

Wastewater Treatment Plants

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Thought of the Day

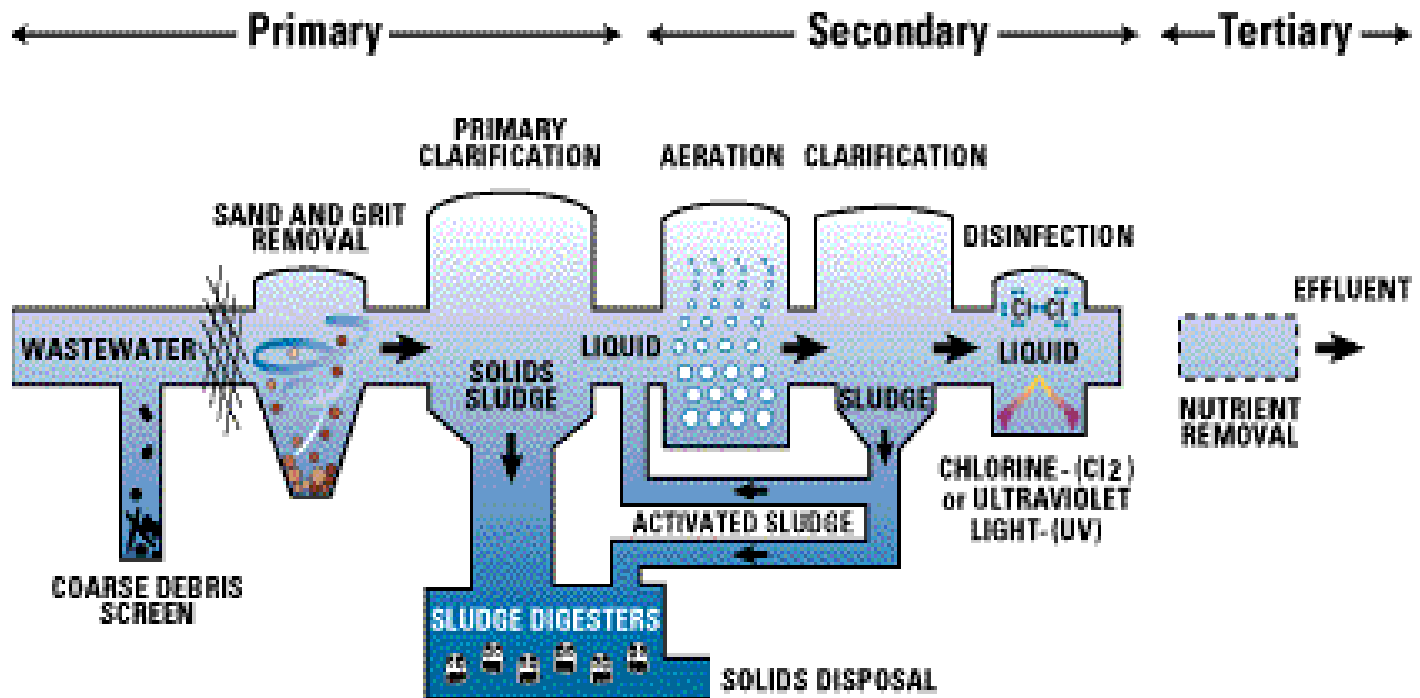


Run after Sarasvati...
... and Laxami will follow you
(Hindi Proverb)

Sarasvati: The Goddess of Knowledge

Laxami: The Goddess of Fortune

Primary, Secondary and Tertiary Treatment



Why Treat Wastewater?



- why such treatment is needed
- the nature of the materials which are removed from wastewater
- explore the processes that accomplish that removal
- consider wastewater treatment in cities
- in small communities
- at individual homes

Why Treat Wastewater?

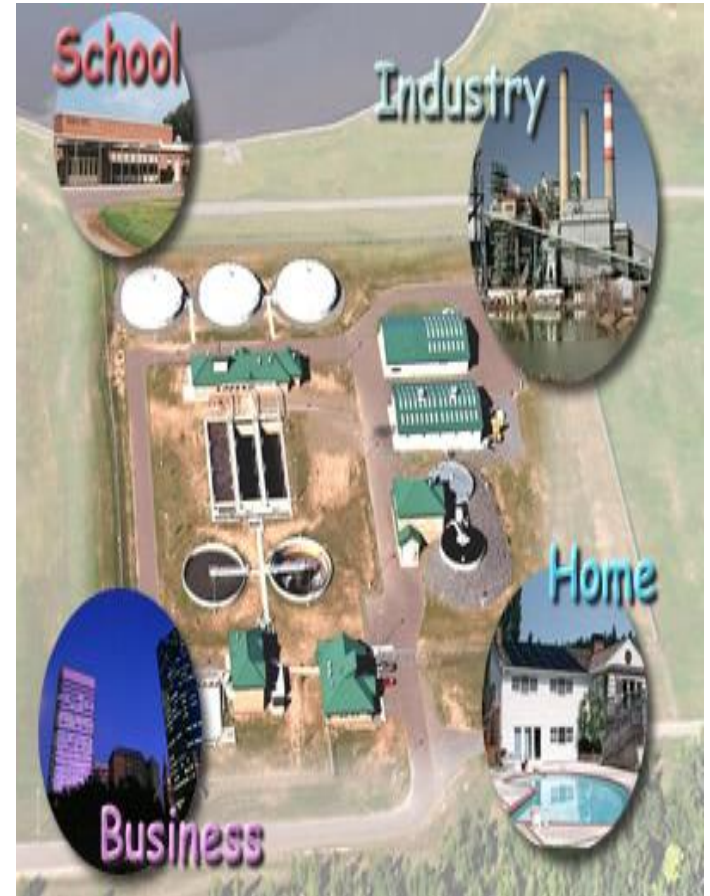


- Domestic and industrial wastes are treated before being discharged to rivers and lakes
- to protect the wildlife that call those environments home
- modern technology offers remarkable capabilities to accomplish these goals
- introduction of new and different pollutants
- cost of treating to required levels is a challenge for the wastewater treatment industry
- in some cases, wastewater can be clean enough for reuse for particular purposes
- wastewater treatment systems use the same processes of purification that would occur in a natural aquatic system only they do it faster and in a controlled situation

