Stack Odors

Latest Developments:
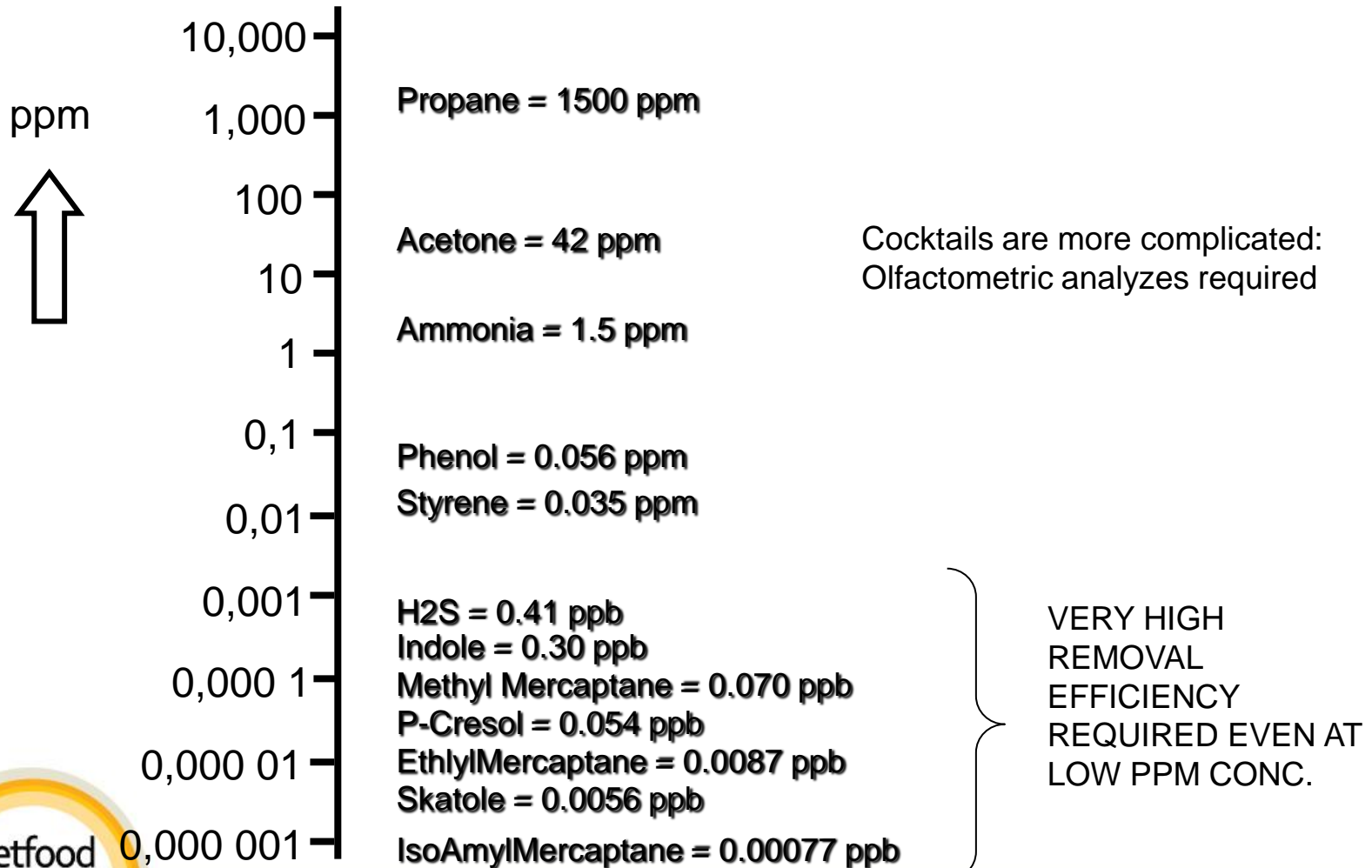- Regulations
- Emission evaluation
- Control

What makes Odor different from VOC's

- <u>Cocktail</u> of hundreds different organic components
- The weight <u>concentration (ppm) is mostly very low</u>
- All odors <u>cannot be detected analytically</u>
- Odor can <u>mask or amplify</u>
- Odor is <u>dynamic</u>, vary in time
- <u>Small Particles</u> can generate odor
- <u>Olfactometric</u> measurements up to 50% tolerance..

