



NC-PC Industry Day Pretreatment 101

Industrial Waste Impacts on POTW Treatment Processes

2025

NC-PC Industry Day

Definitions

- ✧ BOD – Amount of oxygen consumed by biological action breaking down organic matter
- ✧ NPDES – National Pollution Discharge Elimination System – Permit given to WWTP by the State & EPA governing their discharge.
- ✧ DMR – Discharge Monitoring Report – A form on which the WWTP reports to their governing body the characteristics of their discharge.
- ✧ POTW – Publicly Owned Treatment Works
- ✧ WWTP – Wastewater Treatment Plant

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Definitions

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- ✧ Collection System – The matrix of pipes and lift stations throughout a municipality that collects wastewater and delivers it to a WWTP.
 - ✧ Domestic Sewage – that which is generated and introduced to the collection system from homes.
 - ✧ Industrial Waste – That which is generated and introduced to the collection system from industrial or commercial sources.
 - ✧ Pass-Through – A pollutant that alone or in combination, exits the WWTP causing or contributing to a permit violation.
 - ✧ Interference – A pollutant that alone or in combination, disrupts or inhibits the treatment process of the WWTP.

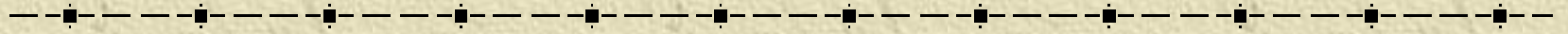
WHY IS INDUSTRY PERMITTED ??

WWTPs are designed to handle domestic sewage. Industrial waste changes those characteristics. The waste stream from an industry can vary widely depending on what the industry is doing.

Pollutant	Domestic	Industrial
BOD	250	1000
TSS	250	800
Nitrogen	40	120
Phos.	10	25

Examples of BOD in mg/l	
Coke	200,000
Antifreeze	300,000
Blood	500,000

INDUSTRY DAY



So what could happen if
discharges to the collection
system were not regulated???

