



# Wastewater Treatment

Cost and Energy Improvement Strategies



# Outline

- Wastewater overview
  - Definition
  - Why it is necessary
  - Common terms
  - The cost
- Industrial Examples
  - Food Processing
  - Pulp and Paper
- Treatment technologies utilized
- How can we decrease the energy consumption

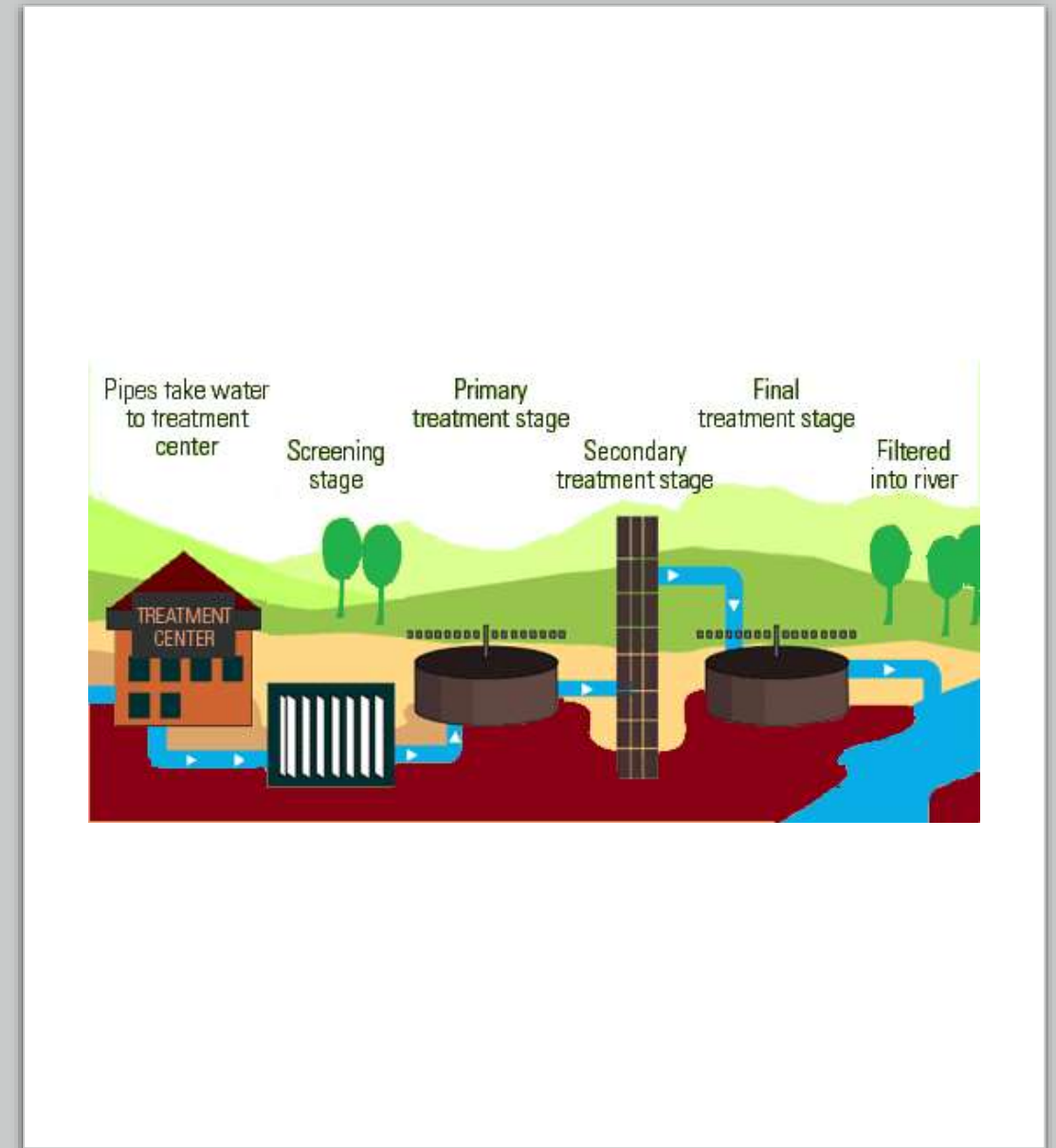


Medium scale aerobic wastewater treatment facility



# What is Wastewater?

- Any process that utilizes water during their process as a transfer medium, washing step, or cooling will generate a wastewater stream.
  - Depending on the process these wastewaters will require treatment prior to their discharge into open waters.
  - Treatments include but are not limited to microbial degradation (aerobic and/or anaerobic) of organics dissolved in the wastewater, air stripping, flocculation, etc.
  - These systems often require tremendous amounts of electricity to preform their intended functions.
  - There is always the cost of pumping, aeration, mixing, dewatering, etc.



