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National Council for Air and Stream Improvement, Inc.

Managing Wastewater Treatment Plant Impacts on Air Emissions

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Outline

- Introduction
- Drivers & Standards
- Wastewater Fugitive Emissions Estimates
- Emissions Examples
  - Methanol
  - Hydrogen Sulfide
- Questions

Drivers

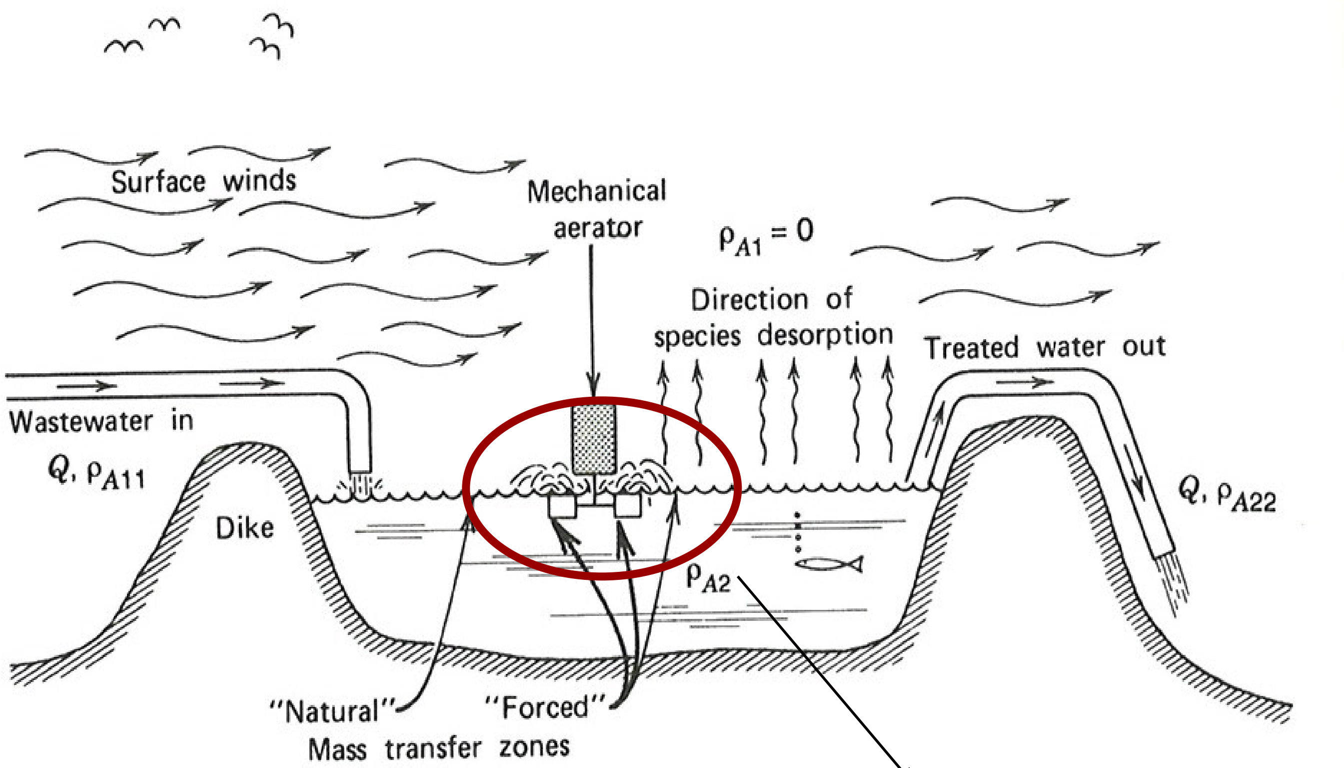
- Methanol
  - Hard-pipe option for MACT I compliance
    - 92% or > lb/ton of treatment
  - Clean Condensate Alternative for MACT II compliance
    - < X Lb/ton of emissions
  - Reporting
- Hydrogen Sulfide
  - Reporting
- Other Air Toxics
  - Ambient impact of wastewater fugitives
    - No real standard, maximum impact level
  - Reporting

