AMERICAN WATER

Method Development and Analysis of 19 Taste & Odor Compounds in Drinking Water Following SM 6040D

Katie Kohoutek, American Water

Environmental Measurement Symposium

August 4, 2025

Taste & Odor in the News

Community Corner

Weird-Tasting Water In West Orange (Here's What Is Causing It)

Notice an "earthy, musty taste" or odor in your drinking water, West Orange? Here's when it is expected to clear up.

Patch Eric Kiefer, Patch Staff

Posted Wed, Jun 26, 2024 at 2:56 pm ET

According to an alert sent from New Jersey American Water on Tuesday, customers in West Orange may temporarily notice an "earthy, musty taste" or odor to their drinking water. (Shutterstock)

NEWS

Why does the Springfield city water smell and taste funny?

by: Tony Nguyen
Posted: Aug 20, 2024 / 11:50 AM CDT
Updated: Aug 20, 2024 / 05:47 PM CDT

SHARE

SPRINGFIELD, Mo. — If you have noticed a strange smell or taste coming from your tap wate
aren't alone. Several people have reported a "musty" or "earthy" smell and flavor to the wa
OzarksFirst spoke with City Utilities to find some answers.

LOCAL NEWS

L.A. water department customers say tap water smells, tastes 'moldy,' 'musty'

by: Josh DuBose
Posted: Jun 19, 2024 / 10:20 PM PDT
Updated: Jun 19, 2024 / 10:50 PM PDT

Drinking water in Wilmington, Delaware is safe despite 'earthy' taste and odor, officials say

By 6abc Digital Staff
Monday, July 8, 2024

Residents of Wilmington, Delaware may notice their water has a different taste or smell, but city officials say the water is safe to drink.

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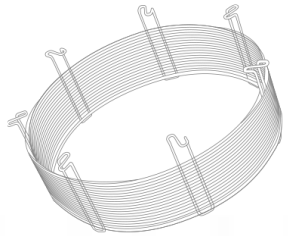
Standard Methods for Taste & Odor

SM 2150B: Threshold Odor Test
SM 2150C: Total Intensity of Odor in Water

SM 2160B: Flavor Threshold Test
SM 2160C: Flavor Rating Assessment
SM 2170: Flavor Profile Analysis



SM 6040B: CLSA GC-MS
SM 6040C: P&T GC-MS
SM 6040D: SPME GC-MS
SM 6040E: CI SPME GC-MS/MS

Standard Methods Online: https://www.standardmethods.org/doi/10.2105/SMWW.2882.117