Sewage or Wastewater

Sewage or wastewater is from:

- Domestic used water and toilet wastes
- Rainwater
- Industrial effluent (Toxic industrial water is pretreated)
- Livestock wastes
- Commercial activities (e.g. laundries, gas stations)
- Institutions



Total Maximum Daily Load (TMDL)

- Water quality standards are set by the Environmental Protection Agency (EPA) to protect uses for surface water
- If the standards are not met, then a calculation is made to determine how much of a pollutant can be discharged to the lake or river without exceeding the standards
- This amount is called the Total Maximum Daily Load (TMDL)

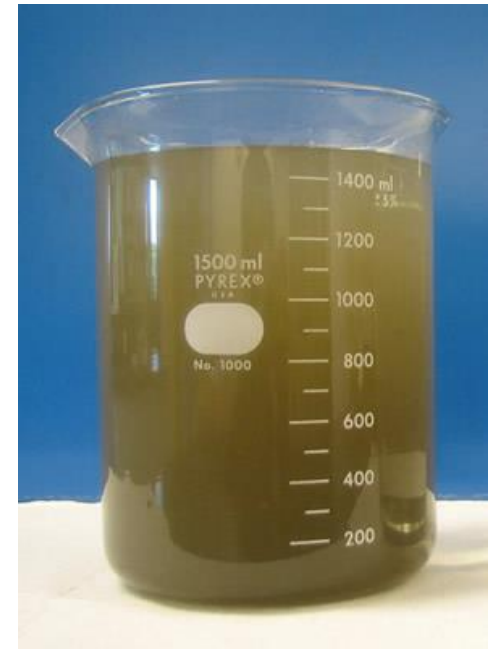
Wastewater - Flows



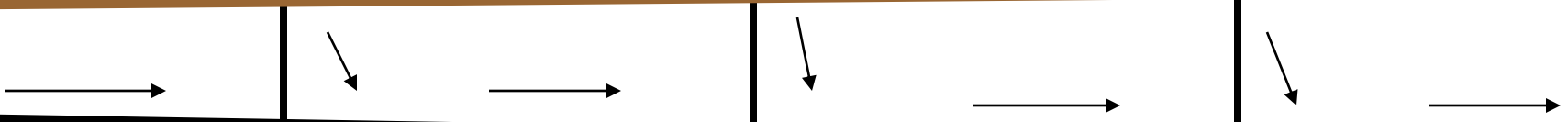
- Each person in a community generates ~40 gallons of wastewater per day
- For Rawalpindi alone, this amounts to almost 80 MGD (million gallons per day)

Wastewater - What's In It?

- Pathogens: disease-causing organisms
- Solids: suspended particles that make the water turbid
- Nutrients: such as phosphorus that can cause nuisance plant growth
- Organic matter: that can rob the oxygen resources of streams
- Toxics: metals and synthetic organic chemicals harmful to humans and wildlife