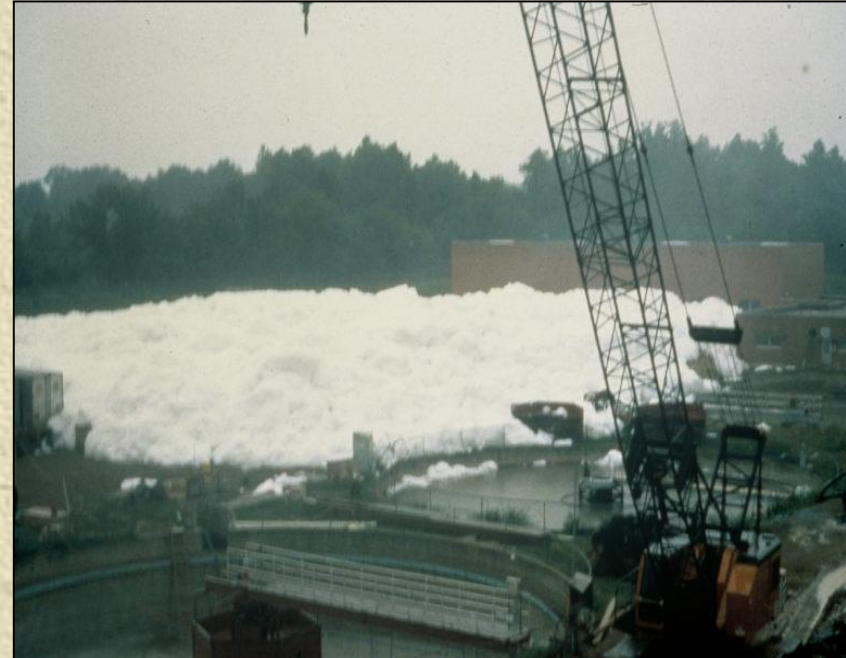
Sanitary Sewer Overflow



Corrosion of Pipes and Manholes



Plant Foaming



Environmental Foaming



Colored Water



Injury to Workers

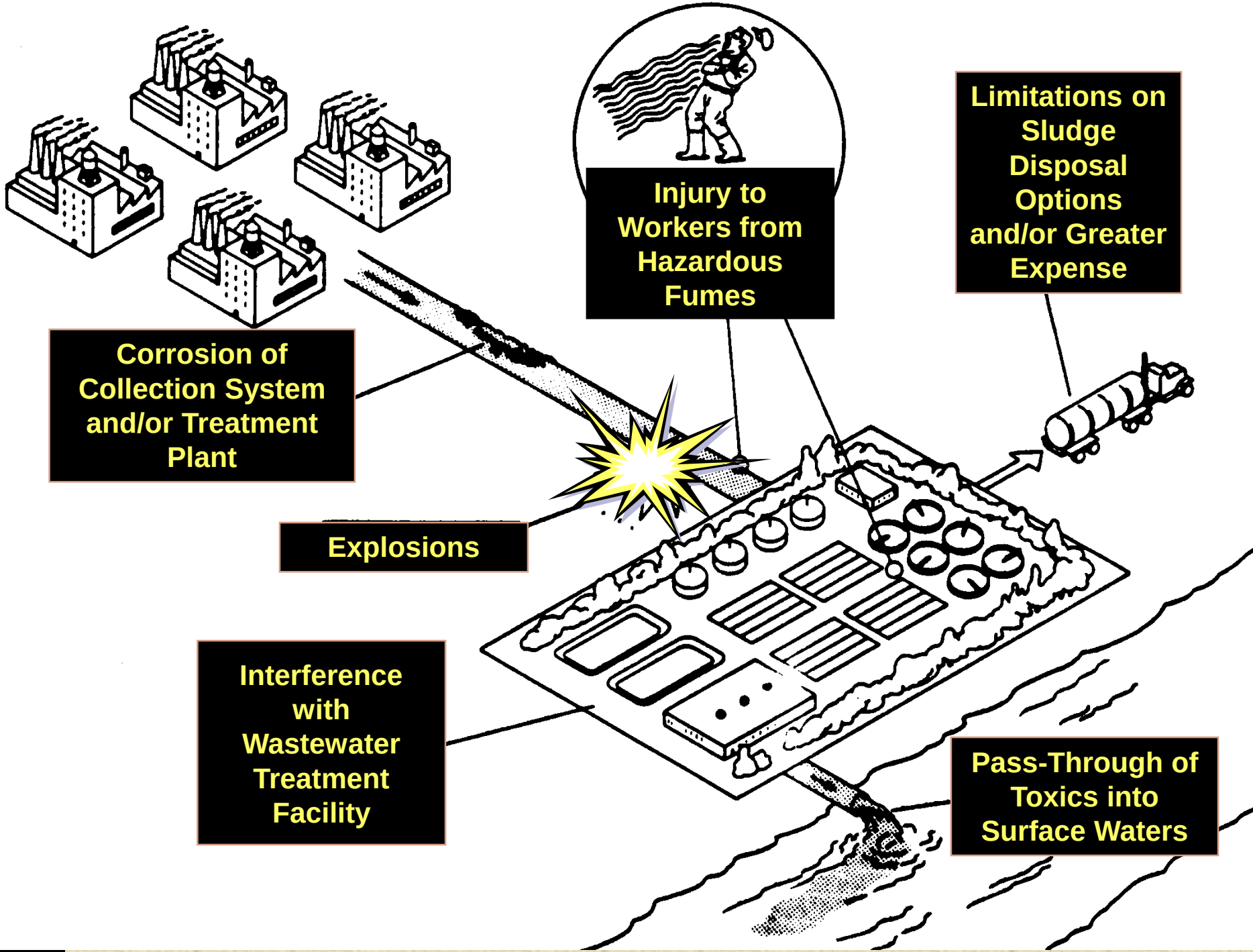


Fish Kills



Explosions

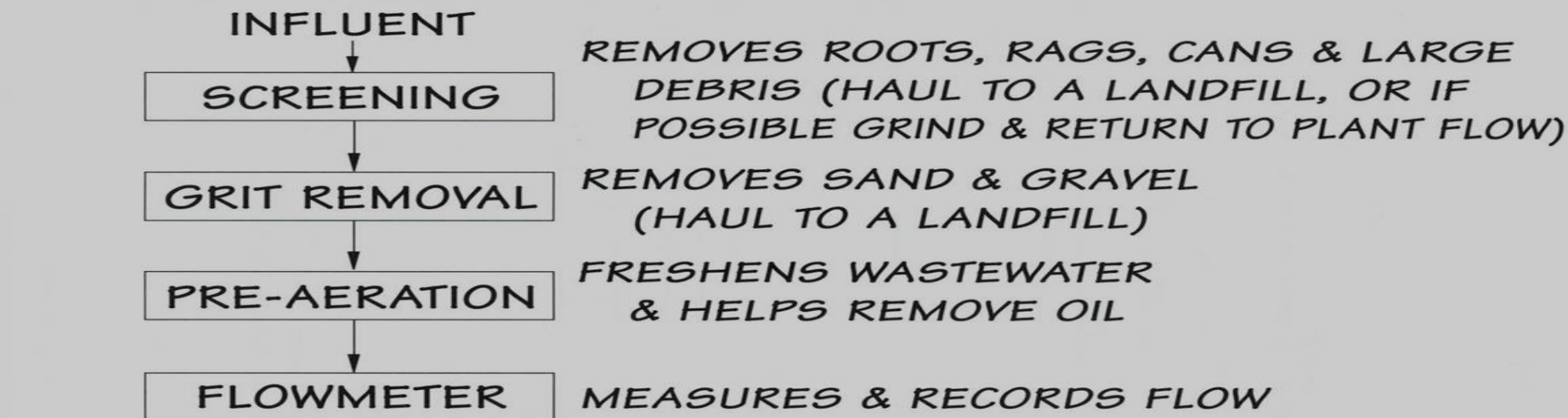




TREATMENT PROCESS

FUNCTION

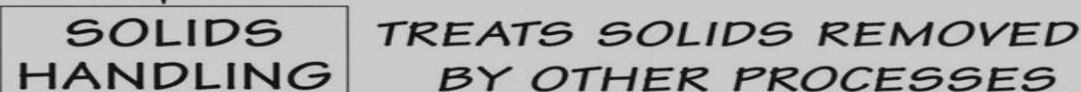
PRELIMINARY TREATMENT



PRIMARY TREATMENT

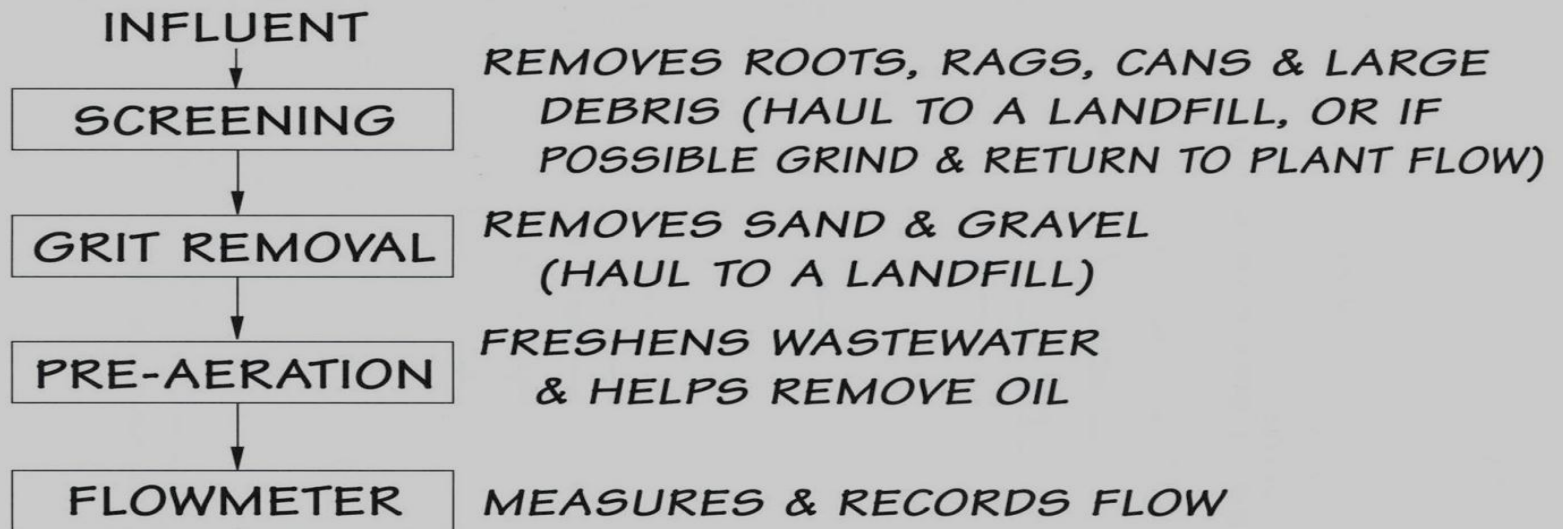


SECONDARY TREATMENT



