

The Impact of Environmental Regulations on Wastewater Treatment Plant Design

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By: Thomas Schultz, Director Sales and Marketing

Water Technologies

The Challenges and Scope of Environmental Regulations

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Waste/Wastewater Environmental Regulations Address

- Water Quality
- Air Pollution
- Worker Health and Safety
- Hazardous Waste Designations
- Bio-Accumulation Effects
- Toxicity

Challenges include:

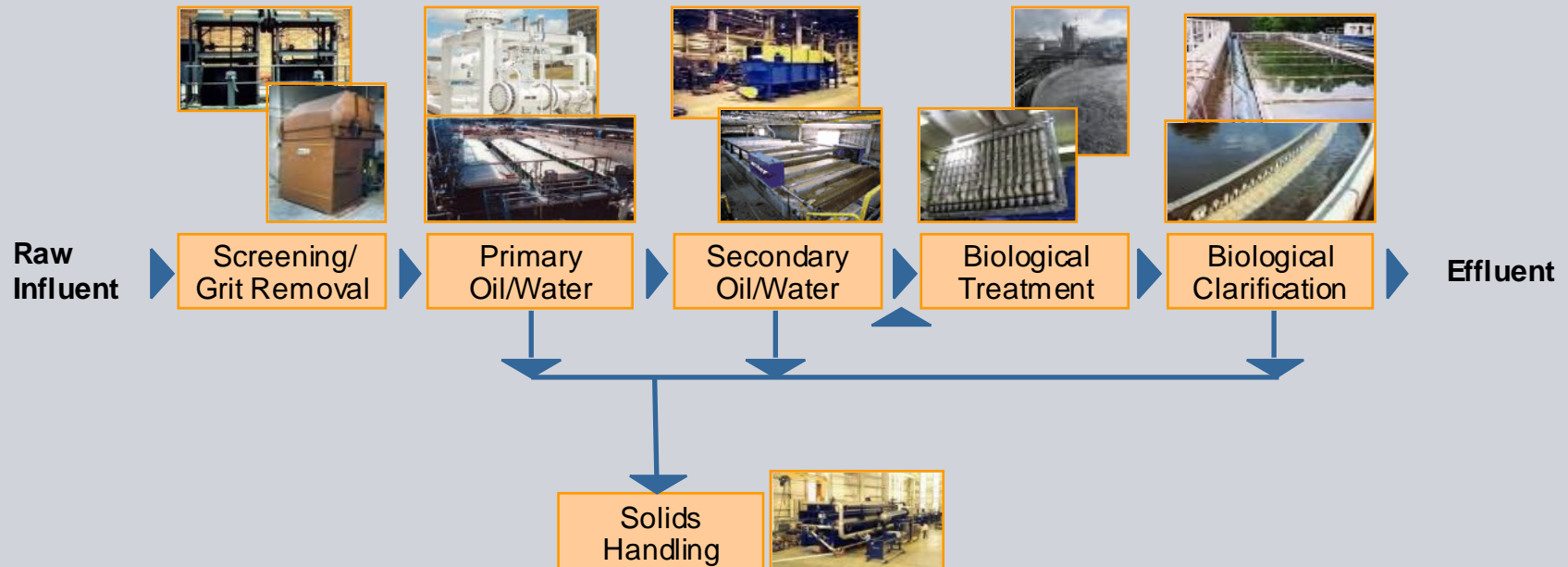
- Number of regulations
- Complexity of each regulation
- Compliance (testing) requirements



Water Quality Regulations The Basics

Conventional Pollutants

- Parameters that impact the ability of the environment to naturally attenuate pollution.
- BOD₅, COD, TSS, Oil and Grease, Ammonia, Nitrates, pH