Introduction

- Fugitive emissions from wastewater treatment sources
  - Complex chemistry and biochemistry
  - Large wastewater systems
  - Load, operation and ambient conditions are variable
- As direct measurements are unfeasible, emissions must be estimated from empirical models
  - Emissions estimates can be tailored to be very site-specific

Site-Specificity
Resource Burden →

Wastewater Treatment Plant Emissions

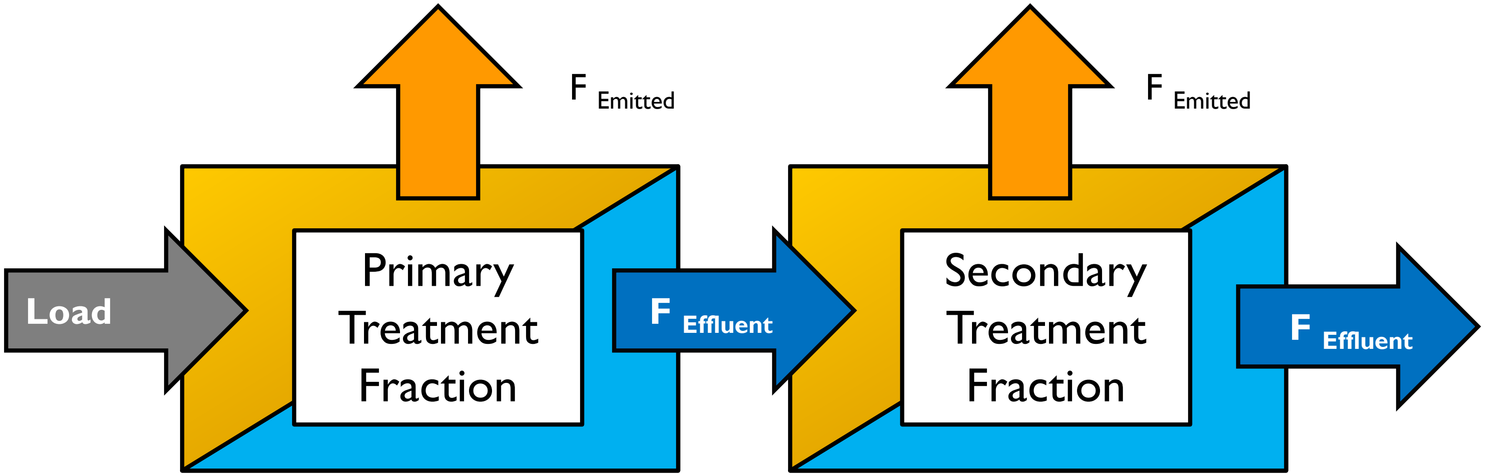


Turbulent Zone around Surface Aerators

Illustration by Thibodeaux
(Figure reproduced from Thibodeaux 1996, page 174)

Introduction – “Generic” Estimates

- Default estimation approach is emissions fraction based



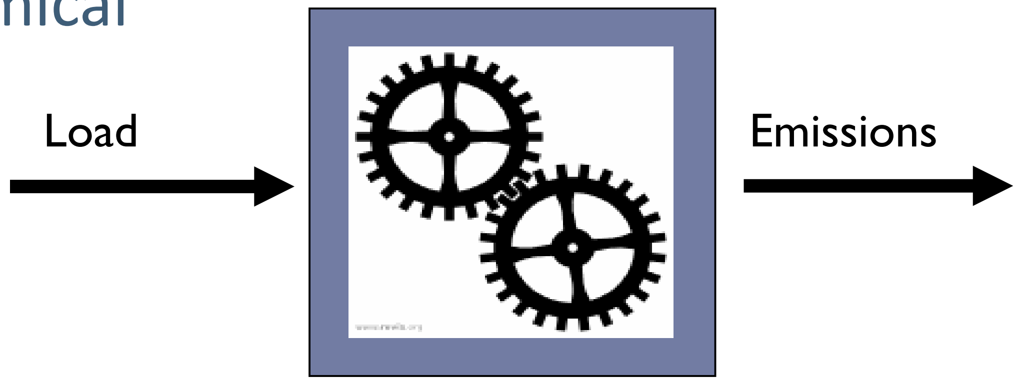
- NCASI SARA Handbook presents emissions, effluent and removal fractions for many chemicals for a “typical” PC/ASB/AST
  - Most “air toxics”: Result of WATER9 Models
  - For methanol and H_2S: Result of field test data