Preliminary Treatment

PRELIMINARY TREATMENT

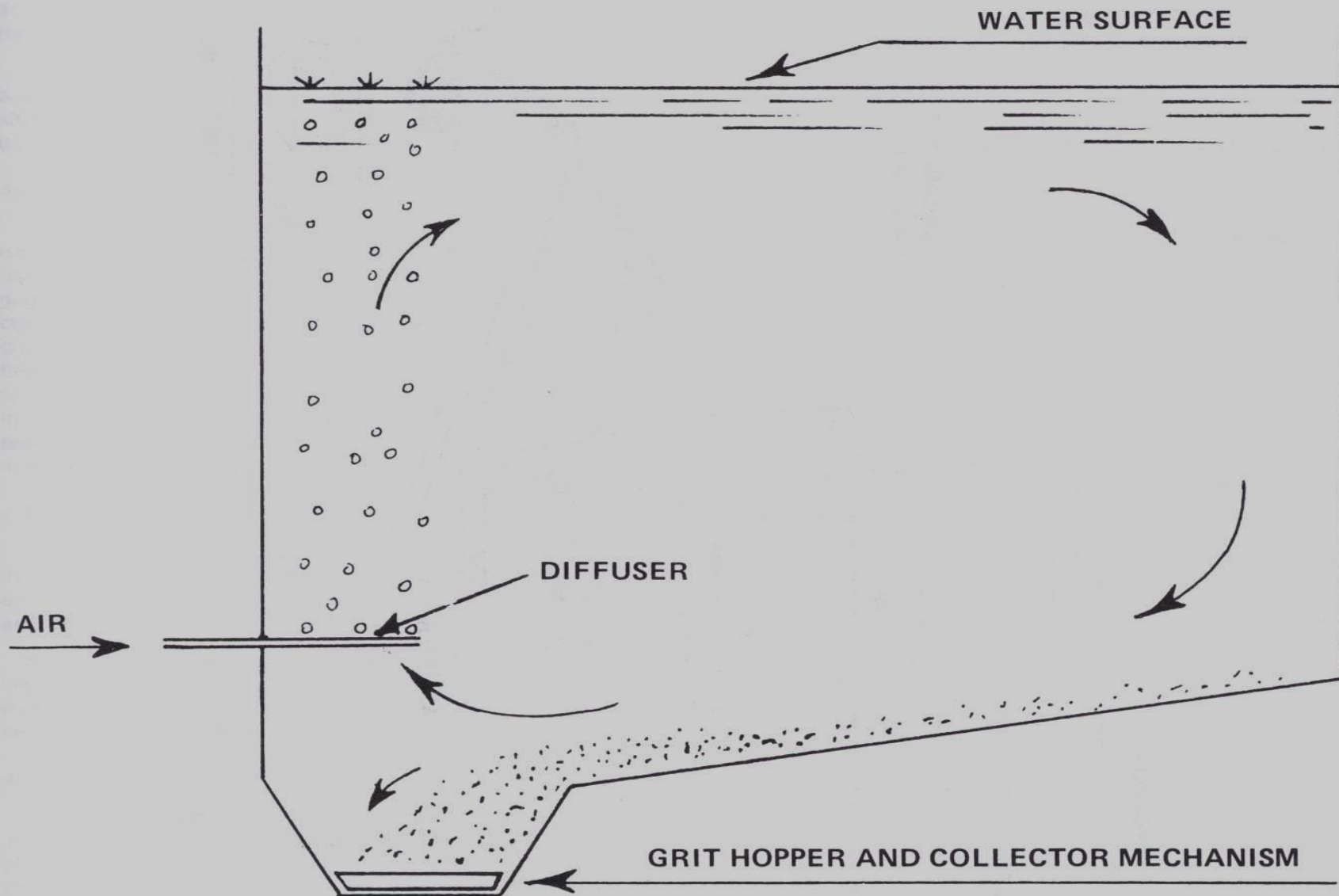


Screening



Grit Removal

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-
- ✦ Removes heavier material such as sand and silt from the wastewater
 - ✦ In typical grit removal scenarios, flow are reduced between 0.7 – 1.4 ft./sec.



NOTE:

Aerated grit chambers often have agitation air systems in the grit hopper to prevent compaction of grit when grit removal is intermittent.