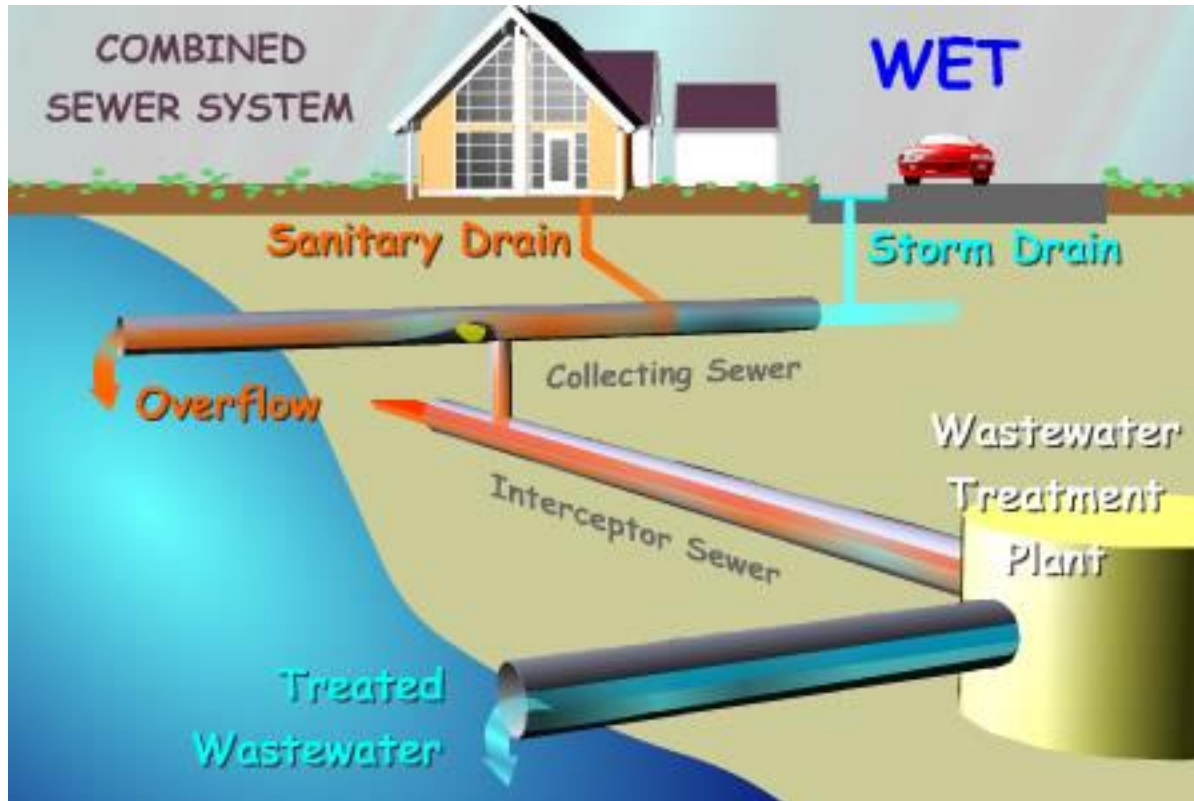
Wastewater



Wastewater - Where Does It Go

- Wastewater is carried to the treatment plant via sanitary sewers
- The connection from the house to the sewer system is a pipe, about 6" in diameter
- A larger pipe (8-12" in diameter), called a collecting sewer, runs down the street picking up the wastewater from individual sewers
- These pipes eventually run to an interceptor sewer which delivers the flow to the treatment plant
- In large cities, interceptor sewers can be huge, sometimes big enough to drive a car through!
- Engineers design sewer systems to take advantage of gravity flow, but sometimes pumping is required
- Rainwater is collected by storm drains and flow through storm sewers to settling ponds or lakes and rivers

Combined Sewer System



Combined and Separate Sewers

- In older cities, the sewers carry both wastewater and rainwater that runs off of the streets
- These are called combined sewers
- During heavy rain events, the flow in combined sewers can reach capacity and threaten to back up into your house
- To prevent this, relief structures called combined sewer overflows (CSOs) are constructed sending the excess water into streams and lakes
- CSOs can grossly pollute rivers and lakes and thus efforts are being made to limit their discharge
- Today, separate sewers are installed, with rain runoff discharge to surface waters via storm sewers and wastewater routed to the treatment plant with no discharge on the way

Wastewater Treatment Overview

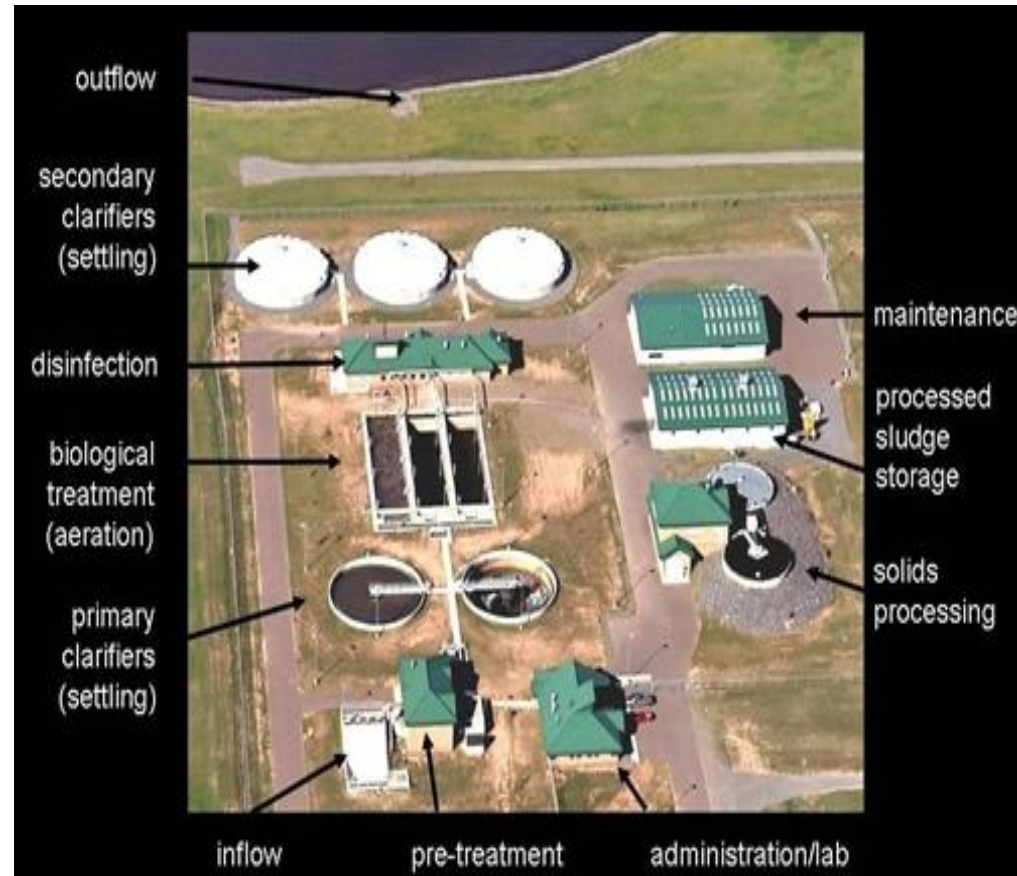


- Everything that happens in a wastewater treatment plant would happen in nature anyway
- Pathogens would die
- Solids would settle to the lake bottom
- Nutrients would be removed from the water by plants
- Organic matter would decompose
- Toxic materials would eventually move into the air or into the bottom sediments of a river or lake

Basic Steps in Wastewater Treatment

The basic steps in wastewater treatment are:

- preliminary treatment - to protect plant operation
- settling - to remove solids
- biological treatment - to remove organic matter
- disinfection - to remove pathogens
- solids processing - to provide safe final disposal