Introduction – Site-Specific Estimates

- Two Types of Estimation Approaches
  - Mechanistic Modeling
    - Simulation of the behavior of a chemical in a wastewater treatment process unit or set of units along multiple fate pathways
    - NOCEPM, WATER9, H2SSIM
  - Pond Profile Based Modeling
    - Characterization of chemical emissions based upon direct measurements of in-basin concentrations and concurrent operational information
    - Appendix C Approach

Introduction – Mechanistic Modeling

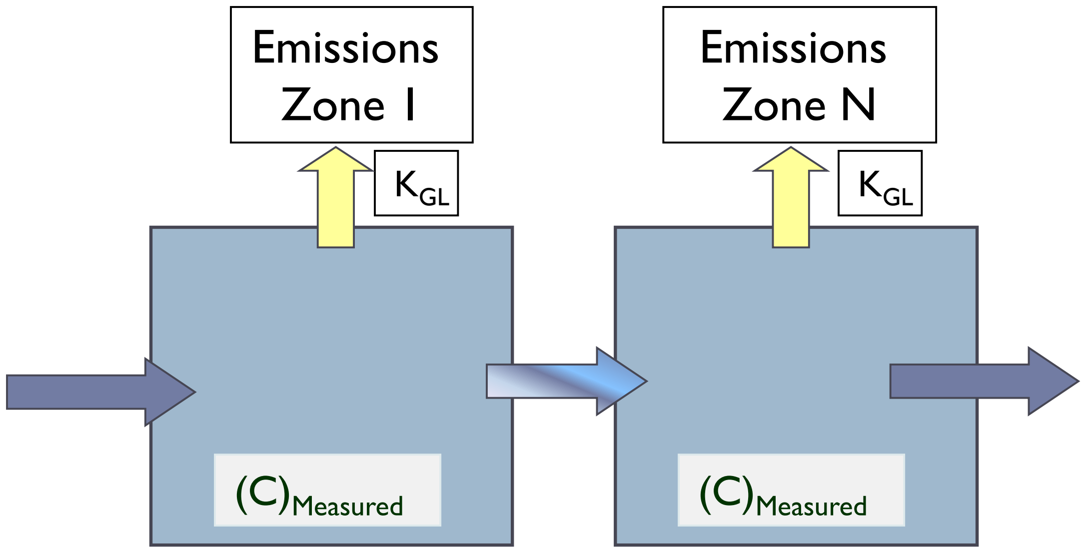
- Mass-balance model that incorporates multiple pathways to simulate the site-specific behavior and fate of a chemical



- Requires WWTP characterization and declaration of biorate for each chemical
- Software Tools:
  - WATER9 & H2SSIM

Introduction – Profile-Based Modeling

- Appendix C calculation procedures
- Empirical model that combines chemical concentration profile with site-specific mass transfer estimates



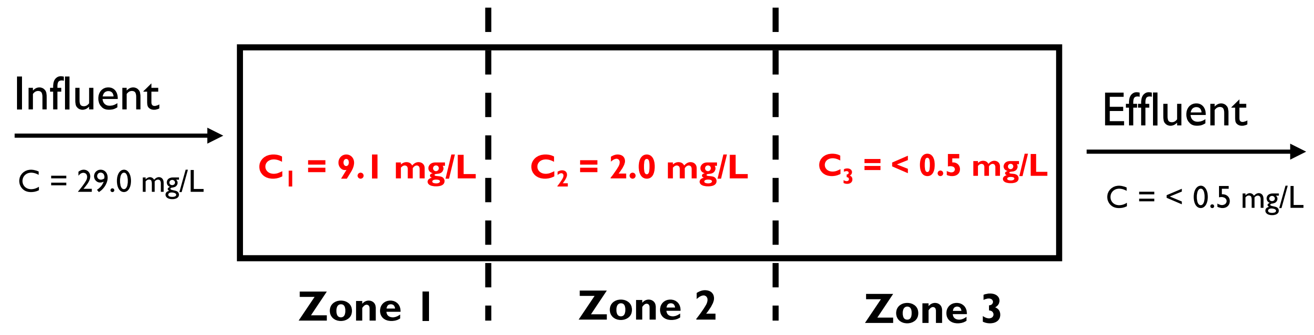
- Results in a "snapshot"
- Requires chemical concentrations throughout WWTP, basin characterization
- Avoids the need for information on the biological destruction rate (Can be used to calculate)

