

CARPINTERIA AIR QUALITY SAMPLING CASE STUDY RESULTS & CONCLUSIONS



August 2019

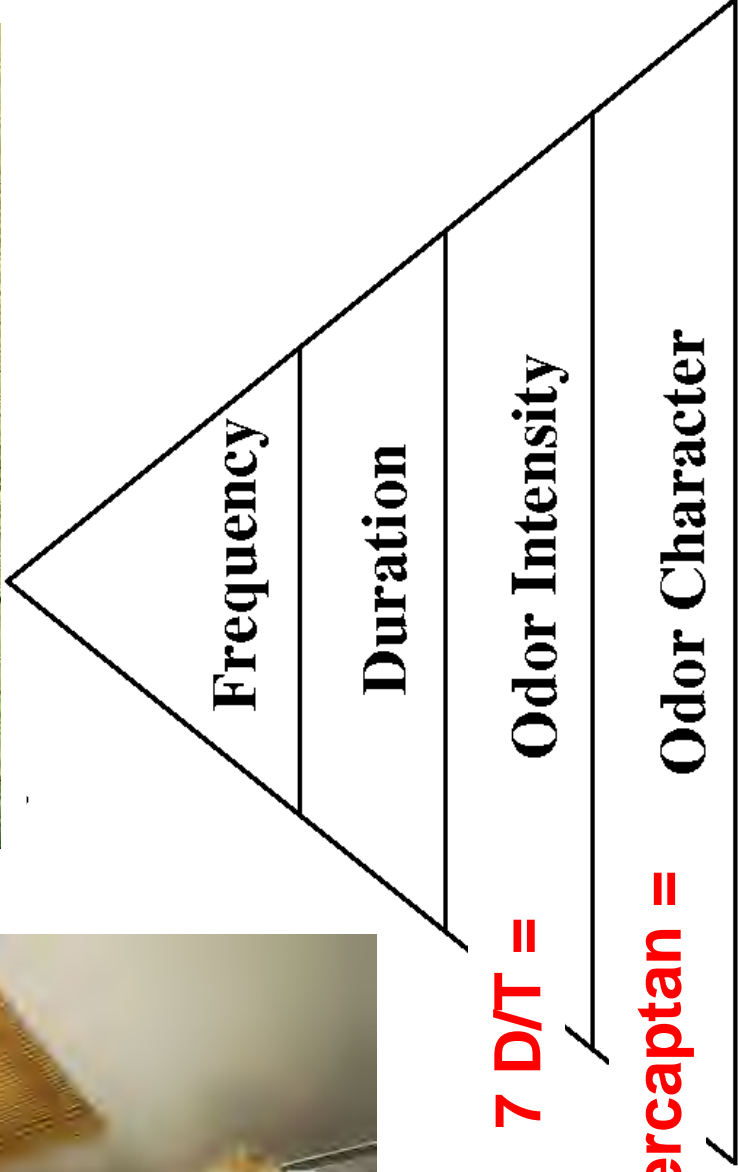
CASE STUDY FINDINGS

CARPINTERIA, CALIFORNIA

- Vapor Odor Neutralizing System reduced odors by 98.7% or better; measured at distances as little as 30 feet from greenhouse.
- Vapor phase performed as good as carbon filtration and is more effective for large volume air spaces such as greenhouses; vapor can also abate odors that escape the primary structure.
- Structure makes a difference, the system performed efficiently with open roof vents.
- Vapor phase system effectively abated odor during harvesting/processing phase, the most odor intensive stage of cannabis cultivation observed.
- Iterations in the technology & application have improved the efficacy of odor neutralizing systems.

METHODOLOGY

ODOR SAMPLE ANALYSIS



METHODOLOGY

ODOR SAMPLE ANALYSIS



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August 13, 2019

Paul Schaefer
SCS Engineers
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RE: Odor Panel Analysis – August 6, 2019
OS&E Project No. 2151LM-00
SCS Sampling Site: C&B

Dear Paul,

This letter presents the results of the recent odor panel analyses conducted by Odor Science & Engineering, Inc. (OS&E) for SCS Engineers. A total of fourteen (14) odor emission samples were collected on August 7th, 2019 by one-site SCS personnel. The odor samples were collected into Tedlar gas sampling bags provided by OS&E. Following sample collection, the sample bags were shipped via UPS Overnight to OS&E's Olfactory Laboratory in Bloomfield, CT for sensory analysis the next day. The samples arrived intact with a chain of custody requesting sensory analysis attached.