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Odor Threshold

ppm ↑

ppm	
10,000	
1,000	Propane = 1500 ppm
100	
10	Acetone = 42 ppm
1	Ammonia = 1.5 ppm
0,1	Phenol = 0.056 ppm
0,01	Styrene = 0.035 ppm
0,001	H2S = 0.41 ppb
	Indole = 0.30 ppb
0,000 1	Methyl Mercaptane = 0.070 ppb
	P-Cresol = 0.054 ppb
0,000 01	EthlylMercaptane = 0.0087 ppb
	Skatole = 0.0056 ppb
0,000 001	IsoAmylMercaptane = 0.00077 ppb

Cocktails are more complicated:
Olfactometric analyzes required

VERY HIGH REMOVAL EFFICIENCY REQUIRED EVEN AT LOW PPM CONC.

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Regulations: Global trends

- Worldwide increase acceptance CEN13725

- Interlaboratory Tests

- Latest regulatory developments

- Setting odor limits - trends

Odor measurement: Olfactometer

- Odor Lab

- Equipment requirements

- Panel selection

- Nose calibration reference gas

- Odor dilution

- Odor concentration ou/m3

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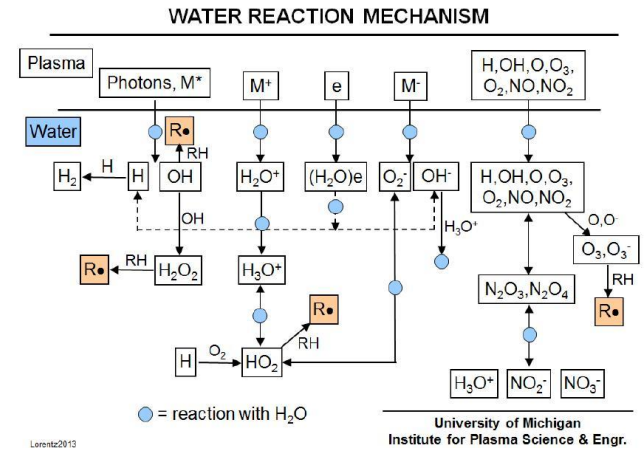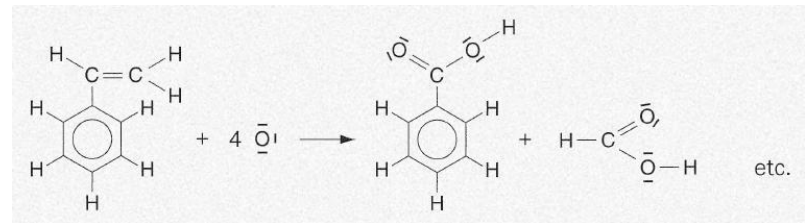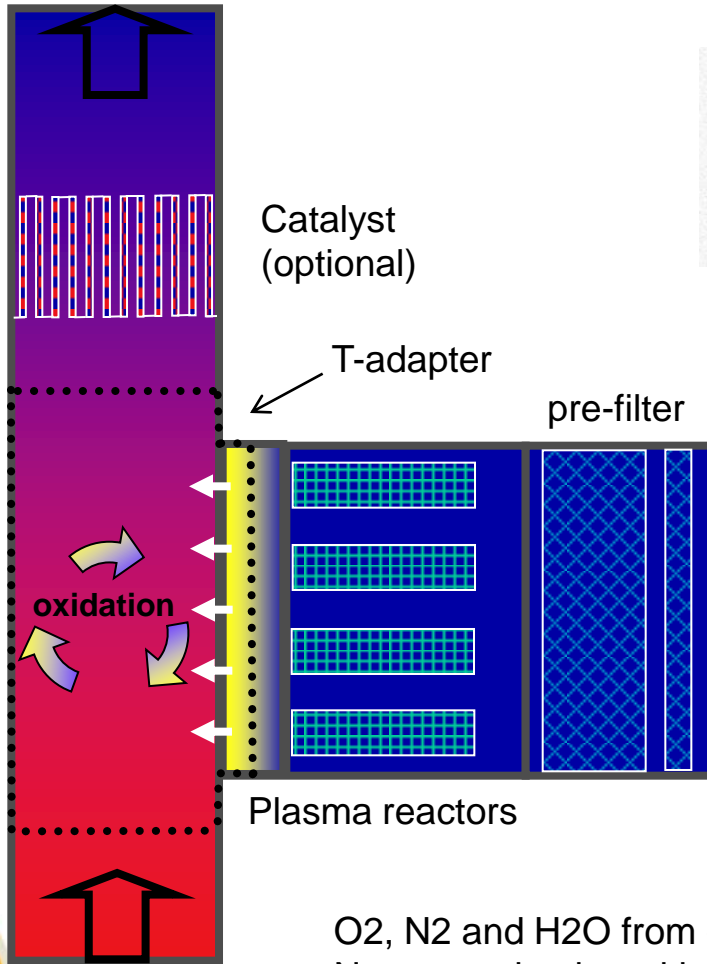
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Odor Control:
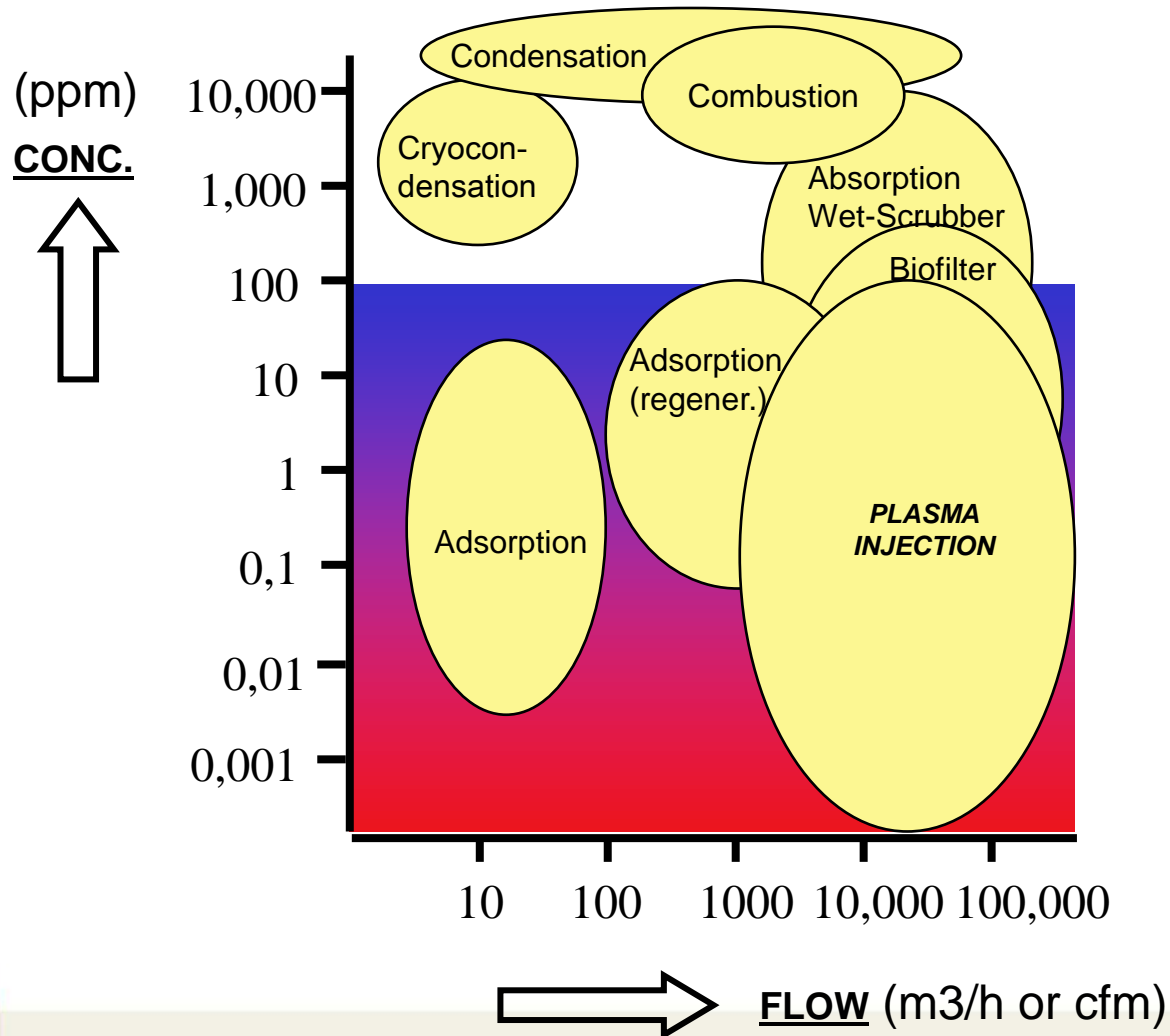
Validation Criteria - Petfood

