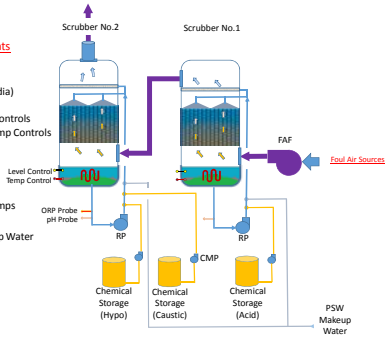
Two Stage Odor Control System

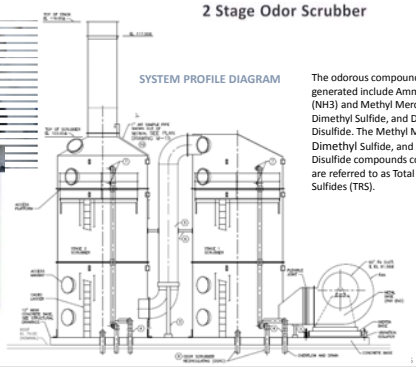
System Components

1. Odor Scrubbers
2. Foul Air Fan (airflow)
3. Scrubbers Packing (media)
4. Scrubber Sump
5. Scrubber Sump Level Controls
6. Scrubber Heaters & Temp Controls
7. Recirculation Pumping
8. Spray Nozzles
9. Mist Eliminator
10. Chemical Storage
11. Chemical Metering Pumps
12. pH & ORP Probes
13. Scrubber Sump Makeup Water



2 Stage Odor Scrubber

SYSTEM PROFILE DIAGRAM



The odorous compounds generated include Ammonia (NH3) and Methyl Mercaptan, Dimethyl Sulfide, and Dimethyl Disulfide. The Methyl Mercaptan, Dimethyl Sulfide, and Dimethyl Disulfide compounds collectively are referred to as Total Reduced Sulfides (TRS).

2 Stage Odor Scrubber

SYSTEM OVERVIEW

First Stage

Scrubber No.1

- Scrubber 1 is used to remove ammonia from the foul air.
- The foul air is blown in through the bottom of the scrubber and recirculated water is discharged at the top.
- Ammonia is transferred from the air to the water at the surface of the water droplets.
- Spraying the water over the media increases the surface area of water that comes in contact with foul air and improves the ammonia transfer.

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2 Stage Odor Scrubber

SYSTEM OVERVIEW

Scrubber No.1

- Maintaining a low pH in the recirculation water helps transfer ammonia from the foul air to the water [chemistry at low pH favors ionized form in the water solution (NH_4^+)], thus increasing ammonia removal.
- Adding sulfuric acid lowers the pH.
- Sulfuric acid also combines with NH_4^+ to produce ammonium sulfate $(NH_4)_2SO_4$.
- The ammonium sulfate is removed from the system via the scrubber overflow (fresh PSW is continuously added to the system to maintain sump level).
- A pH setpoint of 2 ensures that the correct pH condition is maintained and that sufficient H_2SO_4 is available for the chemical reaction.

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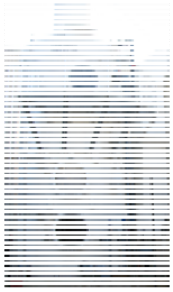
2 Stage Odor Scrubber

SYSTEM OVERVIEW

Scrubber No.2



Second Stage

- Scrubber 2 is used to remove reduced sulfide compounds from the foul air.
- The partially treated air from Scrubber 1 is directed to the bottom of Scrubber 2 and a separate supply of recirculated water is discharged at the top.
- Hydrogen Sulfide is transferred from the air to the water at the surface of the water droplets.
- Spraying the water over the media increases the surface area of water that comes in contact with the foul air and improves the transfer of Hydrogen Sulfide and other reduced sulfur compounds.
- Maintaining a high pH in the recirculation water helps transfer the Hydrogen Sulfide from the foul air to the water as dissolved sulfides [*The raised pH of about 9.5 favors absorption of sulfides into the water solution. But if pH is too high, calcium carbonate scaling may occur on the media*].