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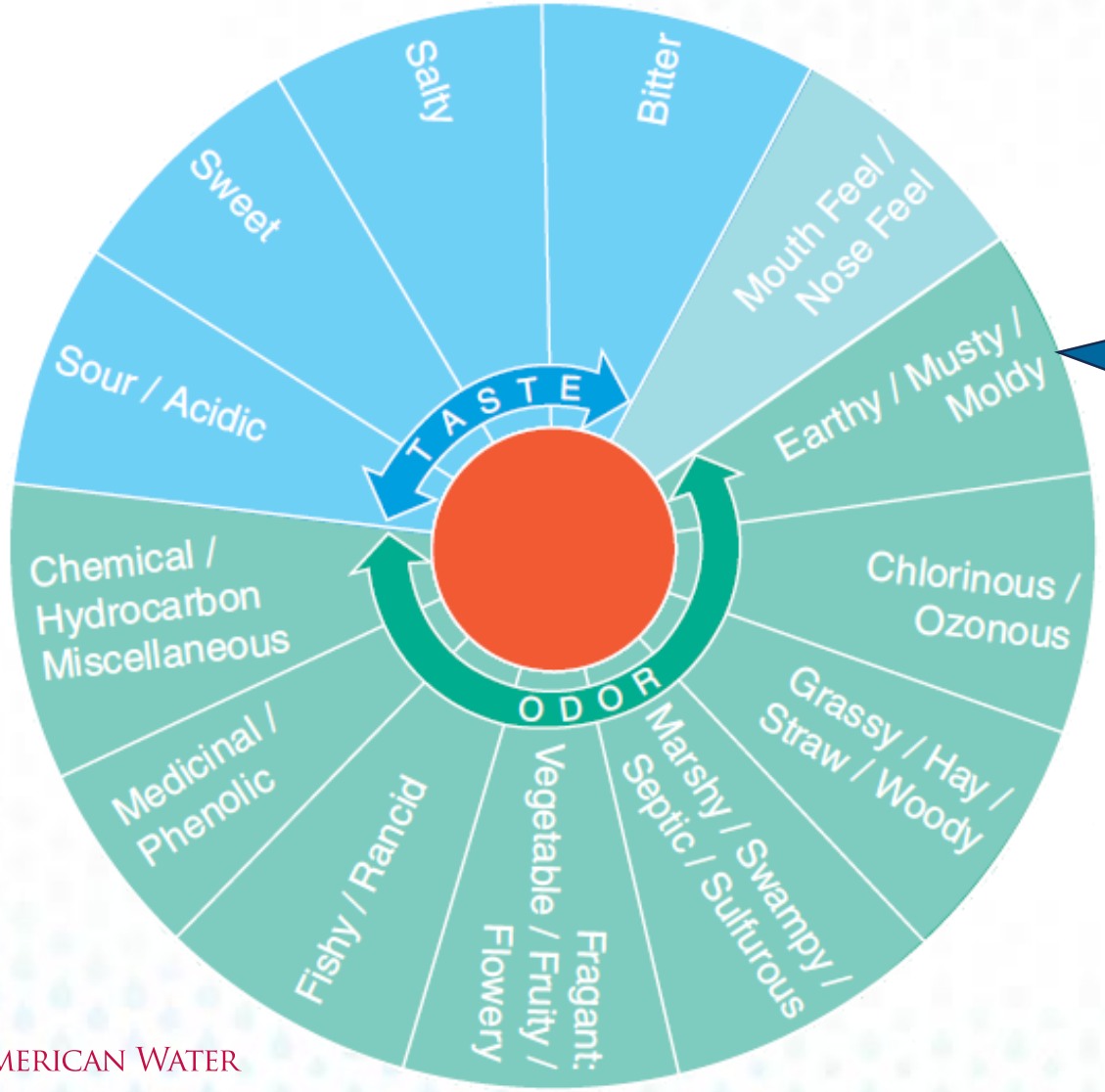
Taste & Odor Wheel – SM 6040D



- Geosmin
- 2-Methylisoborneol (MIB)
- 2-isopropyl-3-methoxypyrazine (IPMP)
- 2-isobutyl-3-methoxypyrazine (IBMP)

SM Figure 2170:1 (inset)