# Why treat Wastewater?

- **Many wastewaters are loaded with dissolved and suspended organics which serve as a food and energy source for microorganisms.**
  - If these wastewaters were released into surface waters (streams, rivers, lakes, or oceans) the effects could be catastrophic.
  - The native microorganisms in these bodies of water would take advantage of this food source and begin to consume it along with the dissolved oxygen thereby depleting the oxygen which is also utilized by fish and other aquatic animals.
  - This results in massive fish kills and a possible increase in pathogens.
  - These aquatic systems require a significant amount of time to recover.



Massive fish kills from release of untreated wastewaters



# Consequences of NOT TAKING CARE OF BUSINESS!

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FOR IMMEDIATE RELEASE Tuesday, December 21, 2021

### Seymour Manufacturing Company Pleads Guilty to Violating Clean Water Act; Agrees to Pay \$2.4 Million

Leonard C. Boyle, Acting United States Attorney for the District of Connecticut, Tyler Amun, Special Agent in Charge of EPA's Criminal Investigation Division for New England, and Commissioner Katie Scherf Dykm of the Connecticut Department of Energy and Environmental Protection announced that **MARMON UTILITY LLC** waived its right to be indicted and pleaded guilty today before U.S. District Judge Karl A. Doolay in Bridgeport to a felony violation of the Clean Water Act for knowingly failing to properly operate and maintain the industrial wastewater treatment system and sludge-processing equipment at the Kerite Power Cable & Pump Cable factory located at 49 Day Street in Seymour, Connecticut. Marmon Utility LLC ("Marmon"), a subsidiary of Berkshire Hathaway, owns and operates the factory.

## Southern Water dumped raw sewage into sea for years

### Company awaits sentencing after admitting 51 violations in biggest-ever Environment Agency investigation

Sandra Laville  
Environment correspondent

Tue 6 Jul 2021 10:40 EDT

PROJECT SAFE  
Our nation-wide commitment to reducing gun crime in America.

In Southampton, above, a wastewater treatment plant released 745m litres of sewage in less than five years. Photograph: Geoffrey Swaine/Rex/Shutterstock

Southern Water discharged enormous volumes of raw sewage into protected coastal waters for nearly six years causing "very considerable environmental damage" because it was cheaper than treating it, a court has heard.



# Things to keep in MIND!

- When dealing with wastewater management, remember their job is to keep the company from incurring fines.
- Any perceived suggest changes to the way the system operates will garner push back.
- Bottom line is that the company must meet the requirements of their permit or face hefty fines and possible halting of operations.
- Communication is KEY!



# Common Terms to Understand

- BOD – Biochemical Oxygen Demand.
  - The amount of oxygen required to convert the organics in a wastewater sample to CO<sub>2</sub> and H<sub>2</sub>O.
- COD – Chemical Oxygen Demand
  - This is an abiotic test that utilizes acids and oxygen to breakdown organics in wastewater.
- These test indicate how a treatment plant should be operated (I.e. how much oxygen should be supplied to treat the waste)
- Suspended Solids
  - Amount of tiny solid particles that remain suspended in water and act as a colloid
- Dissolved Solids
  - The amounts of inorganic salts and organic matter present in solution in water
- These are some of the parameters a company is regulated on by the department of Environmental quality



# What is the cost treating wastewater for industries.

- **The US EPA has estimated that 7% of the US power consumptions goes to treating wastewater.**
  - With the US consuming an average of 3.8 trillion kilowatt hours of electricity annually with industry responsible for 96% of this consumption.
  - Wastewater accounts for 266 billion kilowatt hours of electricity consumption annually.
  - It is safe to say that industry is a major power consumer of electricity for treatment of wastewater especially in the pulp and paper and food processing industries.
  - With the end goal of most treatment systems to turn organics into CO<sub>2</sub> and H<sub>2</sub>O it is obvious these are a significant source of greenhouse gas emissions.





