

# **C & D WASTE / GYPSUM IMPACTS ON H<sub>2</sub>S GENERATION AT LANDFILLS**

## ***ODOR CONTROL AT SOLID WASTE MANAGEMENT FACILITIES***

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# Landfill Odor Sources

1. Landfill Gas
2. H<sub>2</sub>S in Landfill Gas
3. Working Face
4. Leachate / Condensate Breakouts
5. Sludge / Industrial Waste
6. Trucks – “*Hot loads*”
7. Storage Tanks
8. Odor Masking Agents

# H<sub>2</sub>S Sources and Conditions

- ❖ Sulfate Source: Gypsum Drywall (Ca SO<sub>4</sub>)
  - ▶ Plain C&D Waste
  - ▶ C&D Screenings
  - ▶ MSW / Sludge
- ❖ Conditions Required:
  - ▶ Anaerobic – Sulfate Reducing Bacteria (SRB)
  - ▶ Moisture
  - ▶ Organic Carbon
  - ▶ Temp. 20 – 39°C
  - ▶ pH 6 to 9
- ❖ Result: Hydrogen Sulfide Gas Generated!

# H<sub>2</sub>S, Standards and Criteria

1. Toxicity: Fatal = > 1000 ppm  
IDLH = 100 ppm  
OSHA 10 min. max. peak = 50 ppm
2. Air Quality Standards:  
NYS AAQS = 10 ppb  
Air Guide 1 = 10 ppb (SGC)  
ATSDR = 70 ppb (Acute MRL)  
ATSDR = 30 ppb (Intermediate MRL)  
Ambient US Background = 0.1 – 0.3 ppb
3. Odor: **Olfactory Detection Limit = 0.5 – 3 ppb**  
**Offensive Odor = 30 – 50 ppb**  
**Very Offensive – Strong = 10 – 30 ppm**

# Odor and Regulatory Concerns

## ➤ Odors:

- Typical Landfill AP-42 H<sub>2</sub>S ~35 ppm in LFG (no issue)
- H<sub>2</sub>S concentrations > 200 ppm in LFG (caution)
- High H<sub>2</sub>S in LFG > 500 ppm in LFG (problems)

## Clean Air Act:

- Sulfur Dioxide, Potential Concerns
  - PSD
  - BACT
- Major Source Level
  - 250 TPY, Attainment zone
  - 100 TPY, Non-attainment zone
- Sulfur Removal, Technologies



# Northeast H<sub>2</sub>S Experience

1. Many landfills have H<sub>2</sub>S issues.
2. Primary cause: C&D screenings w/Gypsum.
3. H<sub>2</sub>S appears related to total gypsum.
  - Screenings react faster
  - Plain C&D, more slowly
4. Site conditions vary widely

# Experience with C&D Screenings

- Higher Gypsum Content
- Small Size – Larger Surface Area
- Faster Reaction of SRB
- Use as Daily Cover – ADC
- Absorbs Moisture Easily

***CLEARLY A POTENTIAL ODOR PROBLEM!!!!***



# H<sub>2</sub>S Generation from C&D Fines

- Rapid Reaction, 2-6 Months
- High Concentrations, 10,000 – 50,000 ppm
- SRB Out-compete Methanogens
- H<sub>2</sub>S Dilution by LFG reduces concentration
- Steady State and Decline

# Landfill C&D and H<sub>2</sub>S Data

## *Landfill 5-year Avg. C&D Waste & H<sub>2</sub>S Concentrations*

LANDFILL SITE	TOTAL WASTE	C&D SCREENINGS	C&D SCREENINGS	PLAIN C&D	PLAIN C&D	5 <sup>th</sup> YEAR H <sub>2</sub> S ppm
	1000 TPY	1000 TPY	%	1000 TPY	%	
1	306	76	25%	102	33%	9500
2	264	35	13%	-	-	3000
3	1,200	91	9%	80	6%	1000
4	285	-	-	61	21%	800
5	110	-	-	110	100%	3000