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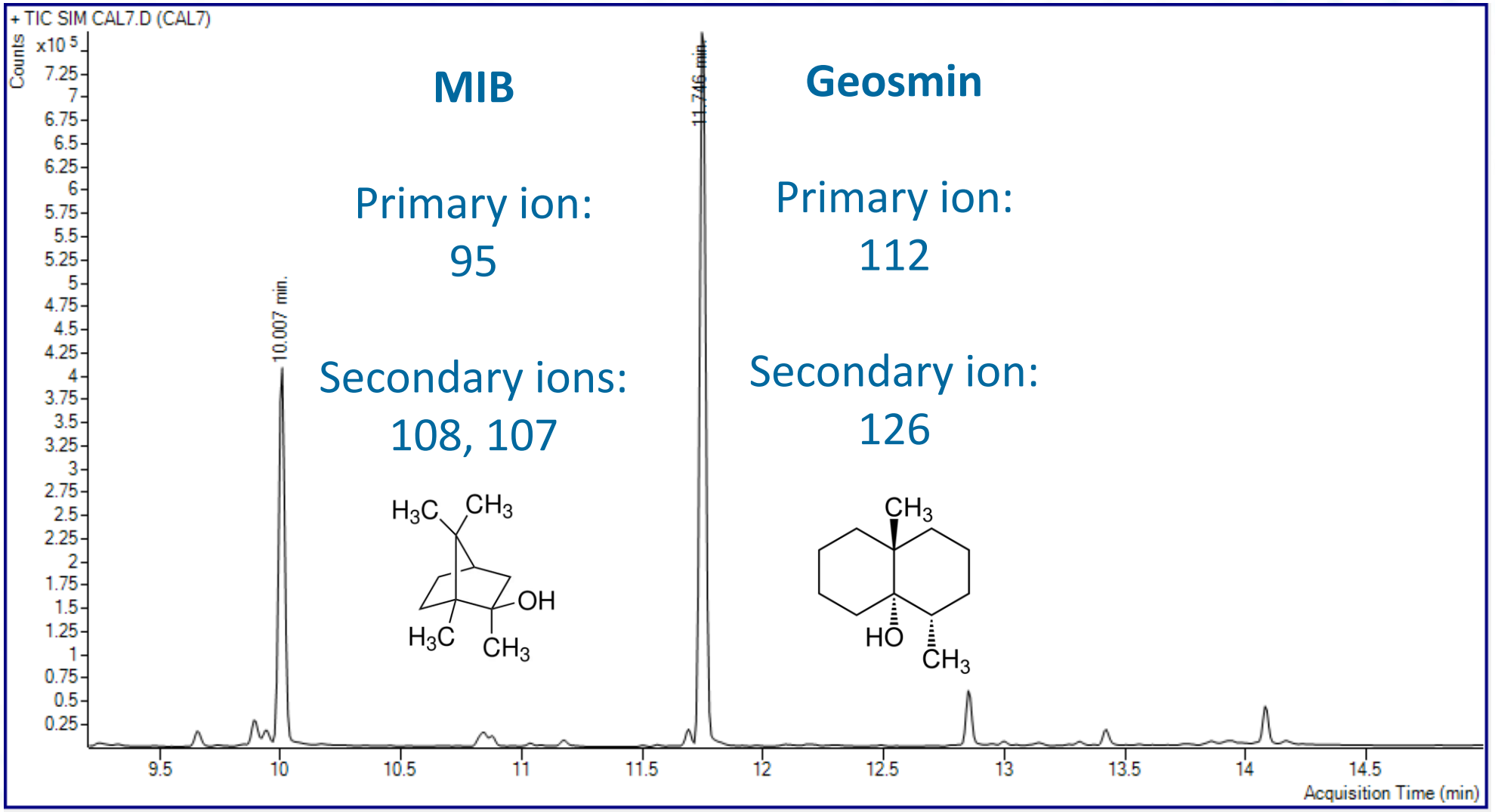
SM 6040D: Selected Ion Monitoring