Aerobic Grit Removal



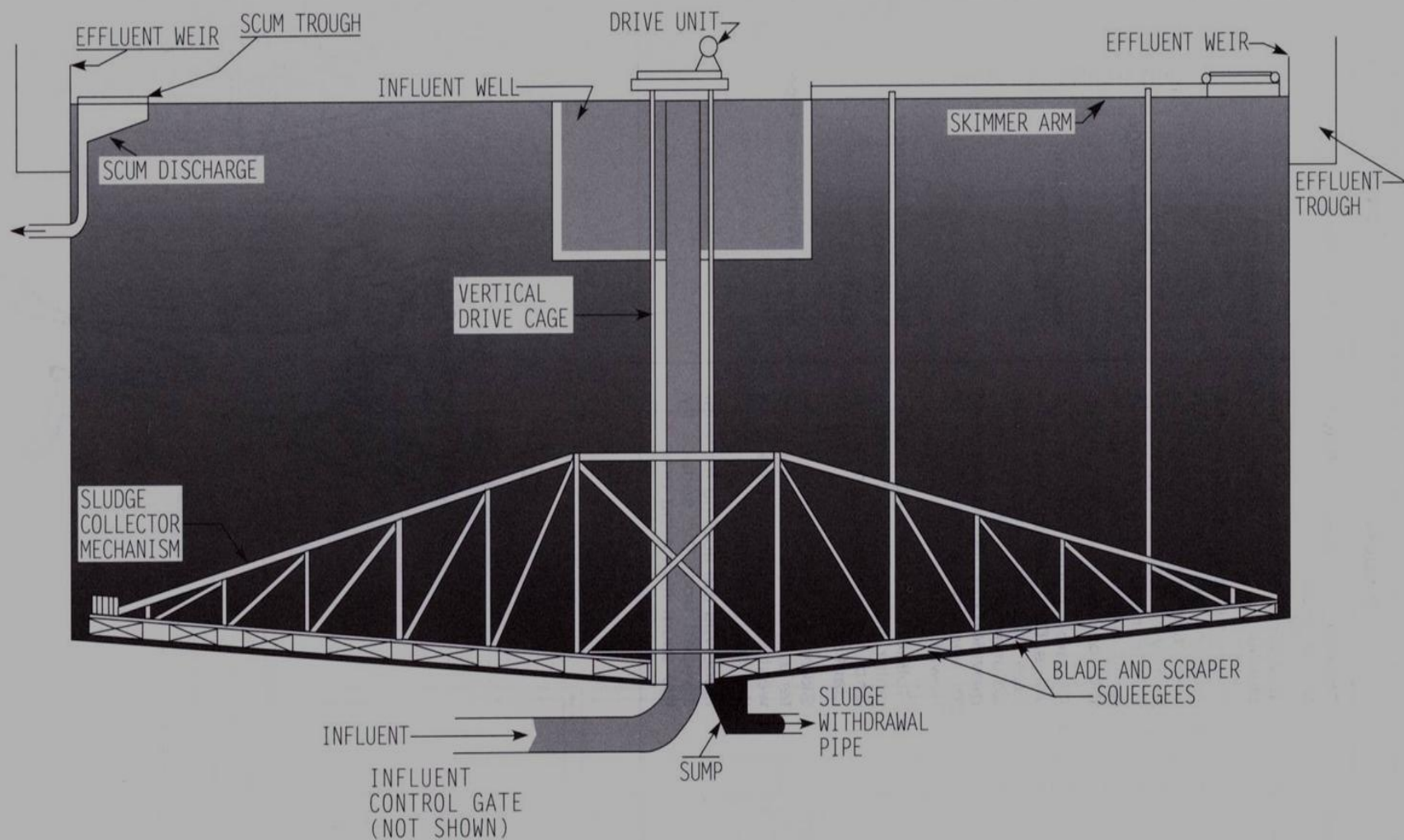
Primary Treatment

✦ SEDIMENTATION and FLOTATION

- ✦ This typically takes place in primary clarifiers
- ✦ Light material will float and be skimmed off of the top of the clarifier
- ✦ Solids settle and are removed to solids digestion and/or disposal

Adverse impacts on Primary Clarifiers

- ✦ Toxic wastes from industrial spills or dumps;
- ✦ Storm flows causing hydraulic overloads
- ✦ Septic conditions in the collection system