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2 Stage Odor Scrubber

SYSTEM OVERVIEW

Scrubber No.2

- The elevated pH causes the sulfides to be released from the hydrogen atoms and return to solution form. Raising the ORP of the scrubbing liquid with sodium hypochlorite provides oxidation of the dissolved sulfides to elemental sulfur (this means that it changes the oxidation state of the sulfur in these compounds such that the sulfur loses electrons). Sodium hypochlorite and dissolved sulfides combine to form Na_2SO_4 (Sodium Sulfate), NaCl (Sodium Chloride) and water.
- The Na_2SO_4 is removed from the system via the scrubber overflow (fresh PSW added continuously to system to maintain sump level).
- The pH setpoint of 9.5 ensures that the correct pH condition is maintained and that sufficient alkalinity is available for the chemical reactions. The ORP setpoint of 600 mV ensures that sufficient sodium hypochlorite is available for oxidation/removal of the sulfides in solution.

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2 Stage Odor Scrubber

Scrubbers (1 & 2)

Function

- Foul air is passed through the two scrubbers via the foul air fan. Each scrubber consists of a cylindrical vessel with filter media above a sump. The sump captures the spray water injected at the top of the media while the foul air enters at the bottom of the media and exhausts at the top, countercurrent to the spray.
- The scrubber sump capacity is the water supply for the recirculation pumping system. A sump heater maintains liquid temperature (freeze protection).
- PSW make-up water is supplied through a rotometer and a flow control valve that is manually adjusted to match the expected evaporation and provide a continuous overflow rate from the scrubber sump.
- A Low Sump Level signal triggers the opening of a solenoid valve located in the make-up water manifold that provides a rapid fill of the sump under this condition.

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2 Stage Odor Scrubber

Component Description

Scrubbers (1 & 2)

Type: Vertical Packed Bed Odor Control Scrubber, 12' diameter by 26'.6" height
Media: 2" RVPT Hi-Flow Polypropylene packing media. Minimum 10' bed depth per tower.

The estimated clean packing media pressure drop is 1.0" WC.

Maximum working pressure is 5" WC.

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Odor Scrubber

Component Description

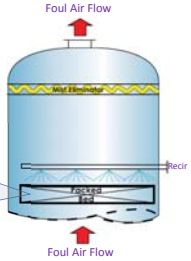
Scrubbers (1 & 2)

Packing Bed Media

The packing material provides increased surface area and detention time for contact between odorous gases and the chemical solution. The gases are up flowing through the media and the chemical solution is down flowing over the media creating large contact areas for odor scrubbing

Packing Information

Packing Type	Hiflow Rings 50-6
Material	Thermoplastic
Nominal Size	2 inch
Weight	3.04 lb/ft³
Surface Area	27.4 ft²/ft³



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Odor Scrubber

Component Description

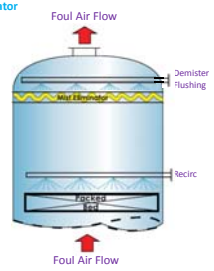
Scrubbers (1 & 2)

Mist Eliminator

A mist eliminator, also called a "demister," is used to eliminate extraneous fluid particles from the flow of vapor.

The mist eliminator captures water droplets as they flow in a vapor. These obstacles along the path of flow cause a drop in pressure, drawing moisture to a collection area.

Mist eliminators help reduce droplet emissions to environmentally acceptable levels.



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Odor Scrubber

Component Description

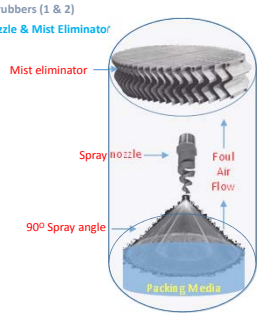
Scrubbers (1 & 2)

Spray nozzle & Mist Eliminator

Spray nozzle features:
- High discharge velocity
- Clog resistant
- Full cone

Spray nozzle characteristics:
- Fine atomization
- Spray angles (90° & 150°)

Mist Eliminator:
- Polypropylene



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Odor Scrubber

SCRUBBER INSTRUMENTATION

Scrubber pH and ORP Analyzing Sensors

- The function of the pH and ORP sensors is to analyze the recirculation water. Contaminants in the foul air captured by the water affect the acidity and oxidation reduction potential of the water.
- The sensors continuously measure pH and ORP levels of the scrubber sump liquid and communicates these values to the sensors controller.
- The controller compares setpoint to actual values and controls start/stop of chemical metering pumps for chemical application to maintain desired pH level and oxidation reduction potential.