Preliminary Treatment

Preliminary treatment seeks to remove

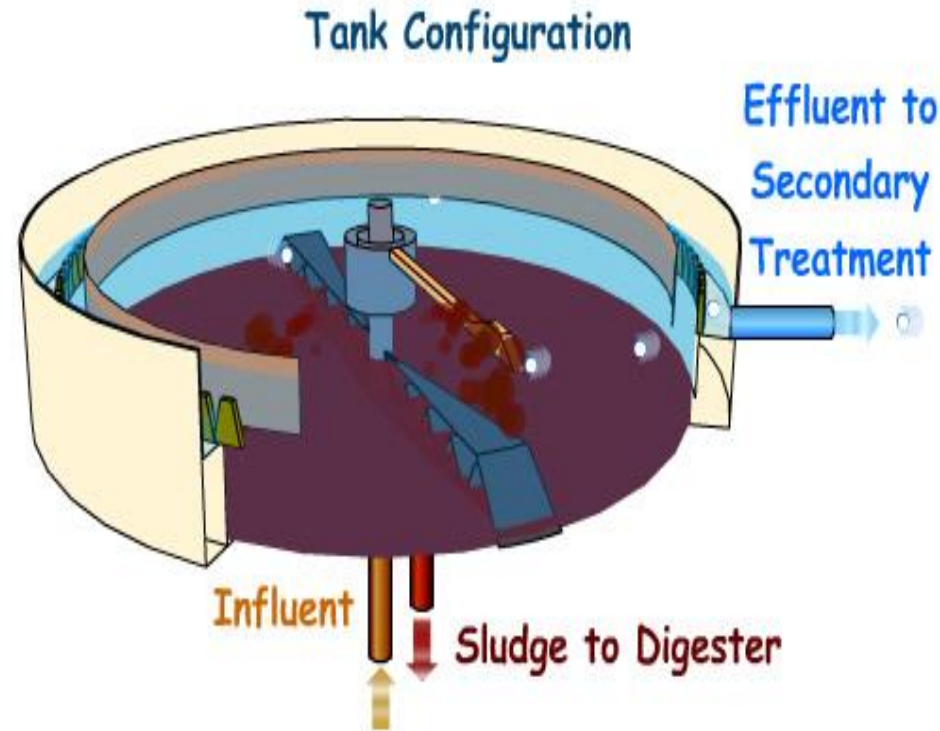
- rags and solids that float which may harm the operation of the rest of the plant
- Bar racks or mechanical screens remove paper, rags and other large solids
- Sand and grit are removed by gravity settling in a grit chamber



Primary Treatment

Following preliminary treatment, the water moves on to a clarifier or settling tank

- This is primary treatment
- Sewage solids settle to the bottom of the tank
- Not all of the solids are removed here in the primary clarifier because very small, light particles take too long to settle
- These small particles and dissolved organic matter are removed later
- The solids that collect at the bottom of the tank are called primary sludge and are pumped from the tank for treatment elsewhere in the plant