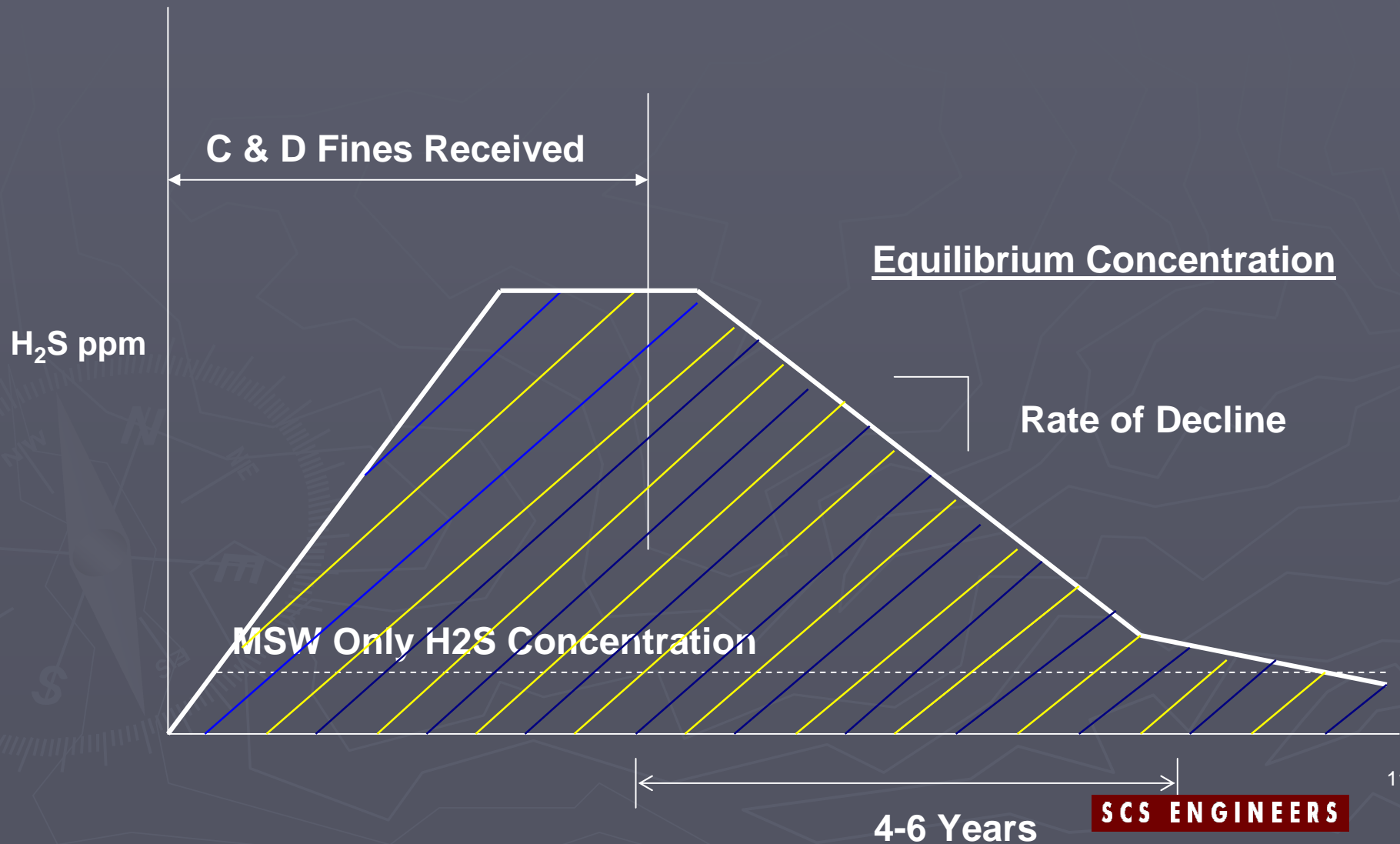
# Theoretical H<sub>2</sub>S Example – Site 2

- Sulfate to Sulfide:



- For 1.6% available sulfate:  
*11 lbs H<sub>2</sub>S per ton C&D Screenings*
- Pure H<sub>2</sub>S Gas Density (100% Conversion):  
*125 cu. ft. H<sub>2</sub>S/ton C&D screenings*
- For 35,000 TPY C&D and 1500 cfm LFG:  
*5,500 ppm Max. H<sub>2</sub>S in LFG*  
*Actual = 3000 ppm*

# H<sub>2</sub>S Growth and Decline



# Control at Landfills

## ***BAN ALL NEW CONSTRUCTION DRYWALL***

Limit C & D Fines

Additional LFG Controls

Early Geomembrane Capping

Test for Wastes Containing Sulfur

Keep Gypsum Wastes Dry

- Clay Cover
- Tarps

Mix with High pH Ash/Lime/Other

# Data Needs & Research

- Sulfate Analysis, Test Method
- Screenings Composition
- H<sub>2</sub>S in LFG
- Additives/Mixtures
- Refined BMP's
- Building De-construction

# Drywall Recycling Issues

- Re-use by Drywall Manufacturers
- Agricultural Soil Amendment
- Source Separation at Const. Sites
  - New Const. – *Prime Target*
  - Demolition – *More difficult*
- Remove Contaminants
- Recycling Infrastructure Changes



# Where Do We Go From Here?

## ❖ *Landfills*

- Require New Const. Drywall Source Separation
- Collect Data, % Sulfate, TPY C&D
- Determine Magnitude of Issue
- Limit Sulfate Receipts

## ❖ *Towns/Counties/Manufacturers*

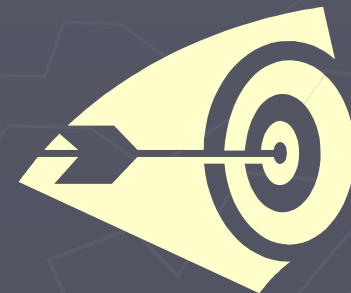
- Expand Drywall Recycling + source Separation

## ❖ *Regulators*

- Initiate Coordination of Multi-party Recycling Efforts
- Expand Input / Awareness

## ❖ *All Parties*

- Education and Awareness



# Current Happenings

- ❑ Burlington County, NJ
  - Separating out new drywall
  - Have recyclers & Markets
  - Will BAN new drywall soon
- ❑ Massachusetts
  - Working with LF & General Contractors
  - Will BAN new drywall when 75% recyclable
- ❑ New Hampshire
  - Georgia-Pacific accepting new construction drywall for recycling

# Current Happenings (cont'd)

## □ Pennsylvania

- Has 2 drywall recyclers making soil amendment
- Gypsum Agri-cycle Inc., Lancaster, PA
  - 50,000 tpy – Soil amendment, bulk
- USA Gypsum, Reinholds, PA
  - 60,000 tpy - Soil amendment, bulk/bag
  - Animal Bedding

## □ Environmental Research & Education Foundation (EREF)

- Grant, Landfill H<sub>2</sub>S Study
- SCS and University of New Hampshire