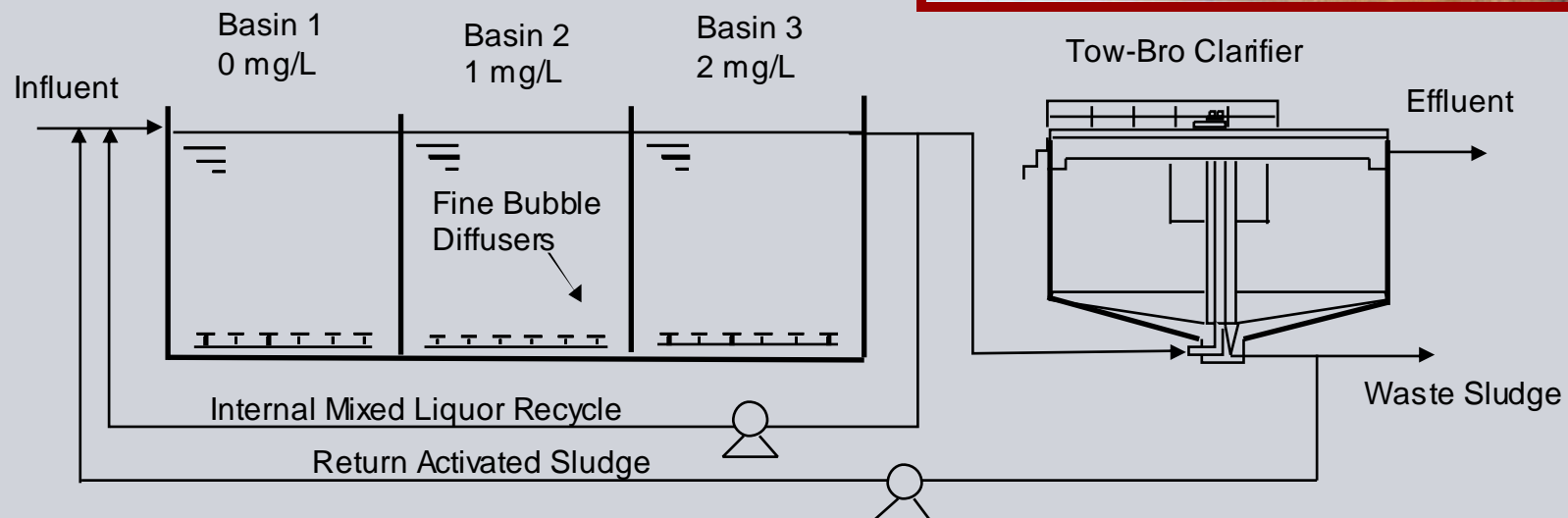


Water Quality Regulations The Basics

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Impact on WWTP Design

- Example – Petroleum Refinery WWTP



Water Quality Regulations

Identification of Specific Toxic Compounds

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Substance which may present negative impact to the environment or public health, which are not addressed by basic environmental regulations (BOD₅, COD, TSS, Oil, etc)

Example – US Toxicity Characteristic Rule

- 25 Organic Compounds
- 8 Metals
- 4 Insecticides
- 2 Herbicides

Designated hazardous waste if water contains any compound in excess of threshold levels. Example - benzene – 0.5 mg/l threshold level

Possible exemptions to hazardous waste designation

- Treatment in a wastewater treatment plant.
- Source control

Water Quality Regulations Identification of Specific Toxic Compounds

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Impact on WWTP Design

- May designate a waste or wastewater as hazardous.
- May require removal of the identified substance prior to discharge of waste or wastewater to the environment.
- May require specific mechanical design of water and wastewater treatment plants to insure containment of the waste.



Water Quality Regulations

Identification of Bio-Accumulating Compounds

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- Specific substances can accumulate in water ways, and the sediment in waterways. While the impact of these substances may not be apparent during the initial discharge to the water way, over time, the accumulation of these substances may have a negative impact on water quality and marine life..
- Every waterway has different capabilities to attenuate substances.
- Determining which substances can have long term impact on individual waterways is a significant task.
- Example - TMDL's (Total Mass Daily Load) – USA regulations which evaluates the specific ability of rivers, lakes and other surface waters to attenuate substances discharged to them.
- May include items such as selenium, radium, arsenic and others.



Water Quality Regulations

Identification of Bio-Accumulating Compounds

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Impact on WWTP Design

- Example – San Francisco Bay
- Identifies selenium as a substance which can accumulate over time in sediments.
- The amount of selenium that the San Francisco Bay can naturally attenuate is calculated and the total amount is distributed to facilities that discharge waste into the Bay.
- Petroleum refineries in the San Francisco Bay area are one of the major dischargers of selenium.
- Most refineries in the Bay area isolate the streams that contain the higher loads of selenium and remove it by precipitation.