0 = poor 10 = excellent	Waste-flow	Area	Energy	Invest. cost	Operat. cost	Life	Easy to operate	**Odour reduction**	**TOTAL**
Adsorption	4	4	4	4	2	7	6	**2**	**33**
Combustion	1	5	1	3	1	6	4	**10**	**31**
Bio filtration	8	1	7	7	8	9	7	**7**	**54**
Chem.scrubber	1	4	7	4	2	7	2	**7**	**34**
Plasma in-situ	8	7	7	7	8	7	8	**8**	**60**
Plasma injection	9	10	7	8	8	10	9	**9**	**70**

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Plasma injection: now at 30,000Hz
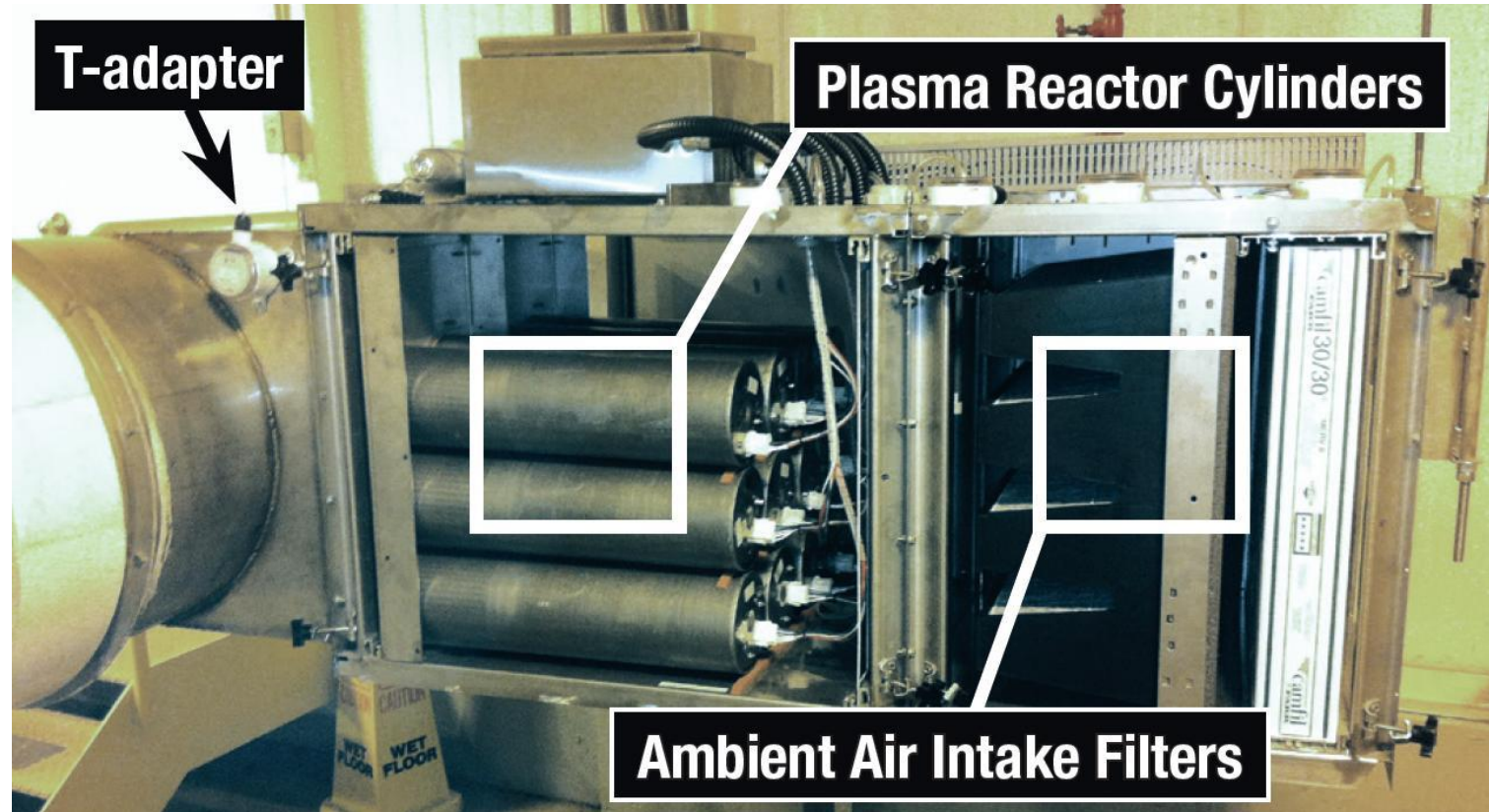