Upon arrival the samples were analyzed by dynamic dilution olfactometry using a trained and screened odor panel of 8 members. The odor panels were chosen from OS&E's pool of panelists from the Greater Hartford area who actively participate in ongoing olfactory research and represent an average to above average sensitivity when compared to a large population. The samples were quantified in terms of dilution-to-threshold (D/T) ratio and odor intensity in accordance with ASTM Methods E-679-04 and E-344-10, respectively. The odor panelists were also asked to describe the odor character of the samples at varying dilution levels. The odor panel methodology is further described in Attachment A.

The results of the odor panel tests are presented in the attached Table

We appreciate the opportunity to be of continued service to SCS Engineers. Please feel free to call Martha O'Brien or me if you have any questions concerning these results.

Sincerely,
ODOR SCIENCE & ENGINEERING, INC

Gary K. Granley

Gary K. Granley
Associate Scientist

**Table 1. Results of dynamic dilution olfactometry
SCS Engineers – Sampling
OS&E Project No. 2151**

Date	Time	Sample ID	Odor Conc. D/T ⁽¹⁾	Stevens' Law Constants ⁽²⁾		Odor Character
				a	b	
8/07/2019	07:12	AM-S1	9	--	--	sour, rubber, burnt
8/07/2019	07:17	AM-S2	11	--	--	stale, musty, onion
8/07/2019	07:21	AM-S3	12	--	--	sour, sweet, rubber, garbage, exhaust, rubber, plastic, exhaust
8/07/2019	07:29	AM-E	9	--	--	sour, rubber, garbage, sewage, plastic, burnt, exhaust
8/07/2019	06:52	AM-LP	12	--	--	sour, stale, sulfur, H ₂ S, rubber, exhaust
8/07/2019	07:11	AM-W	9	--	--	sour, plastic, swampy, sulfur, exhaust
8/07/2019	07:23	AM-GH	163	44	.76	skunk, rotten, mercaptan, burnt sulfur
8/07/2019	13:48	PM-GH	250	53	.89	skunk, dead skunk, marijuana/"pot"
8/07/2019	13:36	PM-N1	13	--	--	sour, rubber, glue, paste, putty, plastic, exhaust
8/07/2019	13:33	PM-L1	11	--	--	sour, sweet, rubber, garbage, exhaust, rubber, floor chemical, plastic, exhaust
8/07/2019	13:25	PM-M2	12	--	--	sour, burnt, rubber, sewage, garbage, exhaust, plastic, exhaust
8/07/2019	13:30	PM-L2	9	--	--	sour, sweet, rubber, musty, vegetation, chemical, plastic, exhaust
8/07/2019	13:21	PM-M1	15	--	--	rotten, skunk, mercaptan, garlic, sulfur, sewage, plastic, exhaust
8/07/2019	13:20	PM-LP	12	--	--	sour, sulfur, sewage, H ₂ S, stale, plastic, exhaust

METHODOLOGY

ODOR SAMPLE ANALYSIS



AIR SAMPLING RESULTS (WITH BASELINE)

ODOR INTENSITY AND CHARACTER

AM – Early Morning
Calm, no wind. From S and SW. 0-2 mph, blowing 205°



AIR SAMPLING RESULTS (NET INCREASE)

ODOR INTENSITY AND CHARACTER

AM – Early Morning
Calm, no wind. From S and SW. 0-2 mph, blowing 205°



AIR SAMPLING RESULTS

ODOR INTENSITY AND CHARACTER

AM – Early Morning

Calm, no wind. From S and SW. 0-2 mph, blowing 205°



ODOR INTENSITY WITH BASELINE

Baseline/Upwind Intensity & Character	In Greenhouse Gross Intensity Increase & Character	Short-Range (0-30 feet) Gross Intensity Increase & Character	Medium-Range (Approx. 31-60 feet) Gross Intensity Increase & Character	Long-Range (Approx. more than 60 feet) Gross Intensity Increase & Character
12 sour, stale, sulfur, H ₂ S, rubber, exhaust	163 skunk, rotten, mercaptan, burnt sulfur	9 sour, rubber, burning, plastic, musty, moldy, light sewage, exhaust	11 stale, musty, oniony, mercaptan, sewage, H ₂ S, plastic, wet cardboard, exhaust	12 sour, sweet, rubber, garbage, exhaust, rubber, plastic, exhaust
			9 sour, rubber, garbage, sewage, plastic, burnt, exhaust	
			9 sour, plastic, swampy, sulfur, exhaust	