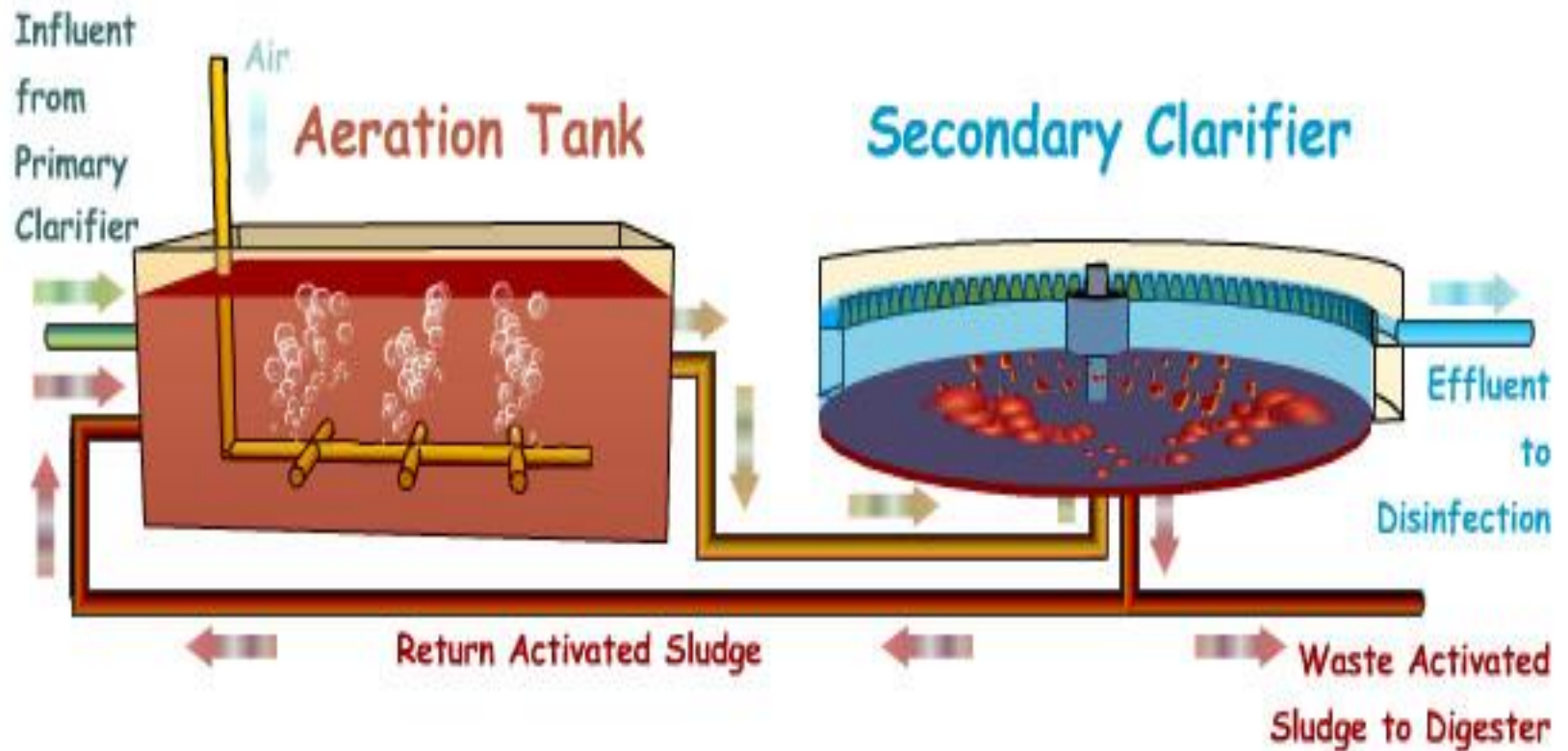
Secondary Treatment

Activated Sludge

- Microorganisms such as bacteria and protozoa can use the small particles and dissolved organic matter, not removed in primary treatment, as food
- Secondary or biological treatment is performed in a tank containing a "soup" of starved microbes called activated sludge
- These microbes require air to live (they are aerobic organisms) and thus air is pumped into the tank
- Microorganisms in this aeration tank use the dissolved and particulate organic matter as food, producing more microorganisms
- Thus the waste materials that left the primary clarifier are changed into microorganisms which can be collected and separated from the water in the next step



Aeration Tank/Secondary Clarifier



Secondary Treatment Clarifier

- It then remains to separate out the microorganisms (activated sludge) so that just clean water is left
- This is done in a secondary clarifier which operates in the same manner as the primary clarifier described previously
- Some of the solids collected in the secondary clarifier (return activated sludge) are sent back to the aeration tank to treat more wastewater and the excess (waste activated sludge) is pumped to another location in the plant for further treatment
- The clean water that flows out the top of the clarifier is sent along for disinfection



Tertiary or Advanced Waste Treatment

- Tertiary treatment, also called advanced wastewater treatment
- provides contaminant removal beyond that achieved in primary (physical settling) or secondary (biological) treatment
- It may include additional removal of organic matter or solids, reductions in the concentration of nutrients such as nitrogen and phosphorus or treatment of toxic substances

Disinfection

- The final step before releasing the treated wastewater to the environment is to kill microorganisms that might be health hazards
- This process, called disinfection, can be accomplished by adding chlorine or by exposing the wastewater to ultraviolet light(UV)
- Disinfection with chlorine can produce chemicals which are dangerous to public health, so alternatives such as ultraviolet light are becoming more popular
- The treated wastewater effluent can now be discharged to rivers or lakes



Solids Management

We have removed solids at various points in the wastewater treatment process

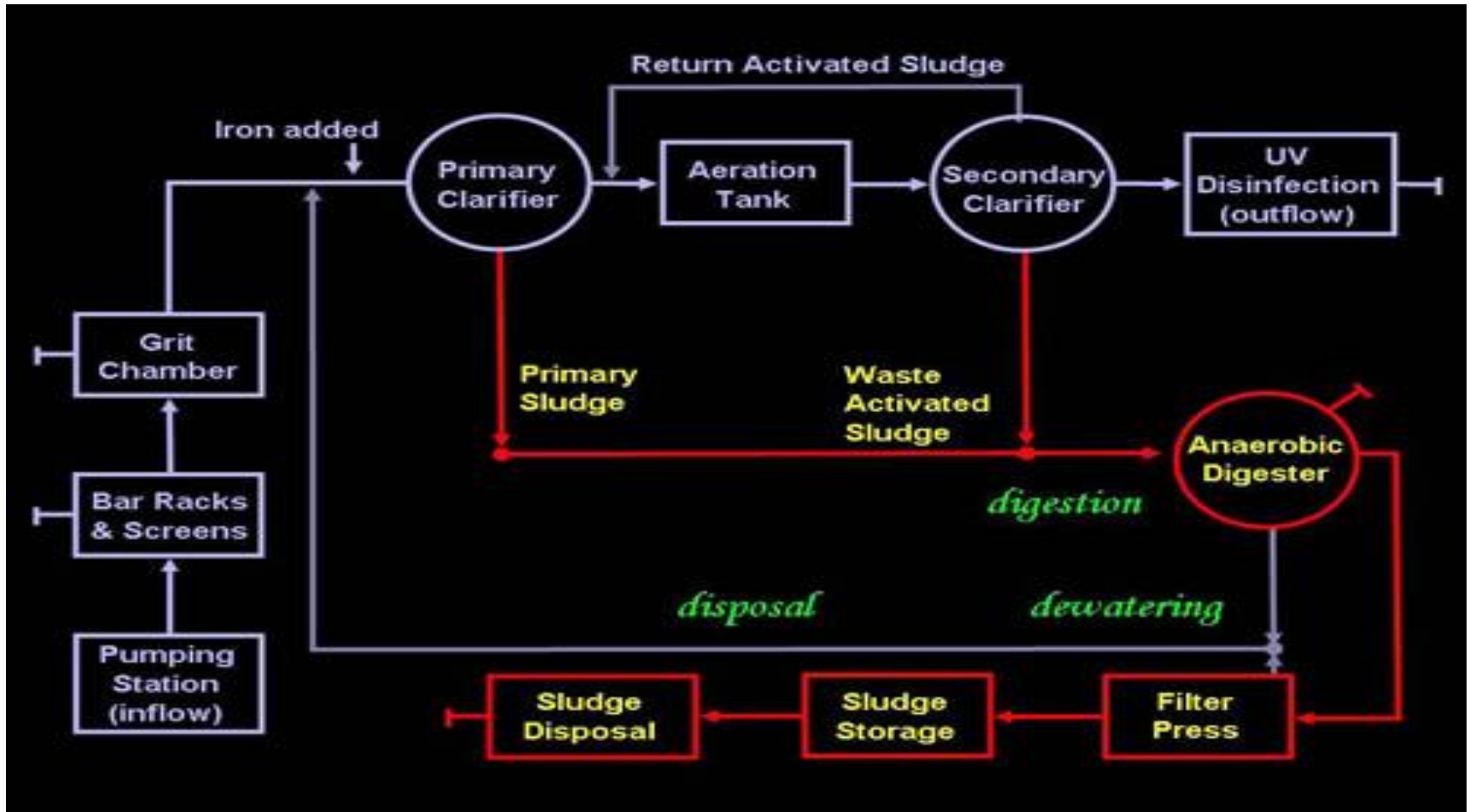
- primary sludge composed of the sewage solids collected in the primary clarifier
- waste activated sludge from the secondary clarifier
- This sludge presents two problems
- First, it is rich in organic matter and will consume oxygen and create foul odors if delivered to the environment without further treatment
- Second, even though it's called sludge, it is mostly water and is difficult to handle in final disposal