Catalyst
(optional)

T-adapter

pre-filter

oxidation

Plasma reactors

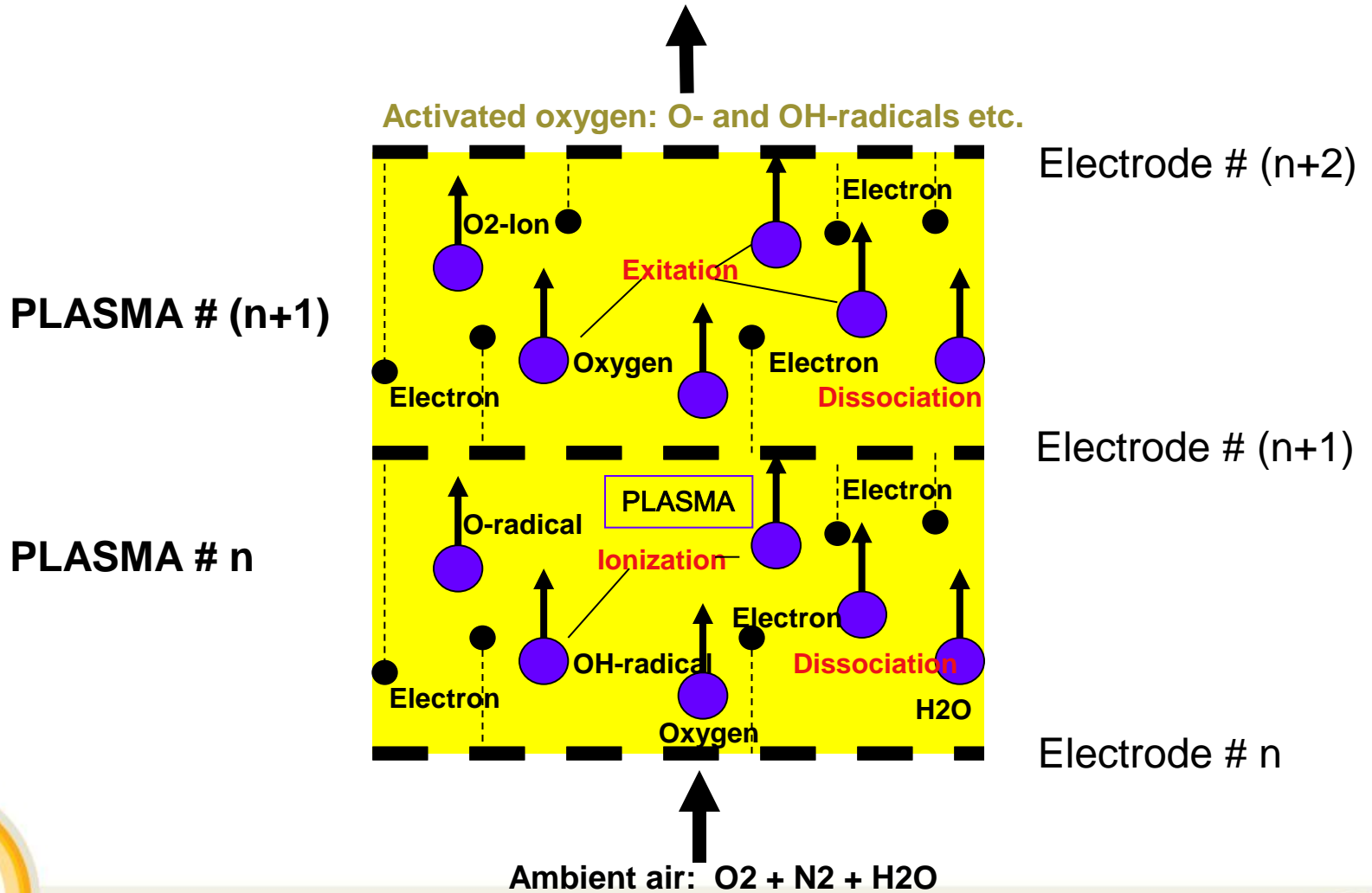O2, N2 and H2O from clean ambient air
No contamination with exhaust air