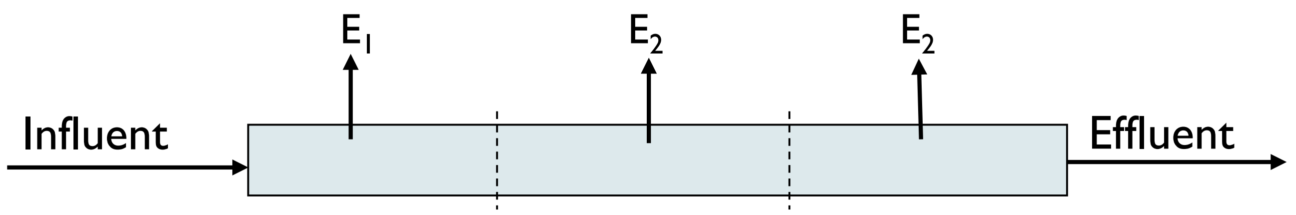
Methanol Issues

- Hard-pipe
  - Lower demonstrated treatment
- CCA
  - Higher emissions
- Issues are more often **not** related to treatment system performance
  - Methanol analysis
  - Calculation errors or changes
  - Collection issues

- Treatment issues may not be seen in monitoring of traditional effluent parameters
- May be localized to the primary hard-pipe treatment zone