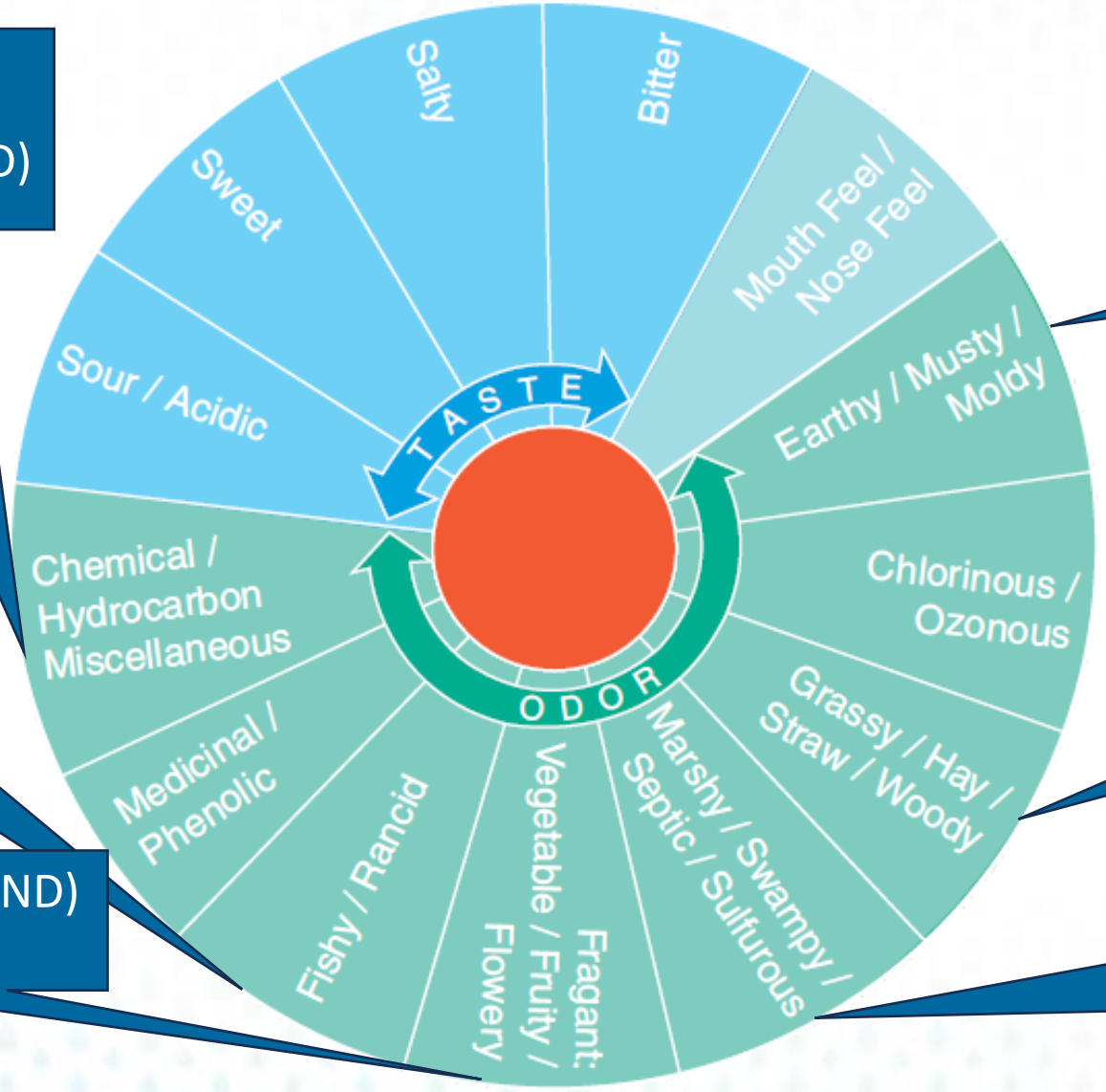


Taste & Odor Wheel – Compound Selection

Pochiraju et al. (2021) *Water Research X*.
https://doi.org/10.1016/j.wroa.2021.100099

- 2-ethyl-4-methyl-1,3-dioxolane (EMD)

- 2,4,6-trichloroanisole (2,4,6-TCA)
- 2,3,6-trichloroanisole (2,3,6-TCA)
- 2,4,6-tribromoanisole (2,4,6-TBA)



- Hexanal
- Cis-3-hexen-1-ol (C3HO)
- Cis-3-hexenyl acetate (C3HA)
- β-cyclocitral
- β-ionone

- 2,4-heptadienal (2,4-HD)
- Octanal*

- Dimethyl sulfide (DMS)*
- Dimethyl disulfide (DMDS)
- Dimethyl trisulfide (DMTS)

- 2,6-nonadienal (2,6-ND)
- Indole

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Standard Methods Joint Task Group Participants

Odor Threshold Concentrations (OTC)