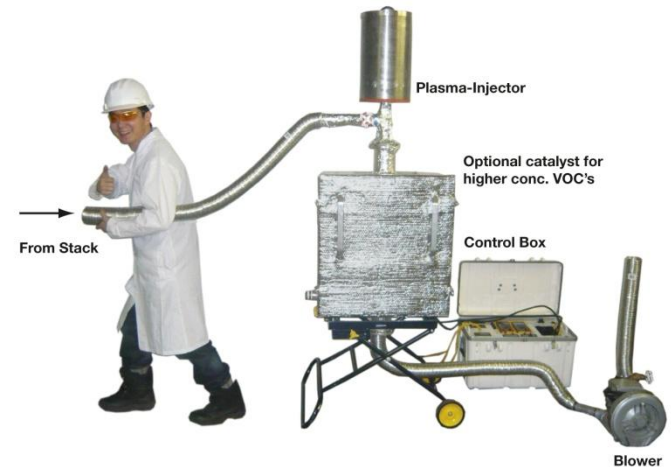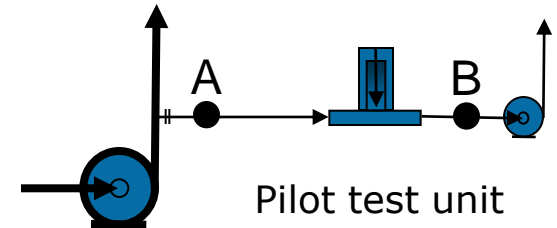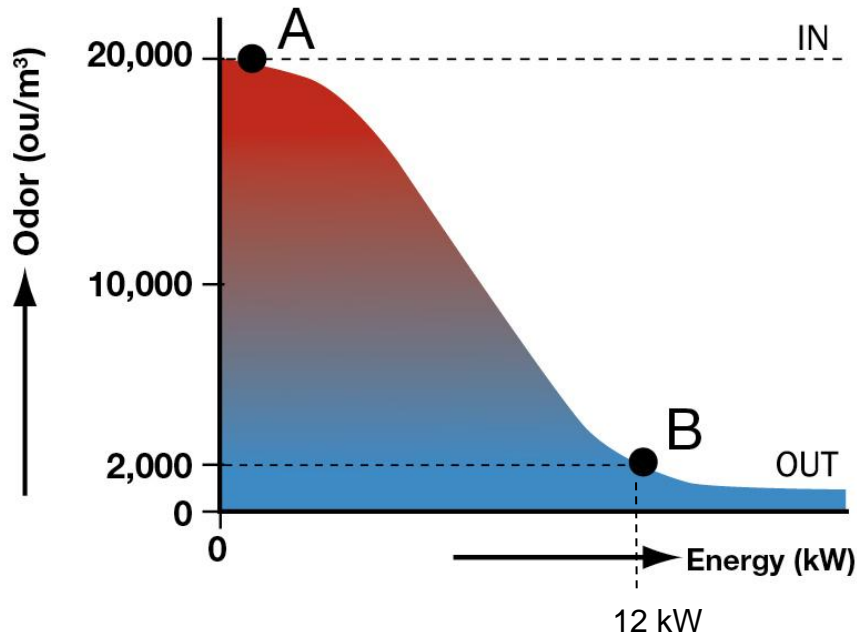# Plasma injection: 16,000 cfm dryer

Size: HxWxL = app. 3ft x 2ft x 5ft

Cold Plasma Reactor

Activated oxygen: O- and OH-radicals etc.

Electrode # (n+2)

PLASMA # (n+1)

O2-Ion

Exitation

Electron

Oxygen   Electron

Electron   Dissociation

Electrode # (n+1)

PLASMA # n

O-radical

PLASMA

Electron

Ionization

OH-radical

Electron

Dissociation

Electron

Oxygen   H2O

Electrode # n

Ambient air: O2 + N2 + H2O

Case: 3 lines x 52,000 cfm (30 t/h)

Dryer = 16,000 cfm; from 20,000 to 1,400 ou/m3

Odor reduction = f (energy)

A

B

Pilot test unit

IN

20,000 — A

Odor (ou/m³)

10,000

B

2,000 OUT

0

0

Energy (kW)