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Odor Scrubber

SCRUBBER INSTRUMENTATION

- Scrubber No.1 & No.2 Sump Liquid pH Sensors
- Scrubber No.1 Sump Liquid pH Transmitters
- Scrubber No.2 Sump Liquid ORP & pH Transmitters

HACH, sc200 controller converts the measured pH/ORP value of the sensor to an 4-20 milliamp analog signal. The signal from these transmitters control the H_2SO_4 & NaOH chemical metering pumps.

pH Controller located by the recirculation pumps

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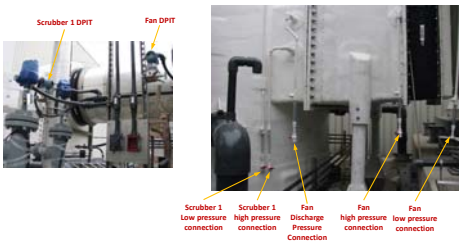
2 Stage Odor Scrubber

SCRUBBER INSTRUMENTATION

Foul Air Fan Differential Pressure Transmitters

Scrubber 1 & 2 Differential Pressure Transmitters



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Odor Scrubber

SCRUBBER INSTRUMENTATION

Scrubber 1 & 2 Differential Pressure Transmitters

Scrubber DPIT devices measure the pressure drop across the packing media at a range of 0-10" WC with a maximum working pressure set point of 5" WC. A high pressure drop indicates fouling of the media.

As packing media fouls the foul air fan can be adversely affected. The Fan DPIT device measures the differential pressure drop between the fan suction & discharge at a range of 0-20" WC with a maximum working pressure of 17" WC. As scrubber differential pressure increases so will fan differential.

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Odor Scrubber

SCRUBBER INSTRUMENTATION

Scrubber Sump Temperature Transmitters

These devices measure the temperature of sump The signal is transmitted to the PCS and controls the sump heating elements.

The sump heaters are set to maintain the liquid temperature between 50-55 °F.

The thermostat is adjustable from 0-100 °F

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Odor Scrubber

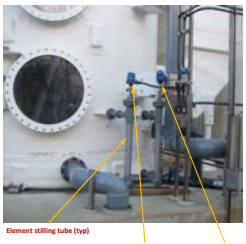
SCRUBBER INSTRUMENTATION

Scrubber Sump Level Transmitters

These devices measure the liquid level in each scrubbers sump and controls the PSW solenoid valve at each scrubber makeup water manifold.

A scrubber sump capacity is achieved based on scrubber diameter and the normal operating range in the sump is between 21-24 inches.

- Low level alarm
- High level alarm



Interlocks
- Sump high level - closes make-up water solenoid valve (hardwired)
- Sump low level opens make-up water solenoid valve (software)

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2 Stage Odor Scrubber

Recirculation Pumps

Function

The function of the recirculation pumps is to recycle the water in the scrubber sumps by drawing the water directly from the scrubber sumps and pumping it to the spray headers above the scrubber media to "wash" the foul air as it is flows upward through the media. The recirculation pumps operate continuously and are controlled through the Process Control System.

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2 Stage Odor Scrubber

MAKE-UP WATER

Function

- PSW makeup water is used to maintain a target level in the scrubber sump and also helps waste the dissolved sulfides from the Hydrogen Sulfide out through the sump overflow.
- A Rotometer with adjustable valve controls PSW flow into the scrubber sump between 0-10 gpm.
- PSW flow to each scrubber is measured through a magnetic type flow meter.
- Typical makeup water flow is ~ 2 - 3 gpm. This flow needs to include water lost to the air + overflow.
- A make-up water solenoid valve will open on sump low level to recover sump level faster. The valve closes when the level has recovered.