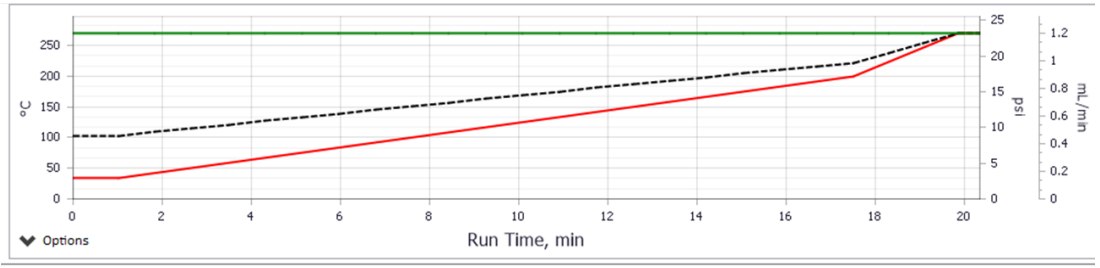
Category	Compound Name	OTC (ppt)	Category	Compound Name	OTC (ppt)
Earthy Musty Moldy	2,3,6-TCA	0.1 – 2	Grassy Hay Straw Woody	β-cyclocitral	19,000
	2,4,6-TBA	0.1 – 10		β-ionone	7
	2,4,6-TCA	0.1 – 2		C3HO	70,000
	IBMP	<1		C3HA	1,000 – 2,000
	IPMP	<1 – 2		Hexanal	4,500
	MIB	2 – 15	Fishy Rancid	2,4-HD	1,000 – 5,000
	Geosmin	4 – 10		Octanal	Unknown
Moldy Swampy Septic Sulfurous	DMDS	30	Fruity Flowery	2,6-ND	20
	DMS	1,000		Indole	100
	DMTS	10	Chemical	EMD	10

Method Development Considerations

Parameter	Tests	Final
Sodium chloride	1 – 8 g	4 – 8 g
SPME type	DVB/PDMS Arrow DVB/CAR/PDMS fiber	Either
SPME conditioning	2 – 5 min	5 min
Extraction temperature	50 – 65 °C	65 °C

Parameter	Tests	Final
Incubation time	4 – 5 min	4 min
Sample agitation	Yes / No	Yes
Extraction time	15 – 30 min	15 min with agitation
Desorption time	0.8 – 2 min	2 min with 5:1 split

Method Development Considerations



	Rate °C/min	Value °C	Hold Time min
(Initial)		35	1
Ramp 1	10	200	0
Ramp 2	30	270	0.5

Parameter	Tests	Final
GC inlet flow and split ratio	Splitless, 50 mL/min Split 5:1, 1.2 mL/min Split 7.5:1, 1.2 mL/min	Split 5:1 1.2 mL/min
GC inlet temperature	250 – 270 °C	250 °C
GC temperature gradient	Start: 35 – 50 °C End: 250 – 280 °C	Start: 35 °C End: 280 °C
Transfer line temperature	250 – 280 °C	280 °C
Ion source temperature	230 – 300 °C	230 °C