ASB - Methanol Example – Baseline

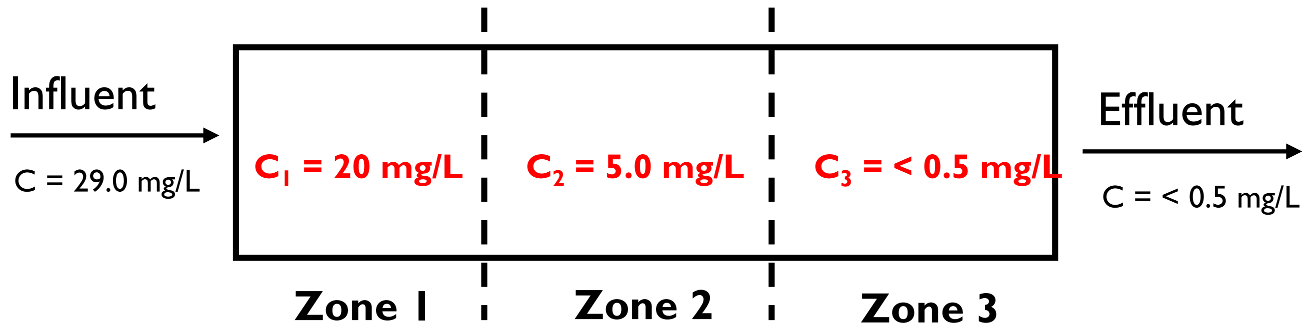


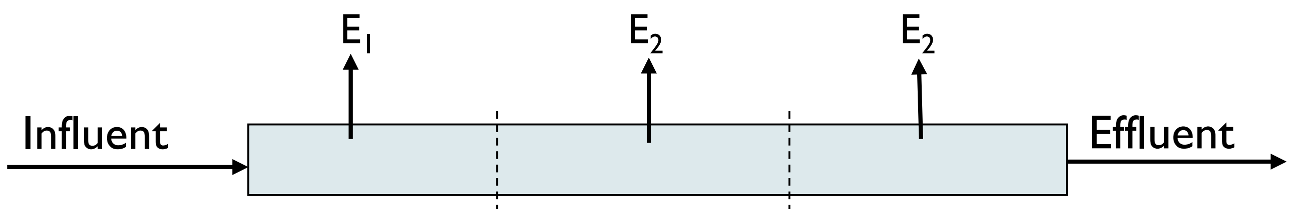


Emissions = $K_{L,1} A_1 C_1 + K_{L,2} A_2 C_2 + K_{L,3} A_3 C_3 = 63.4$ **g/s**

F_{bio} **= (Influent – Effluent – Emissions)/Influent = 0.954 = 95.4%**

ASB - Methanol Example – Higher MeOH Concentration



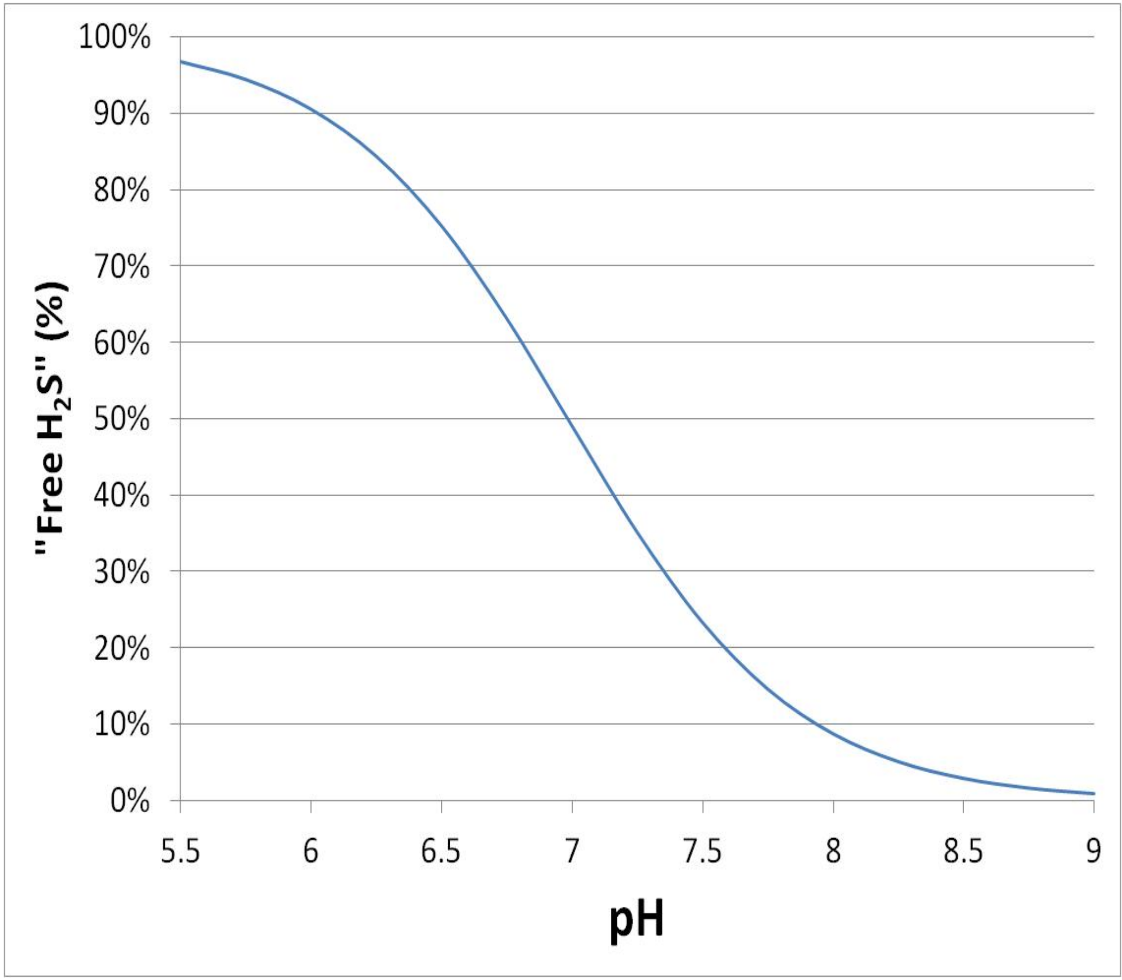


Emissions = $K_{L,1} A_1 C_1 + K_{L,2} A_2 C_2 + K_{L,3} A_3 C_3$ **= 139.4 g/s**