Side-view section of a circular clarifier with blades and scraper squeegees

Secondary Treatment

✦ Trickling Filters

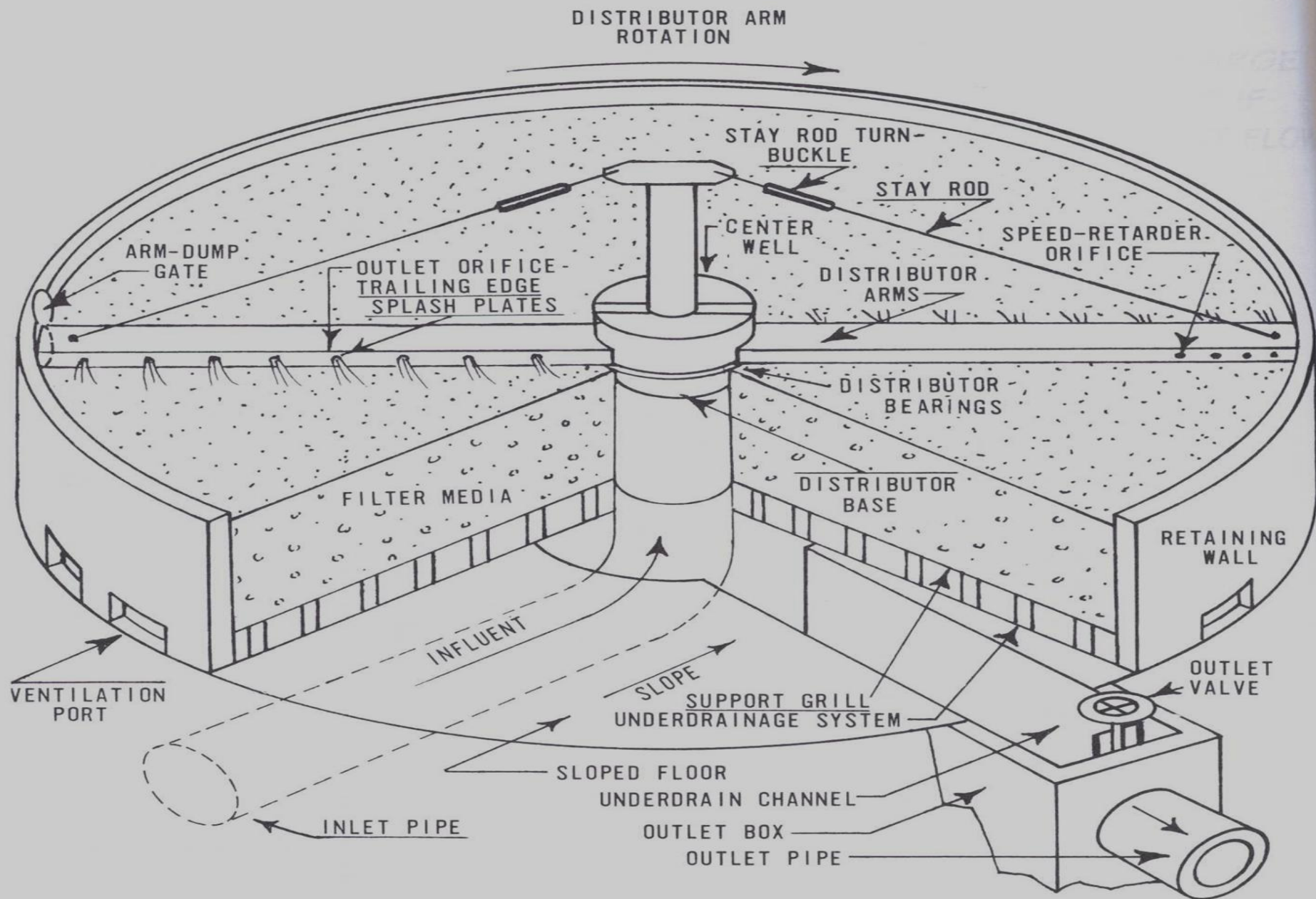
✦ Rotating Biological Contactors

✦ Activated Sludge

✦ Oxidation Ditch

Trickling Filters

- ✦ Typically large diameter cylinders
- ✦ Shallow
- ✦ Filled with some sort of media – usually stone
- ✦ Has an overhead distributor
- ✦ Highly loaded Filters are typically used with an activated sludge process.



Trickling Filter Issues

- ✦ The filter must maintain a good slime growth with adequate ventilation
- ✦ Continuous flow is imperative. Freezing and/or very cold weather will cause kill off the zooglear mass

Adverse Industrial Impacts

✦ Toxic wastewaters, i.e.

- ◆ Pesticides

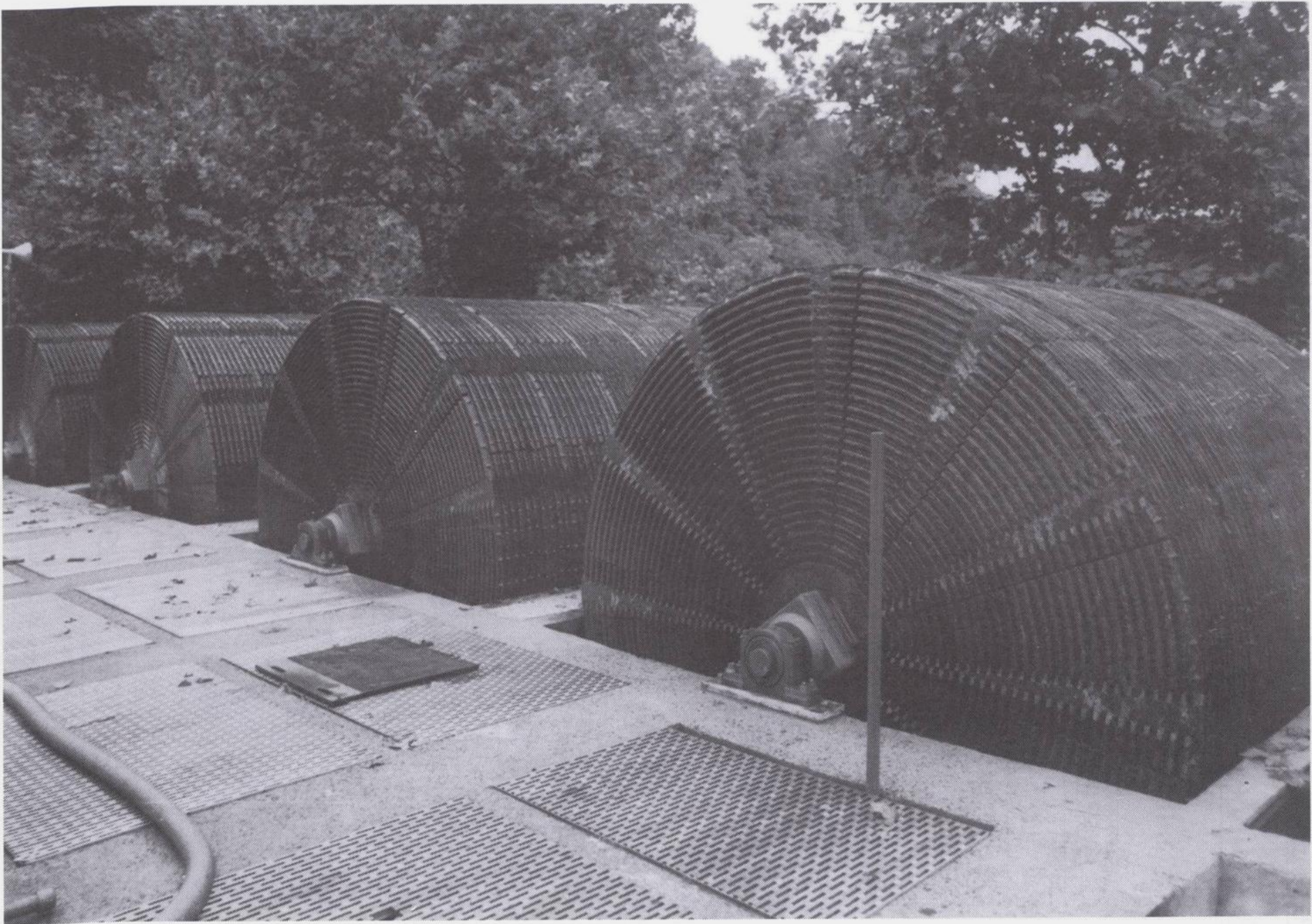
- ◆ Heavy metals

✦ Highly acidic wastewaters

✦ Highly alkaline wastewaters

Rotating Biological Contactors (RBC's)