Effluent Toxicity

- Substances in water or wastewater discharged to the environment can have negative impact on the survival rate and reproduction of aquatic species.
- Many times, it is difficult to determine if the presence of a single substance, or even a group of substance, will have a negative impact on the aquatic life in a receiving stream.
- Many times a single substance may not have any toxic effects. However, the cumulative effect of multiple substances can exhibit toxic characteristics.
- In many regions of the world, in addition to having specific limits on various substances which may be discharged, the treated water is used to determine if there are any negative effects on representative aquatic species.
- If a treated wastewater does exhibit toxic characteristics, many times it is difficult to determine which substance caused the toxicity. Many times, it is the cumulative effect of a group of substances.

Effluent Toxicity

Example

- Petroleum refinery exhibited toxicity in the treated wastewater being discharged to a river, after oil/water separation, biological treatment and clarification.
- Extensive studies were undertaken to identify the specific substance, or group of substances, that were causing the toxicity.
- After many tests and studies, the toxic substance(s) could not be identified and effluent media filters and activated carbon columns were added to the wastewater treatment system as the toxic substances were felt to be partially organic in nature.



Air Regulations

Air regulations can:

- Address emissions of green house gases from wastewater treatment equipment.
- Address objectionable odors from wastewater treatment equipment.
- Address emissions which may negatively impact worker health and safety.

An example might be benzene emissions from petroleum refinery wastewater treatment plants, which have worker health, environmental and odor concerns.



Air Regulations

Impact on WWTP Design

- Covers on wastewater treatment equipment for VOC/odor collection.



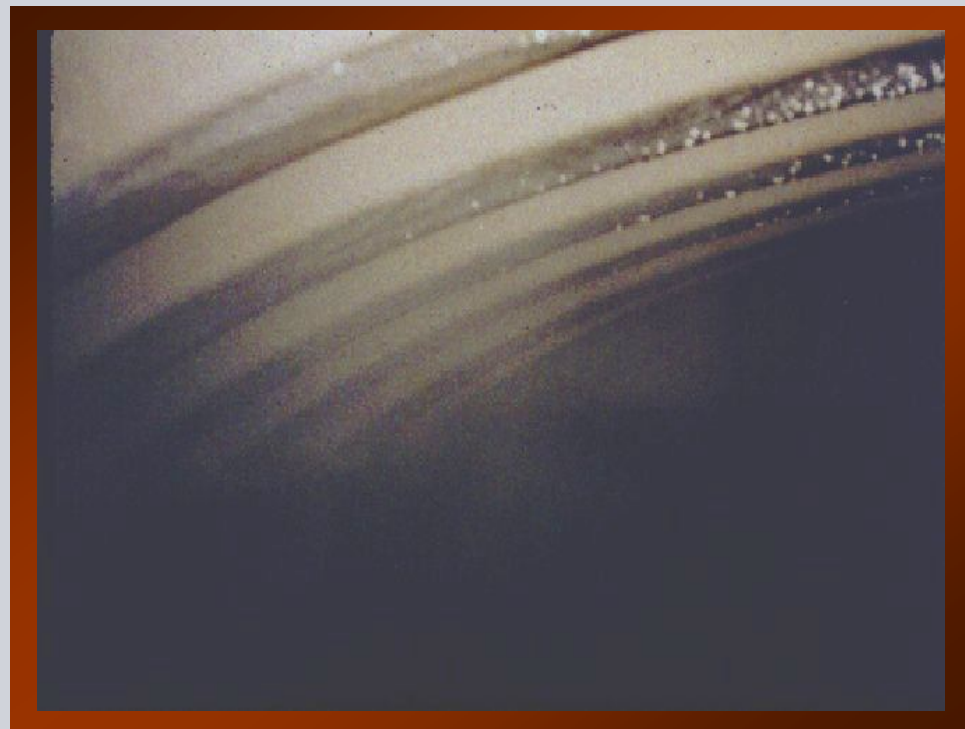
Air Regulations Odor/VOC Containment

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Safety is a valid concern!!!!

Fires/Explosions have occurred in refinery oil/water separators.

- Methods to mitigate explosion risks.
- VOC Containment Methods
- VOC Control Methods



Air Regulations Risk Assessment - Safety



Potential Hazard

Explosion from accumulated gases

Spark from static electricity

Spark from electrical devices

Spontaneous combustion

Explosion relief

Solution

Eliminate oxygen from the vapor space.
Purge with inert gases.