12 kW

Plasma-Injector

Optional catalyst for higher conc. VOC's

From Stack

Control Box

Blower

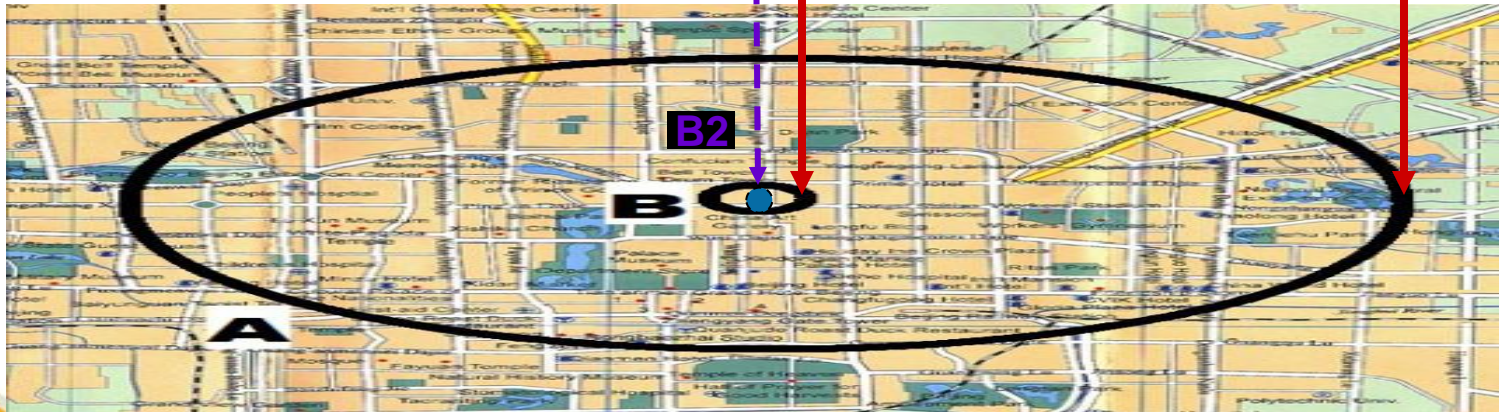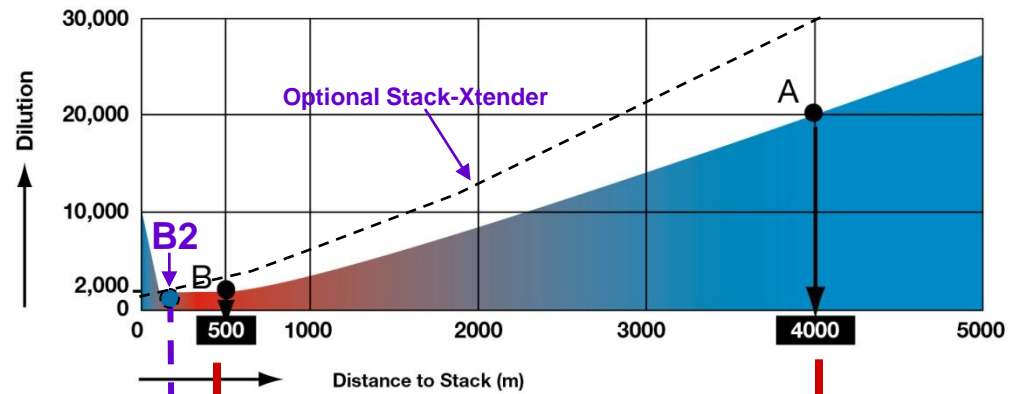Petfood Forum

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Odor Dispersion Modeling

Odor reduction = f (energy)
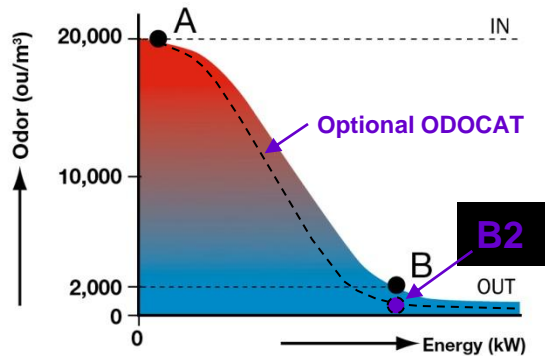
Dilution versus Distance to Stack (example)

Petfood plant 30 t/h, 12 stacks

Modeling Case 1b:
- Stack ft/s Increased;
- No stacks treated;
- Weather: Nov 13
  and Dec 14 (9 odor
  complaints total).