# A closer look at the Food Processing Industries



Food Prep Equipment

- **What is water used for in Food Processing**
  - **Initially food items are washed to remove dirt and/or feathers**
  - **Used in the sizing of food for packaging**
    - Poultry processors use water to wash away blood and small trimmings during the cutting stages.
      - In 2009, Georgia processors produced over 9 billion gallons of high strength wastewater.
    - Fruit and vegetable processors use water to keep these items cool and aid in the slicing and packaging which results in carbohydrates, fats, and proteins being removed by the water.
  - As a result of these steps their wastewater contains a significant amounts of dissolved organics that if discharged into surface water would have sever environmental consequences such as aquatic life kills and disease transmissions.



# A closer look at the Pulp and Paper Industries

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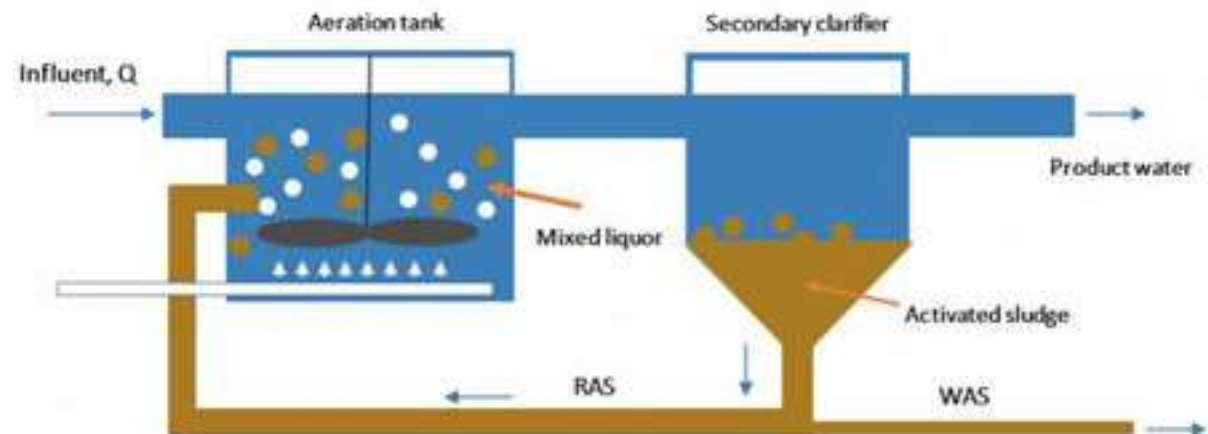
- The third largest income producing crop in Mississippi is timber and it stands to reason that the pulp and paper industry is a large player driving this market.
  - Trees are valued for their boards and pulp.
  - The Kraft process separates the fibers from the trees and utilizes it to make paper, cardboard, tissue, etc.
  - In this process a tremendous amount of water is utilized resulting in the production of vast amounts of wastewater.
    - There is an estimated 300,000,000 gallons of wastewater produced daily by the pulp and paper industry.
    - Moving this volume of water is very energy intensive.



International Paper Redwood, MS.

# Typical treatment technologies for wastewater

- Return Activated Sludge Process (RAS)
  - Works by maintaining an aerobic environment with active microorganisms
  - Requires the Wastewater to be aerated and circulated to prevent anaerobic pockets from forming.
  - It is relatively a fast treatment technology but requires significant pumping and aeration.
  - Generates a sludge (mostly microorganisms) that requires dewatering and disposal.