Thus sludge processing involves two steps:

1. digestion - to break down the organic matter
2. dewatering- to reduce the water content and make it easily handled

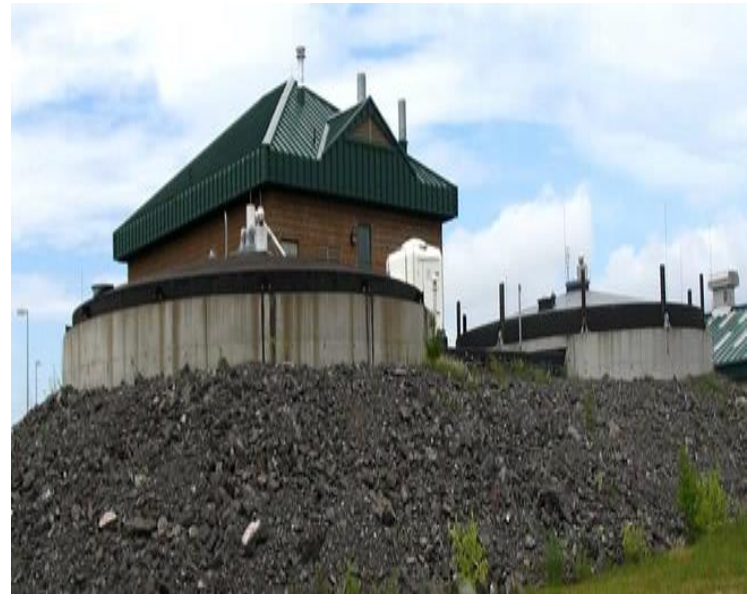
The treated sludge is then sent on for final disposal

Wastewater Treatment



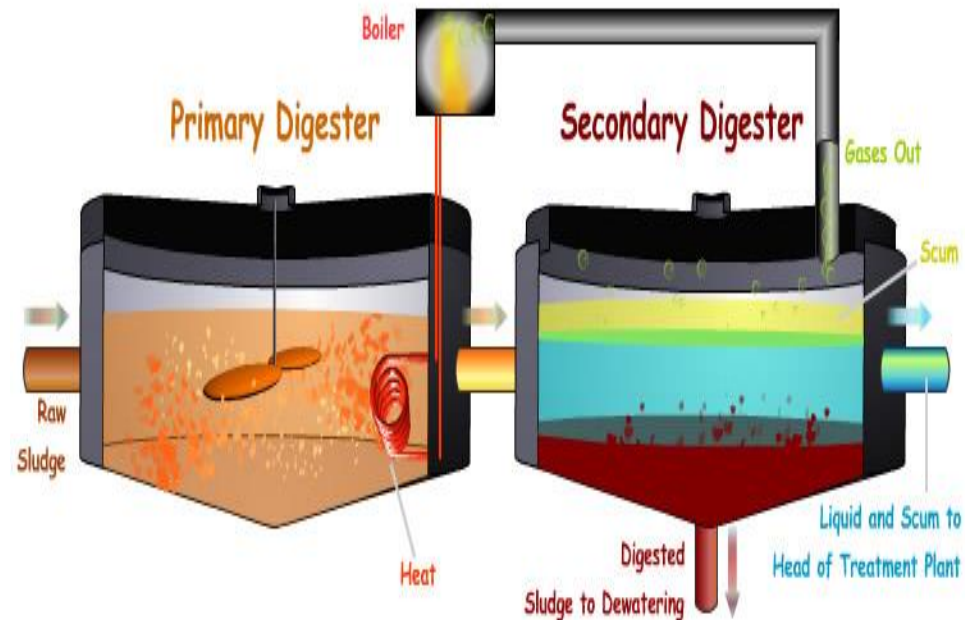
Digestion

- Organic matter is broken down and made inert in a process called anaerobic digestion
- Specialized bacteria, able to live without oxygen (anaerobic conditions), use the biodegradable organic matter as a food source
- Producing carbon dioxide and methane gas and inert organic matter



Digestion Process

- Anaerobic digestion is a two-step process
- In the first step, bacteria and sludge are mixed together in a heated tank called a digester
- This is where the biological activity takes place and biodegradable organic matter is broken down producing gases and inert organic matter
- The sludge is then delivered to the second step
- This digester is not mixed and the sludge separates with gases at the top of the digester, liquid in the middle and solids on the bottom
- Gases that have risen to the top are collected and burned
- The liquid is returned to the beginning of the plant to be treated again
- Solids are sent to the next step for dewatering