- ✦ Like Trickling Filters – requires a slime growth (zooglear growth)
- ✦ Made of large rotating cylinders are 40% submersed in the wastewater – revolving at a rate of 1.5 RPM
- ✦ Usually in four stages, separated by a bulk head or a wall, with openings to allow flow to the next phase



Rotating biological contactors

Rotating Biological Contactors (RBC's)

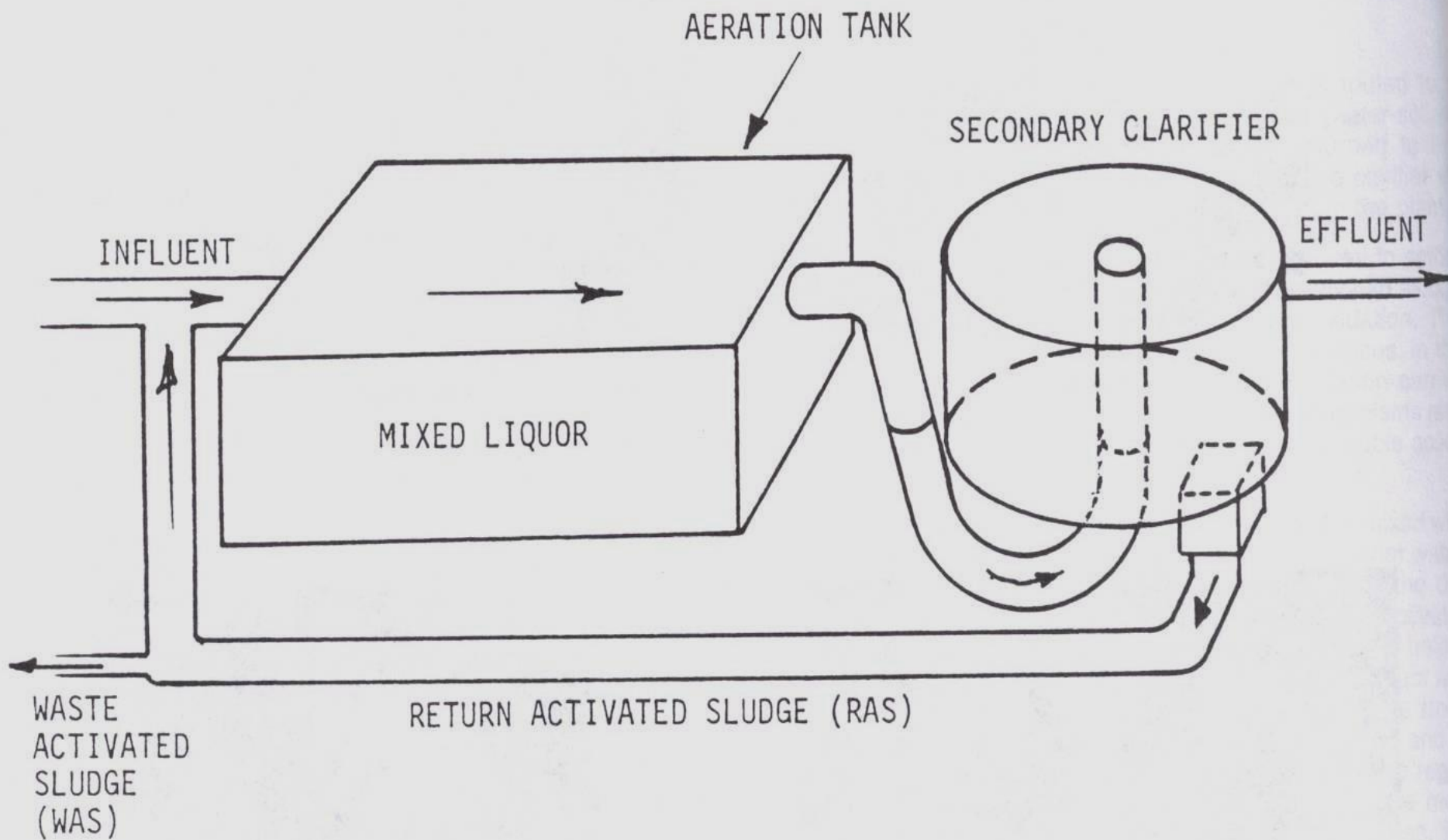
- ✦ Removes both BOD and Ammonia
- ✦ Discharge to a secondary clarifier to remove the sloughing and scum
- ✦ Ammonia is removed through nitrification

Adverse Impacts

- ✱ Reduced temperature of the wastewater
- ✱ Unusual variations in the flow or organic loading
- ✱ pH variations outside of the 6.5 – 8.5 S.U.'s range

Activated Sludge

- ✧ Biological Process
- ✧ Microorganisms are grown in a liquid – not a solid surface
- ✧ The microorganisms in the liquid are called the Mixed Liquor Volatile Suspended Solids (MLVSS)
- ✧ The solids in the aerated system are called the Mixed Liquor Suspended Solids (MLSS)
- ✧ Activated Sludge is the term for the biomass and solids that are re-circulated through this process



Activated sludge process

Aeration Systems

✧ Mechanical

- ✧ Agitates the top of the mixed liquor causing spray and waves with paddle wheels, mixers or brushes

✧ Diffused Air

- ✧ A diffuser breaks up the air stream from a blower that creates fine bubbles

Needed Operating Parameters

✧ Number of Organisms

- ✧ Usually between 10^{12} to 10^{18} /100 ml of activated sludge....bacteria...fungi....protozoa....etc