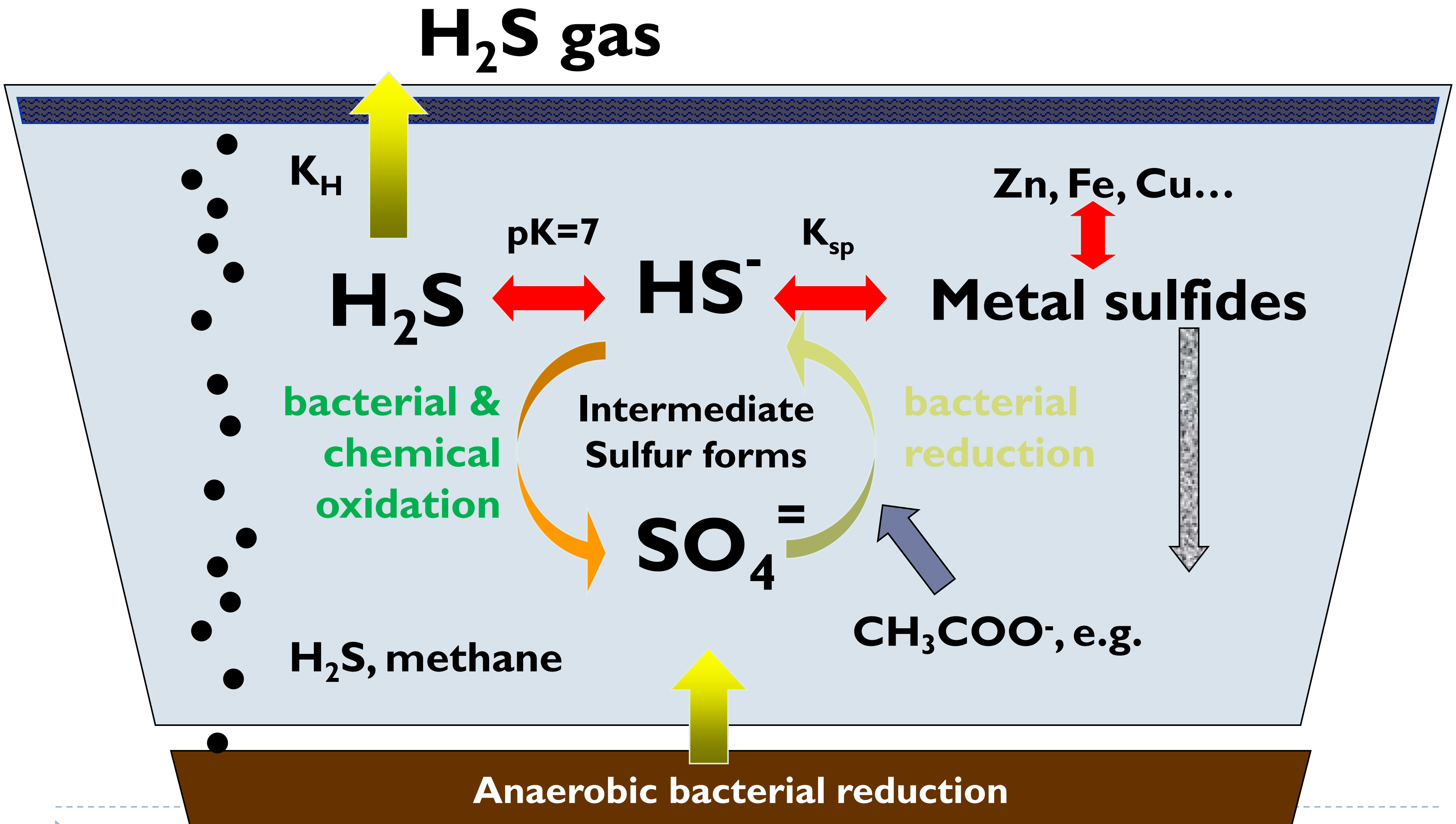
F_{bio} **= (Influent – Effluent – Emissions)/Influent = 0.899 = 89.9%**