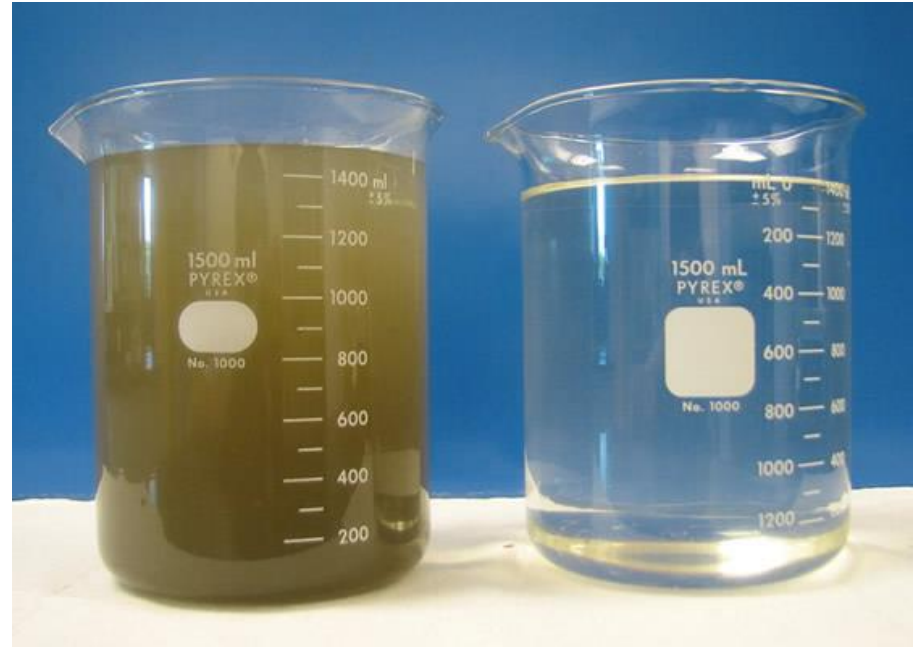
Dewatering

- There are several different ways to remove water from sludge
- One of these is called a belt filter press
- Sludge is placed between two cloth belt filters that pass over a series of drums or rollers squeezing out the liquid
- At the end of the press, a knife scrapes the sludge cake off of the belt filter
- Liquid removed during pressing is returned to the beginning of the plant for further treatment
- The sludge cake is then sent on for final disposal



Final Effluent

- Influent is water that "flows in"
- This is the raw, untreated wastewater
- Effluent means to "flow out"
- This is the treated wastewater
- The picture at right compares influent and effluent
- More than 95% of the pollutants have been removed
- This water is safe for discharge to lakes or rivers