KEY: Odor Units/Cubic Meter
100: Extremely Strong
60: Very Strong
30: Strong
20: Distinct to Strong
10: Weak to Distinct
5: Weak
1: Very Weak
0: No Odor

Contours
— 1.0
— 2.0
— 3.0
-- 4.0
— 5.0
— 6.0
— 7.0
— 10.0
— 15.0
— 20.0

Untreated 3 lines x 52,000 = 156,000 cfm

Petfood plant 30 t/h, 12 stacks

Modeling Case 3b:
- Stack ft/s Increased;
- All stacks treated;
- Weather: Nov 13 and Dec 14 (9 odor complaints total).

KEY: Odor Units/Cubic Meter
100: Extremely Strong
60: Very Strong
30: Strong
20: Distinct to Strong
10: Weak to Distinct
5: Weak
1: Very Weak
0: No Odor

Contours
— 1.0
— 2.0
···· 3.0
- - 4.0
— 5.0
— 6.0
— 7.0
— 10.0
— 15.0
— 20.0
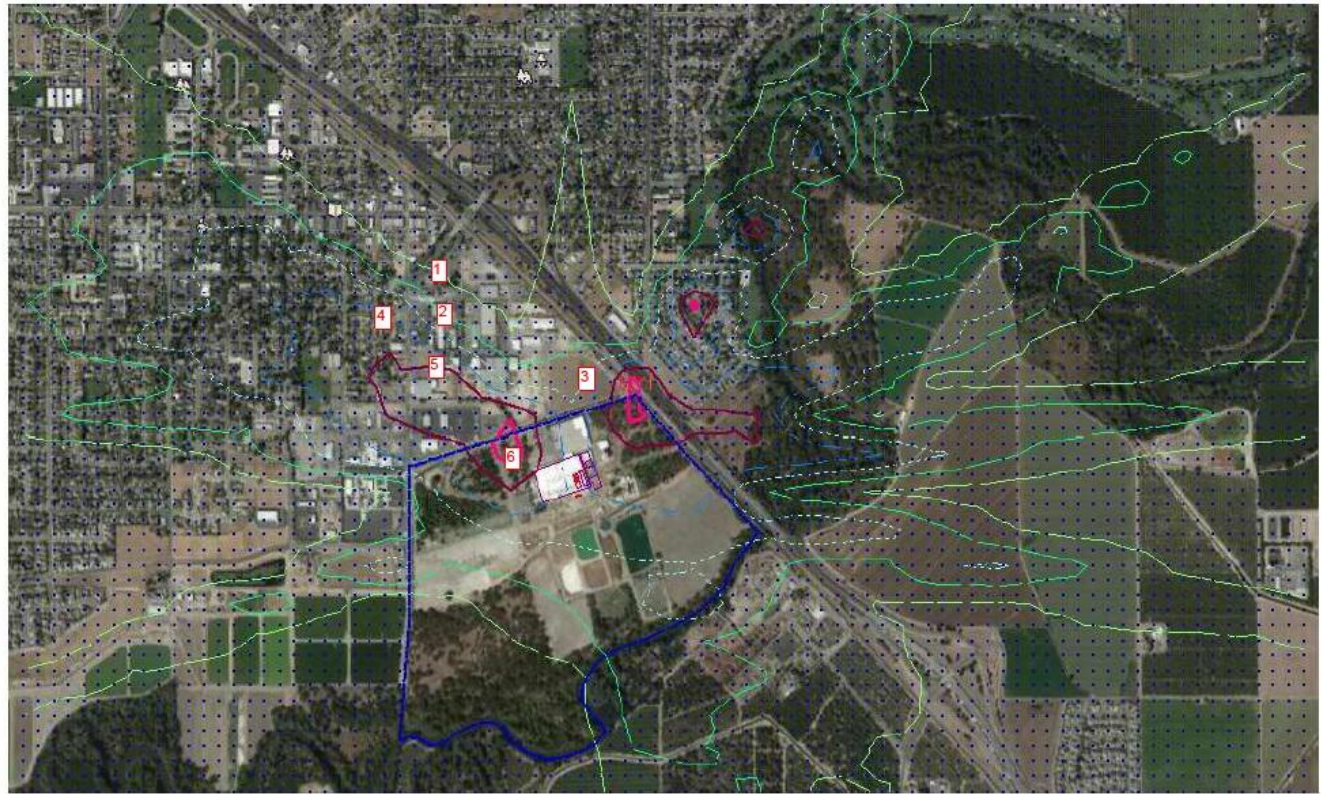
Plasma injection on all stacks (99kW for 156,000cfm)

Thank you

Any questions?

More info: info@uniqair.com