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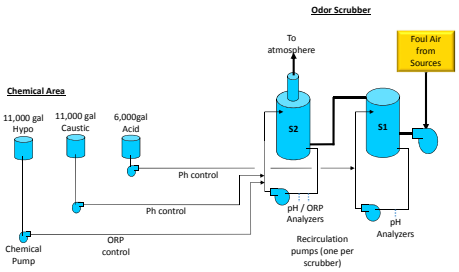
2 Stage Odor Scrubber

Chemical Application Schematic



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2 Stage Odor Scrubber

Chemical Unloading Stations

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2 Stage Odor Scrubber

Chemical Safety for Sodium Hydroxide

OVERVIEW

Sodium Hydroxide (NaOH), also known as caustic soda, is used to raise the pH of the scrubbing liquid which cause hydrogen sulfide to exist in soluble state, dissolved sulfides.

Sodium hydroxide is a corrosive nonflammable clear odorous liquid that has a pH of 14. It is rated to be completely soluble in water and has a specific gravity of 1.275.1

This product reacts violently with water, generating a large amount of heat. If the chemical is added to fast it can accumulate at the bottom of the tank, where excess heat may be generated and boiling occurs with splattering results. This chemical can react explosively with acids, aldehydes and organic compounds.

Sodium Hydroxide NFPA Chemical Hazard Label

2 Stage Odor Scrubber

Chemical Safety for Sodium Hypochlorite

OVERVIEW

Sodium Hypochlorite (NaOCl) is used as an oxidizing agent, which assists in removal of sulfides.

The ORP measurement provides an indication that enough hypochlorite has been added.

Sodium hypochlorite is a nonflammable yellow-green corrosive liquid that has a pH between 12.5 to 13.5. It is rated to be completely soluble in water and has a specific gravity of 1.224.1

Sodium Hypochlorite NFPA Chemical Hazard Label

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2 Stage Odor Scrubber

Chemical Safety for Sulfuric Acid

OVERVIEW

The Sulfuric Acid (H_2SO_4) feed pump serves to adjust the pH of the chemical solution in Odor Scrubber No.1 by driving the pH down, thereby maintaining a pH value of 2.0.

• This product is a clear corrosive solution and can be damaging to unprotected tissue.

• Ingestion or inhalation of large quantities can be fatal.

• This product may decompose to produce a variety of compounds (i.e. carbon monoxide, carbon dioxide and oxides of sulfur).

• Emergency responders must wear the proper personal protective equipment suitable for the situation to which they are responding.

•Mixing Sulfuric Acid with either Caustic or Hypochlorite will create a potential for severe personal hazard and environmental and equipment damage.

Sulfuric Acid NFPA Chemical Hazard Label

Types of Hazards		Hazard Rating
BLUE	= Health Hazard	0 = Minimal
RED	= Fire Hazard	1 = Slight
YELLOW	= Reactivity	2 = Moderate
WHITE	= Specific Hazard	3 = Serious
		4 = Severe

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Packed Media Odor Control

Inspecting and Cleaning The Scrubber Packing

- It is particularly important to control the buildup of mineral scale and/or biological growth on the scrubbers internal packing surface.
- The tendency of the packing to foul depends on the pH and mineral content of the PSW, and on climatic conditions.
- The differential pressure (ΔP) drop across the packed section should be check monthly. Fouling of the packing will cause a gradual increase in the ΔP.
- Whenever ΔP creeps up to twice its initial value, the scrubber must be shut down and packing cleaned.
- Mineral scale, caused by precipitation of iron and manganese oxides or calcium and magnesium carbonates from the hardness of the PSW, can be removed by washing the packing with muriatic acid (hydrochloric acid [HCl]).
- Algae growth can be removed by washing packing with caustic solutions of bleach (sodium hypochlorite).
- Sometimes fouling deposits include both inorganic and organic matter. When in doubt, a simple lab test with a few pieces of fouled packing can identify the most effective cleaning agent.

Packed Media Odor Control

Inspecting and Cleaning Scrubber Packing

To dissolve mineral scale without removing the packing from the scrubber the following procedure can be used.

1. Drain desired scrubber sump and fill with a dilute muriatic acid (3% HCl). With the system exhaust fan OFF, recirculate the acid solution over the packing and check the pH of the acid solution once an hour.
2. If the pH rises above 4, then the acid solution has been exhausted. If so, drain the sump, refill sump with a fresh 3% acid solution and repeat the process.
3. If the pH remains <4 after 3 hours, then the packing should be clean.
4. Drain the acid solution from the sump, neutralize and dispose of the spent acid solution and rinse the packing with fresh PSW.
5. Place the scrubber back in operation.