Hydrogen Sulfide Issues

- Higher Emissions due to
  - Treatment system performance issues
  - Increase with lower pH
    - Emissions as “Free” H_2S
  - Some systems can have sulfide generation due to anaerobic activity

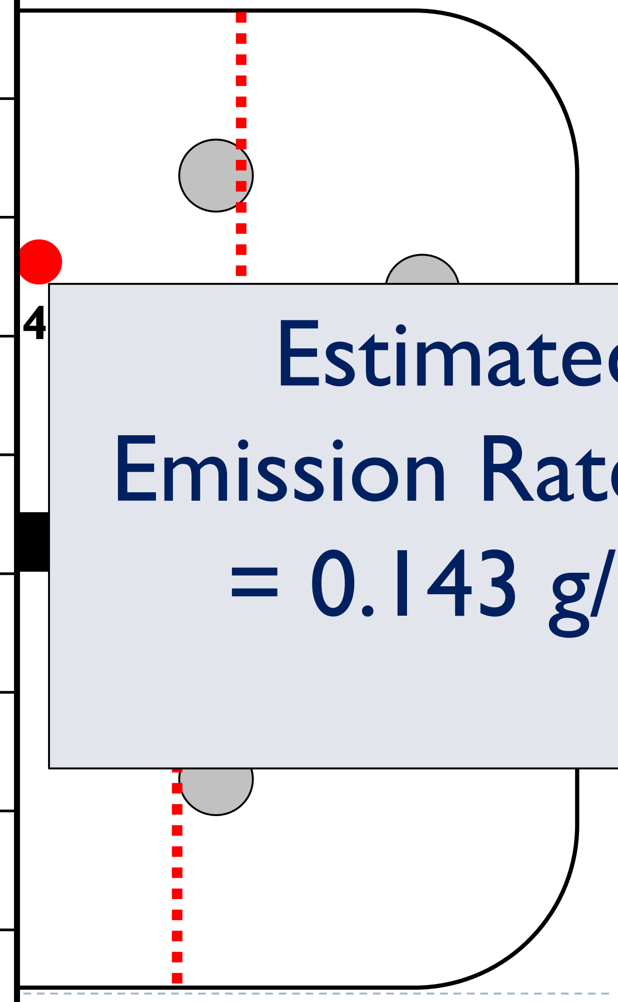


Sulfur Transformations
in a Treatment Pond



H_2S Emissions – Baseline emissions

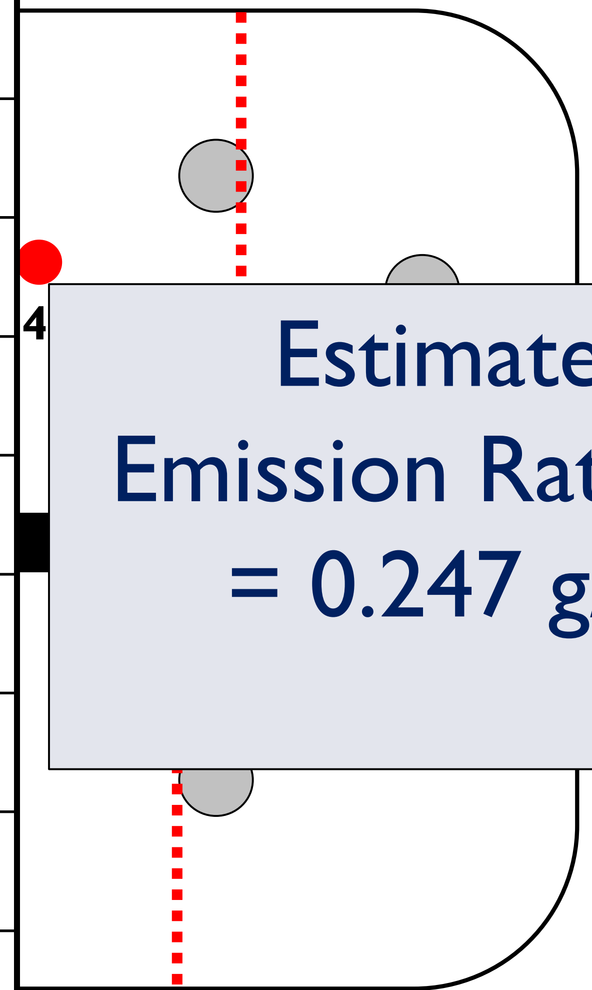
	Sulfide	pH
SP 1	300 ppb	7.2
SP 2	300 ppb	7.2
SP 3	250 ppb	7.3
SP 4	100 ppb	7.4
SP 5	50 ppb	7.5
SP 6	<30 ppb	7.5
SP 7	<30 ppb	7.5
Effluent	< 30 ppb	7.5