Wastewater Treatment Plant Kasur

Settling Tanks



Inflow



Screening



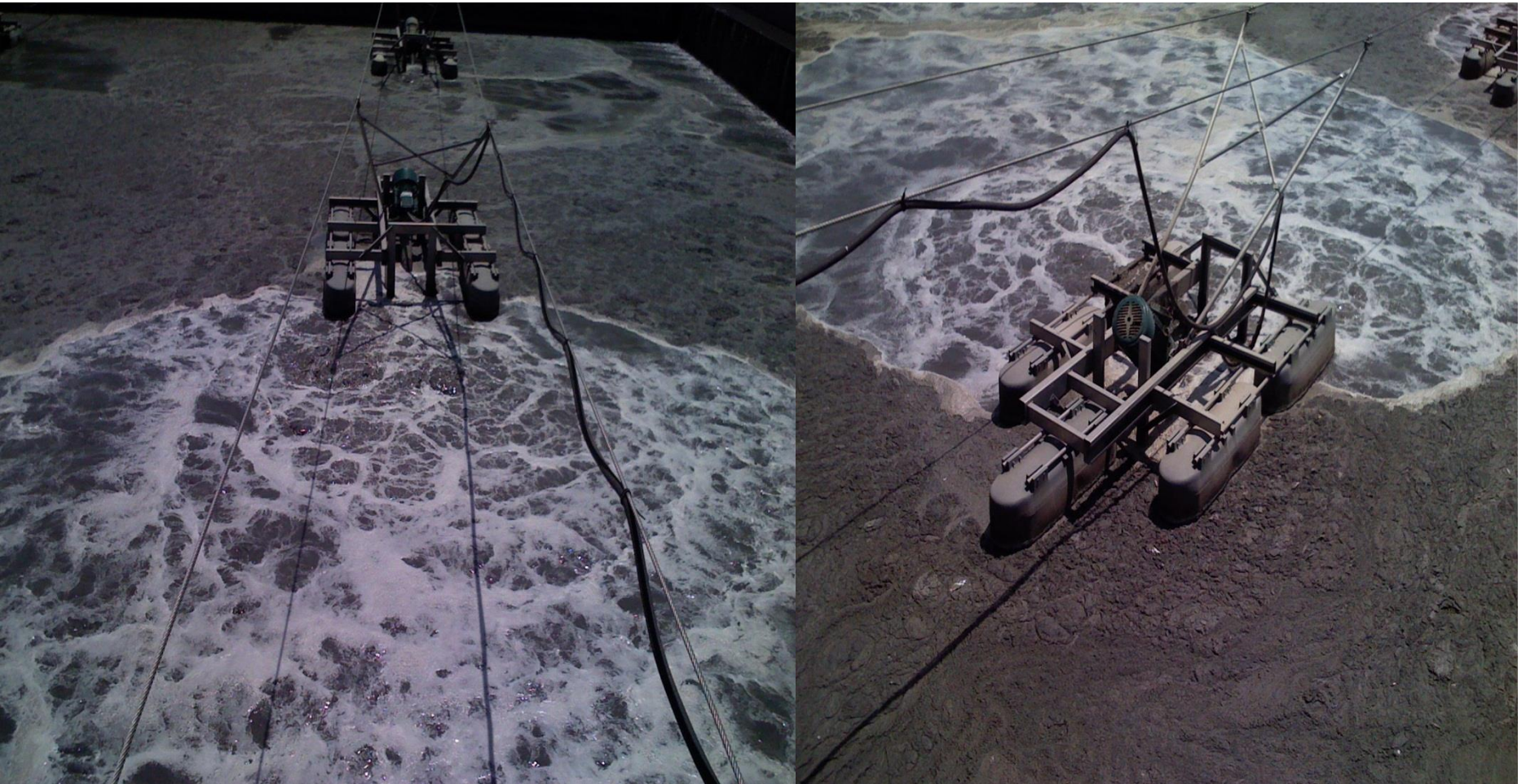
Inflow



Aerators



Aerators



Sedimentation Basin



Lagoons



Wastewater Treatment Plants

Influent vs Effluent



Wastewater Treatment Plant Islamabad



Screening



Aeration



Aeration



Sedimentation Basin



Supernatant Water



Sludge



Dry Sludge



Wastewater Treatment Plant Nestle



Aeration



Aeration vs No Aeration



Wastewater Treatment Plants

Suspended Solids



pH & Temperature



Wastewater Treatment Plants

Wastewater rich in Oil/Grease



Sedimentation Tank



Automatic Feeding



Scrappers



Under Construction



Equalization Tank



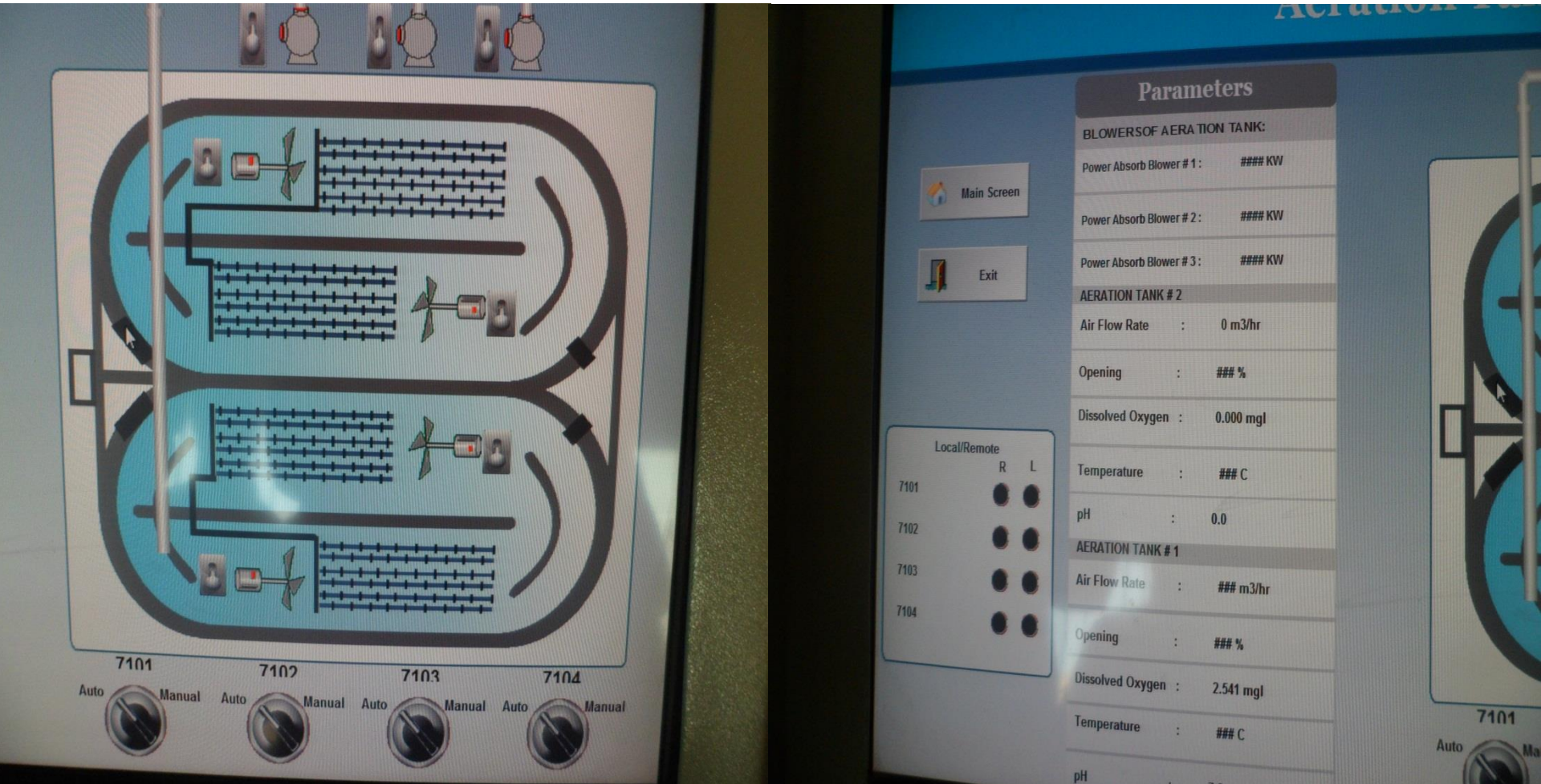
Automation Drive



Fully Automated



Fully Automated



Final Effluent



Advanced Wastewater Treatment



Thank You