Typical design for Aerobic Wastewater Treatment



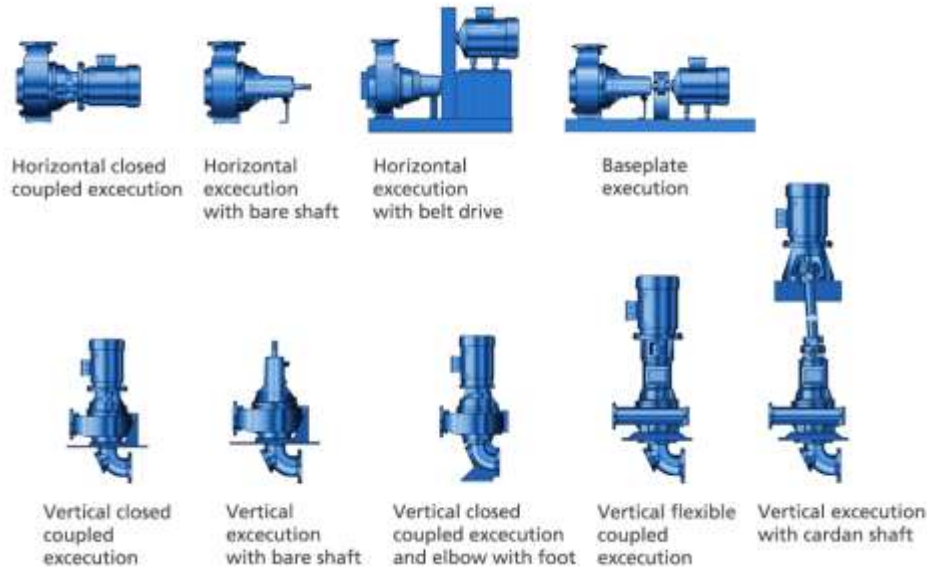
# Typical treatment technologies for wastewater continued

- Extended Aeration
  - Works by extending the aerated wastewater over a large surface area and letting the microorganisms consume the organics completely and then starving the same microbes until they cannibalize themselves.
    - Energy intensive but no immediate sludge disposal problems.



# What consumes power with RAS and Extended Aeration?

- Primarily Pumps and Aerators
  - Must be capable of moving 31,000 gallons a minute

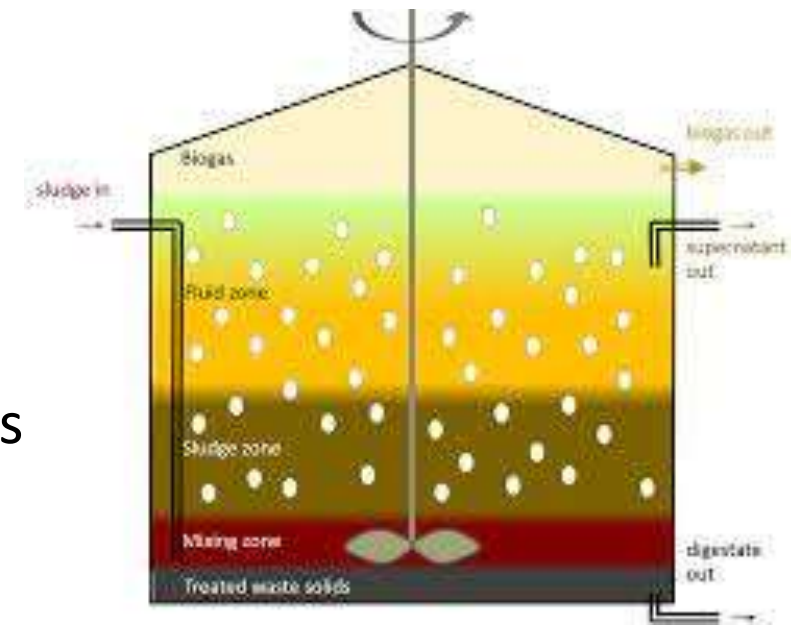


- A) Disk Aerators
- B) Bubble Aerators
- C) Floating Aerators



# Typical treatment technologies for wastewater continued

- Anaerobic digestion (without oxygen)
  - Digest the organics in the absence of oxygen to produce a mixture of methane and carbon dioxide (Biogas).
  - Very dependent on the type of organics in the wastewater stream.
  - Requires mixing and some pumping but no aerators.
    - Produces much less sludge to dispose.
  - The biogas can fuel generators
  - The electricity generated can be used in the system
  - Biogas if not used must be flared.
  - Digestate must be further processed to remove nutrients



Traditional Mixed Slurry Digester



# What consumes power with Anaerobic Digestion?



**Jet Mixers**



**Impeller Mixers**



**Pump Mixers**



# Power saving advances in WWT

- Energy efficient pumps and motors
  - Proper pump sizing
  - Instillation of variable frequency drives
- More energy efficient aeration
  - Automated Control of Dissolved Oxygen
  - Fine bubble generators
- Disinfection
  - Switching to Low Pressure Low Intensity UV
- Anaerobic Digestion for power generation



Variable Frequency Drives



Low pressure UV Sterilization