To remove algae growth from the packing use a 2% to 3% sodium hypochlorite solution and perform the same procedure used for mineral scale removal.

SAFETY NOTE: Under **NO** circumstances should any **ACID** be used **WITH SODIUM HYPOCHLORITE**.

Packed Media Odor Control

Inspecting and Cleaning Scrubber Packing

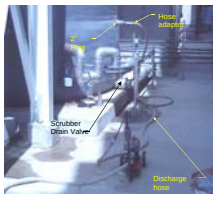


Photo 1

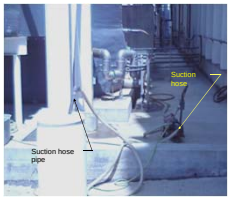
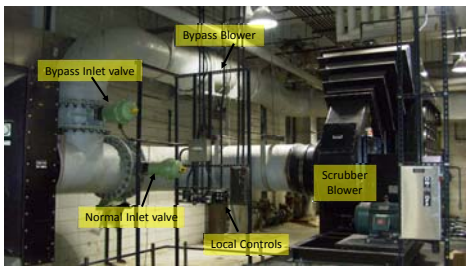


Photo 2

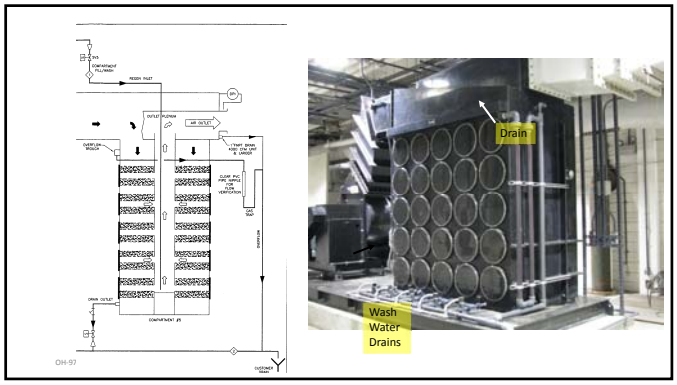
- The odor scrubber is a carbon regeneration type
- consists of 10 chambers, with each chamber containing 10 carbon canisters (total 100).
- Odorous air coming in contact with the carbon is stripped of hydrogen sulfide, and other odor odorous compounds.
- Forms weak sulfuric acid that is trapped in the carbon.
- Over time the carbon becomes saturated with this acid
- When it does it is automatically regenerated using water to wash the acid from the carbon.