Estimated Emission Rate = 0.143 g/s

H_2S Emissions – Lower pH

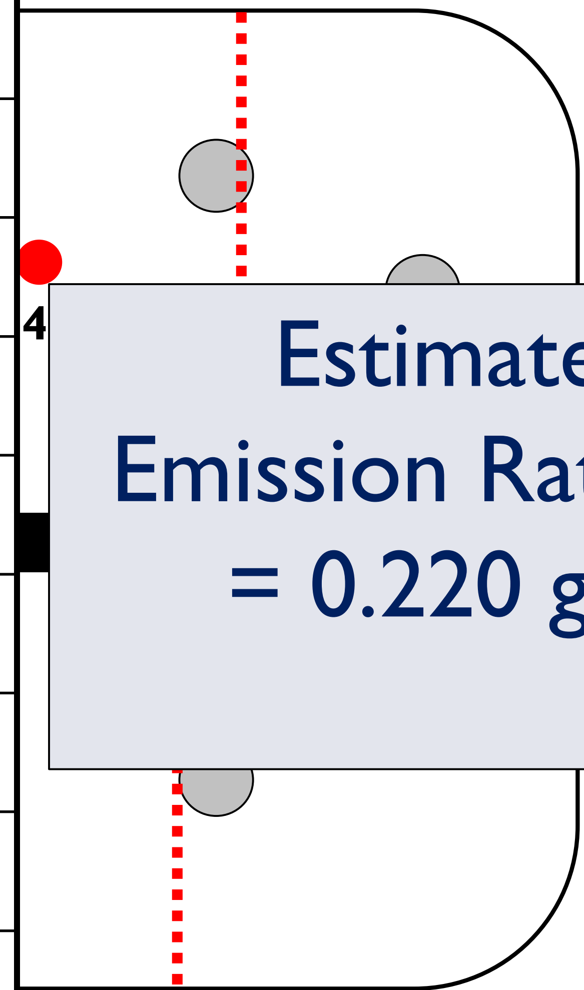
	Sulfide	pH
SP 1	300 ppb	6.7
SP 2	300 ppb	6.7
SP 3	250 ppb	6.8
SP 4	100 ppb	6.9
SP 5	50 ppb	7.0
SP 6	<30 ppb	7.3
SP 7	<30 ppb	7.5
Effluent	< 30 ppb	7.5



Estimated Emission Rate = 0.247 g/s

H_2S Emissions – Sulfide Generation

	Sulfide	pH
SP 1	300 ppb	7.2
SP 2	300 ppb	7.2
SP 3	250 ppb	7.3
SP 4	100 ppb	7.4
SP 5	150 ppb	7.5
SP 6	150 ppb	7.5
SP 7	300 ppb	7.5
Effluent	500 ppb	7.5



Estimated Emission Rate = 0.220 g/s

Summary
Best strategy to maintain emission levels

- Methanol
  - Maintain good treatment
- Hydrogen Sulfide
  - Maintain good treatment
  - Avoid low pH spikes
  - Avoid anaerobic conditions, especially in front of the system

Questions and contact information

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