✧ Dissolved Oxygen

- ✧ Typically between 1mg/l – 3 mg/l

✧ Detention Time

- ✧ Sludge age
- ✧ Food to Microorganisms (F/M)
- ✧ Mean Cell Residence Time (MCRT)

Dissolved Oxygen (DO)

✦ Controlled by Oxygen Feed or mixer speeds

◆ If the DO is too high

- Pinpoint floc will form, carrying over the secondary clarifier

◆ If the DO is too low

- Facultative bacteria may form
- Filamentous bacteria will increase

Detention Time

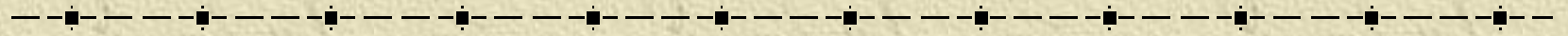
✧ Sludge Age

- ◆ Suspended solids under aeration, lbs/suspended solids added
- ◆ Typically 3.5 – 10 days

✧ Food to Microorganisms (F/M)

- ◆ Either BOD or COD lbs per day/MLVSS lbs per day
- ◆ Typically 0.5 – 1.0 lbs of COD or 0.25 – 0.50 lbs of BOD

Pollutant Removal



- ✦ BOD is removed during the first part of the aeration tanks
- ✦ Ammonia is removed next

Oxidation Ditch

- ✦ Basically an activated sludge process without primary clarification
- ✦ Ran as an extended aeration process
- ✦ Velocities in the oxidation ditch are typically 1.0' to 1.5 per second.
- ✦ High mixed liquor concentrations
 - ◆ 2,000 – 6,000 mg/l
 - ◆ As high as 6,000 – 8,000 mg/l

Oxidation Ditch



Adverse Impacts

- ✦ High concentrations of acid or bases
- ✦ Toxic chemicals
- ✦ Uneven flows
 - ◆ Hydraulic
 - ◆ Organic
- ✦ Surfactants

Secondary Clarifiers

- ✦ Used in all biological processes
- ✦ Used for solids removal from sloughing from trickling filters or RBS's
- ✦ Used to clarify and capture the activated sludge in the activated sludge process so it can be returned to the beginning of the aeration process

Disinfection

✦ Used to destroy pathogenic organisms, i.e.

- ✦ Salmonella
- ✦ Amoebic dysentery
- ✦ Hepatitis
- ✦ Cholera
- ✦ And other water borne diseases

Types of Disinfection

✦ Chlorination

✦ Ozone (O^3)

✦ Ultraviolet light (UV)

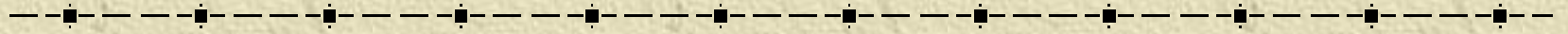
OZONE (Protoplasmic Oxidation)

- ✦ Ozone is produced when O_2 molecules collide with oxygen atoms – they go from O_2 to O_3 (ozone)
- ✦ Uses High voltage
- ✦ Very corrosive
- ✦ Very complex and expensive
- ✦ Decomposes rapidly

Chlorination

- ✦ Pathogenic organisms are more sensitive to destruction by chlorination than non-pathogenic organisms
- ✦ Wastewater organic substances are oxidized by adding chlorine gas or a highly chlorinated solution such as bleach.