Properly ground equipment. Special coatings to reduce static build-up.

Locate all electrical devices on equipment exteriors. Use explosionproof devices.

Do not use carbon steel wearing parts. Hydrogen sulfide forms iron sulfide. Spontaneous combustion occurs when exposed to air.

Incorporate deflagration vents in accordance with NFPA into cover design

Air Regulations Odor/VOC Control Device

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Once VOC's and/or Odors are collected, they must be treated or disposed of.

- Activated Carbon
- Thermal Oxidation
- Chemical Scrubber

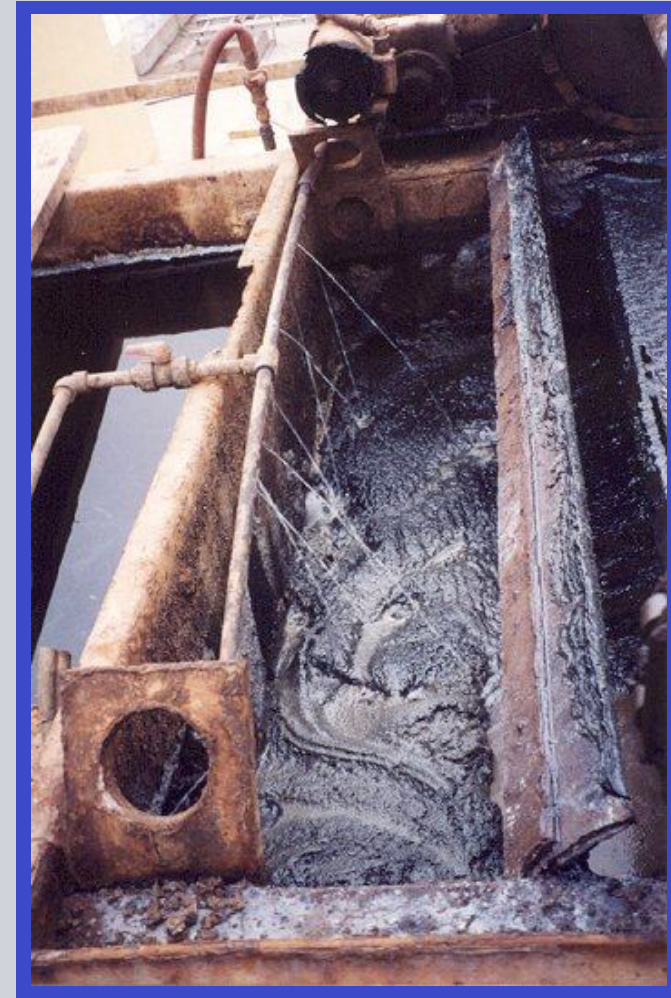


Hazardous Waste Regulations

Specific wastes, or waste streams, may be identified as hazardous due to the characteristics of the waste or the source of the waste.

Examples may include:

- Spent caustic from petroleum refineries and ethylene plants due to its reactive, corrosive and high COD characteristics.
- Oil sludge from wastewater treatment operation in petroleum refineries due to flammable nature and the likely presence of toxic substances such as benzene.
- Elimination of the hazardous characteristic through treatment, or through beneficial reuse of the waste, will greatly reduce disposal costs.



Hazardous Waste Regulations

Treatment examples:

- Oily sludge from petroleum refineries can be feed to a coking unit at the refinery. The coking operation allows hydrocarbons in the oily sludge to be recovered in the refining process. Inert solids are disposed of with the coke.
- Spent caustic is oxidized under high temperature and pressure to eliminate the corrosive and reactive characteristics, allowing the treated spent caustic to be further treated as a non-hazardous waste.



Methods to Address Environmental Regulations

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- End of Pipe WWTP
- Segregation of Waste Streams
- Source Control



The Potential Result of Environmental Regulations

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Regulation can drive wastewater quality to the point it can be recycled/reused without further treatment, or minimal additional treatment. Don't forget the costs benefits this may yield over treatment of water for use from other sources.

Regulations continue to drive the development of new and more efficient technologies.

- EcoRight™ MBR
- Membrane Distillation
- Oil/Water Separation Technologies



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