AIR SAMPLING RESULTS

ODOR INTENSITY AND CHARACTER

AM – Early Morning

Calm, no wind. From S and SW. 0-2 mph, blowing 205°



NET INCREASE

ODOR INTENSITY

Baseline/Upwind Intensity & Character	In Greenhouse <u>Net</u> Intensity Increase & Character	Short-Range (0-30 feet) <u>Net</u> Intensity Increase & Character	Medium-Range (Approx. 31-60 feet) <u>Net</u> Intensity Increase & Character	Long-Range (Approx. more than 60 feet) <u>Net</u> Intensity Increase & Character
0 sour, stale, sulfur, H2S, rubber, exhaust	151 skunk, rotten, mercaptan, burnt sulfur	-3 sour, rubber, burning, plastic, musty, moldy, light sewage, exhaust	-1 stale, musty, oniony, mercaptan, sewage, H2S, plastic, wet cardboard, exhaust	0 sour, sweet, rubber, garbage, exhaust, rubber, plastic, exhaust
			-3 sour, rubber, garbage, sewage, plastic, burnt, exhaust	-3 sour, plastic, swampy, sulfur, exhaust

AIR SAMPLING RESULTS (WITH BASELINE)

ODOR INTENSITY AND CHARACTER

PM-Early Afternoon
Steady breeze from SW. 6
mph, blowing 225°



AIR SAMPLING RESULTS (NET INCREASE)

ODOR INTENSITY AND CHARACTER

PM-Early Afternoon
Steady breeze from SW. 6
mph, blowing 225°



Legend
G Greenhouse Sample
U Upwind Sample
N North Sample
W West Sample
E East Sample

AIR SAMPLING RESULTS

ODOR INTENSITY AND CHARACTER

PM-Early Afternoon

Steady breeze from SW. 6 mph, blowing 225°



ODOR INTENSITY WITH BASELINE

Baseline/Upwind Intensity & Character	In Greenhouse Gross Intensity Increase & Character	Short-Range (50 feet) Gross Intensity Increase & Character	Medium-Range (Approx. 75 feet) Gross Intensity Increase & Character	Long-Range (Approx. 165 feet) Gross Intensity Increase & Character
12 sour, sulfur, sewage, H ₂ S, stale, plastic, exhaust	250 skunk, dead skunk, marijuana/"pot"	13 sour, rubber, glue, paste, putty, plastic, exhaust	12 sour, burnt, rubber, sewage, garbage, exhaust, plastic, exhaust	9 sour, sweet, rubber, musty, vegetation, chemical, plastic, exhaust
			15 rotten, skunk, mercaptan, garlic, sulfur, sewage, plastic, exhaust	11 sour, sweet, rubber, garbage, exhaust, rubber, floor chemical, plastic, exhaust

AIR SAMPLING RESULTS

ODOR INTENSITY AND CHARACTER

PM-Early Afternoon

Steady breeze from SW. 6 mph, blowing 225°



NET INCREASE

ODOR INTENSITY

Baseline/Upwind Intensity & Character	In Greenhouse <u>Net Intensity Increase</u> & Character	Short-Range (50 feet) <u>Net Intensity Increase</u> & Character	Medium-Range (Approx. 75 feet) <u>Net Intensity Increase</u> & Character	Long-Range (Approx. 165 feet) <u>Net Intensity Increase</u> & Character
0 sour, sulfur, sewage, H2S, stale, plastic, exhaust	238 skunk, dead skunk, marijuana/"pot"	1 sour, rubber, glue, paste, putty, plastic, exhaust	0 sour, burnt, rubber, sewage, garbage, exhaust, plastic, exhaust	-3 sour, sweet, rubber, musty, vegetation, chemical, plastic, exhaust
			3 rotten, skunk, mercaptan, garlic, sulfur, sewage, plastic, exhaust	-1 sour, sweet, rubber, garbage, exhaust, rubber, floor chemical, plastic, exhaust