OH-95

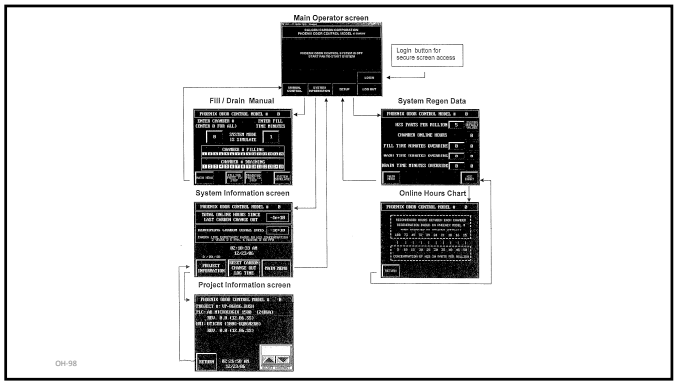
'O' Street Pumping Station



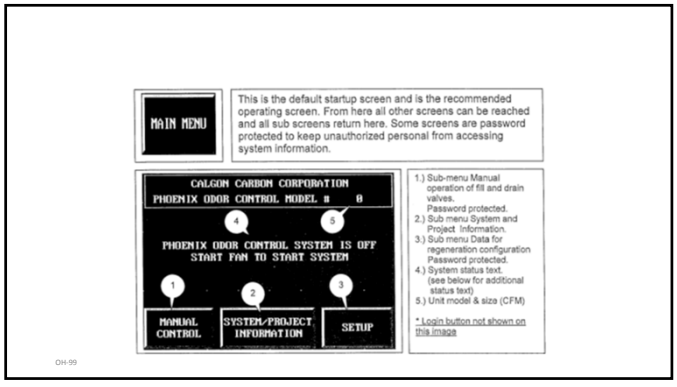
OH-96



OH-97



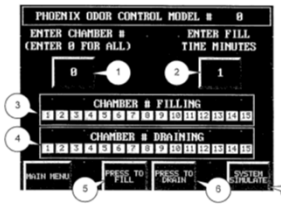
OH-98



OH-99

MANUAL CONTROL

All chamber fill and drain valves are manually operated from this screen. This screen is intended primarily for field service and maintenance.
This screen is password protected.

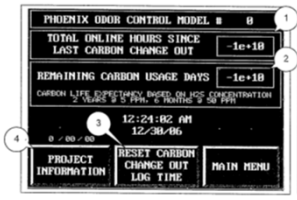


1.) Entry field for fill and drain valve open/close control selection.
2.) Maximum fill valve open time entry field.
3.) Indicator for which fill valve is on, blinking indicates valve on.
4.) Indicator for which drain valve is on, blinking indicates valve on.
5.) Fill valve open\close control button.
6.) Drain valve open\close control button.
7.) Calgon field service only.

OH-100

SYSTEM/PROJECT INFORMATION

This screen displays the carbon canisters usage and remaining life expectancy as well as the reset button for that data. The button to access project information is also found here.

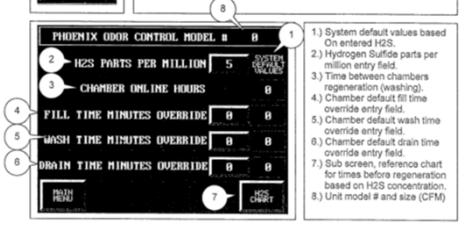


1.) Hours carbon canisters have been in use.
2.) Calculated life of carbon canisters remaining.
3.) Button to reset the hours carbon canisters have been in use.
4.) Sub screen, information about this system.

OH-101

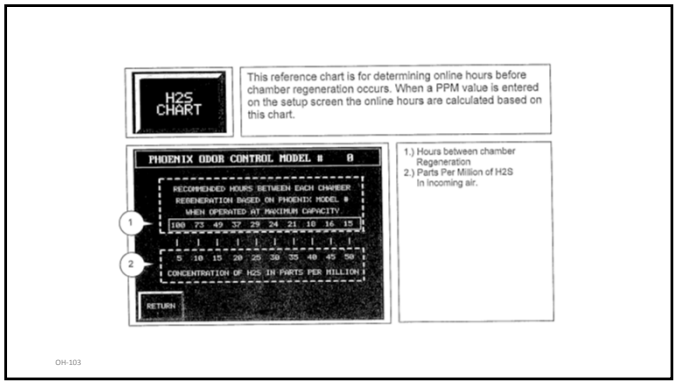
SETUP

This screen shows the Phoenix™ unit size, current selected H2S concentration in PPM, system default operating values for fill, wash & drain for the given unit size and H2S concentration and the override timer values if used.



1.) System default values based On entered H2S.
2.) Hydrogen Sulfide parts per million entry field.
3.) Time between chambers regeneration (washing).
4.) Chamber default fill time override entry field.
5.) Chamber default wash time override entry field.
6.) Chamber default drain time override entry field.
7.) Sub screen, reference chart for times before regeneration based on H2S concentration.
8.) Unit model # and size (CFM)

OH-102


H2S CHART
This reference chart is for determining online hours before chamber regeneration occurs. When a PPM value is entered on the setup screen the online hours are calculated based on this chart.
PHOENIX ODOR CONTROL MODEL # 8
RECOMMENDED HOURS BETWEEN EACH CHAMBER REGENERATION BASED ON PHOENIX MODEL # WHEN OPERATED AT MAXIMUM CAPACITY
100 73 49 37 29 24 21 18 16 15
5 10 15 20 25 30 35 40 45 50
CONCENTRATION OF H2S IN PARTS PER MILLION
RETURN
1
2
1.) Hours between chamber Regeneration
2.) Parts Per Million of H2S In incoming air.
OH-103