Chlorine inhibition



✱ Organic material

✱ Hydrogen sulfide

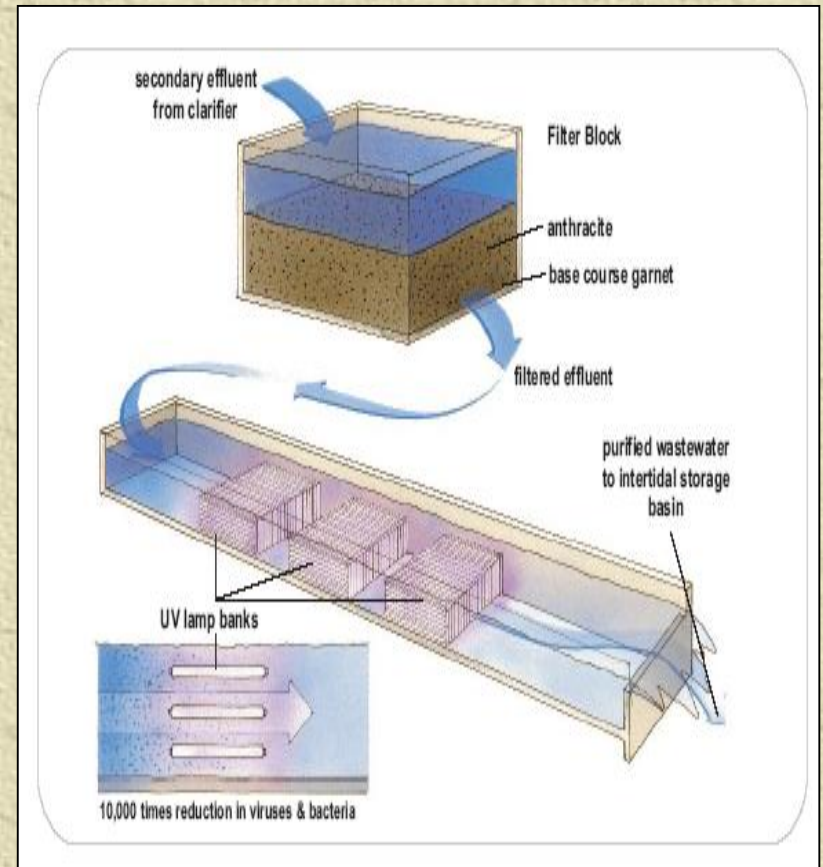
✱ Phenols

✱ Thiosulfate

✱ Ferrous iron

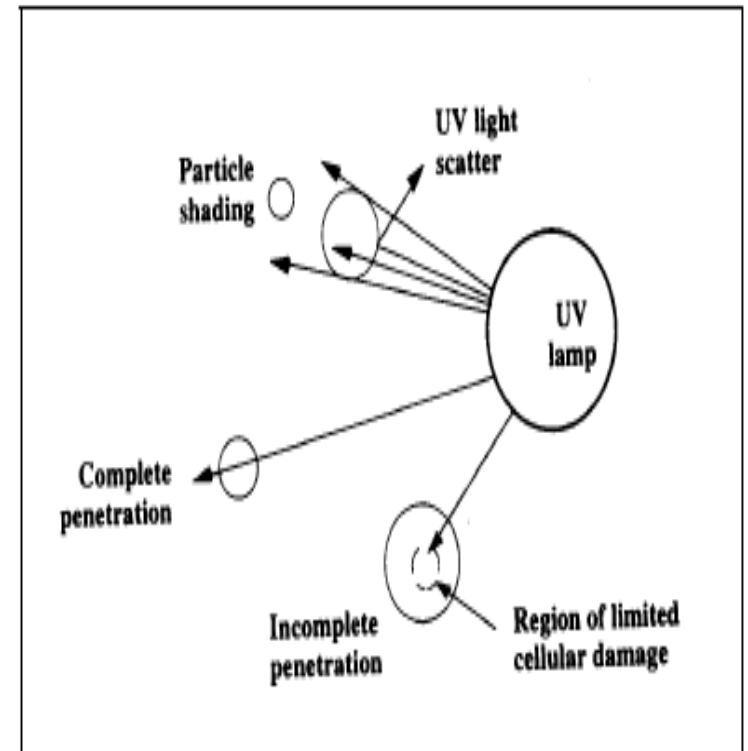
Ultraviolet (UV) Disinfection

✦ **Ultraviolet (UV) disinfection** uses the energy from a mercurial arc lamp to pierce through the cell wall of a pathogen and reach its DNA or RNA and render it unable to reproduce

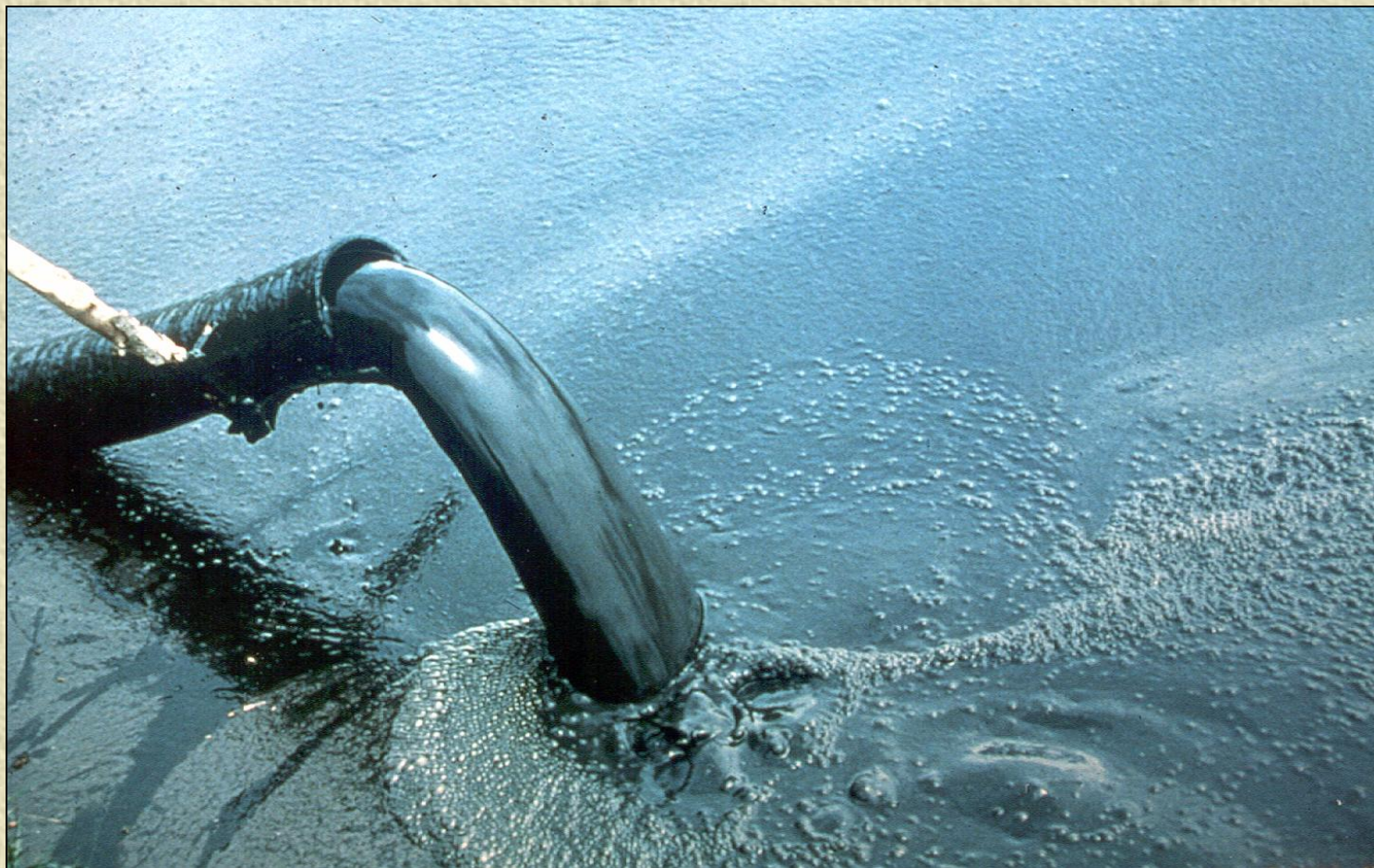


UV Interference

Particle Size in microns	UV demand
<10	Easily penetrated, Low UV demand.
10-40	Can be penetrated, UV demand increased.
>40	Will not be completely penetrated, High UV demand.



Biosolids



Digester



Biosolids