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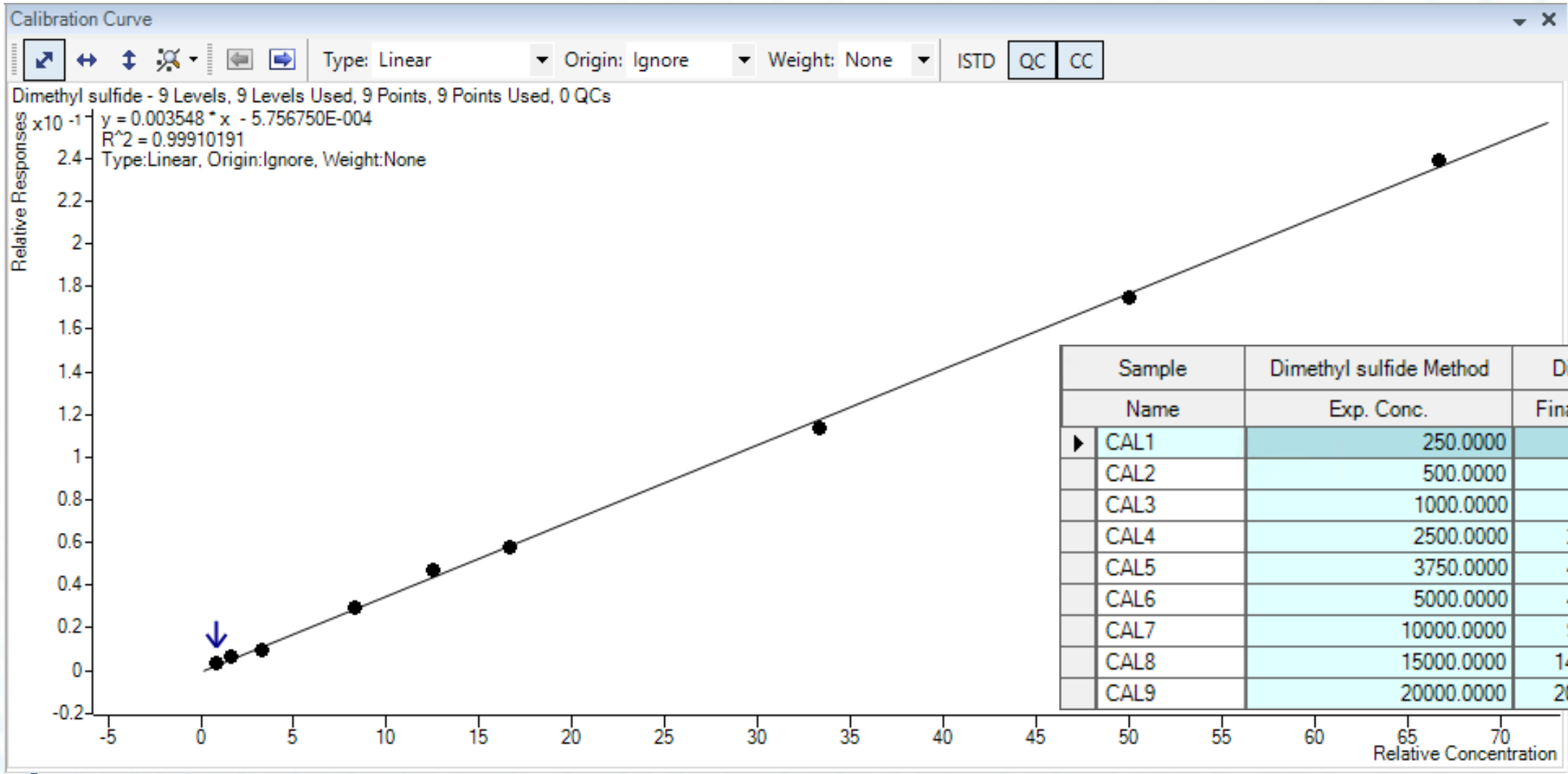
Interlaboratory Comparison Study

- Optimize SPME GC-MS instrument starting with recommended settings
- Prepare multipoint calibration curve with internal standard encompassing the OTCs of each compound
- Analyze:
  - Calibration curve
  - Method Blank (MB)
  - Seven Laboratory Fortified Blank (LFB) replicates
  - Mid-range Continuing Calibration Verification (CCV)

Acceptance Criteria

- Analyte recovery in MB < ½ lowest calibration point
- Calibration curve minimum 5 points for linear and 6 points for quadratic
- Lowest calibration point recovery 50 – 150%
- All other calibration points recovery 70 – 130%
- LFB recovery 70 – 130%
- CCV recovery 70 – 130%
- Internal standard recovery ± 10% RSD

Dimethyl Sulfide Calibration Curve Example



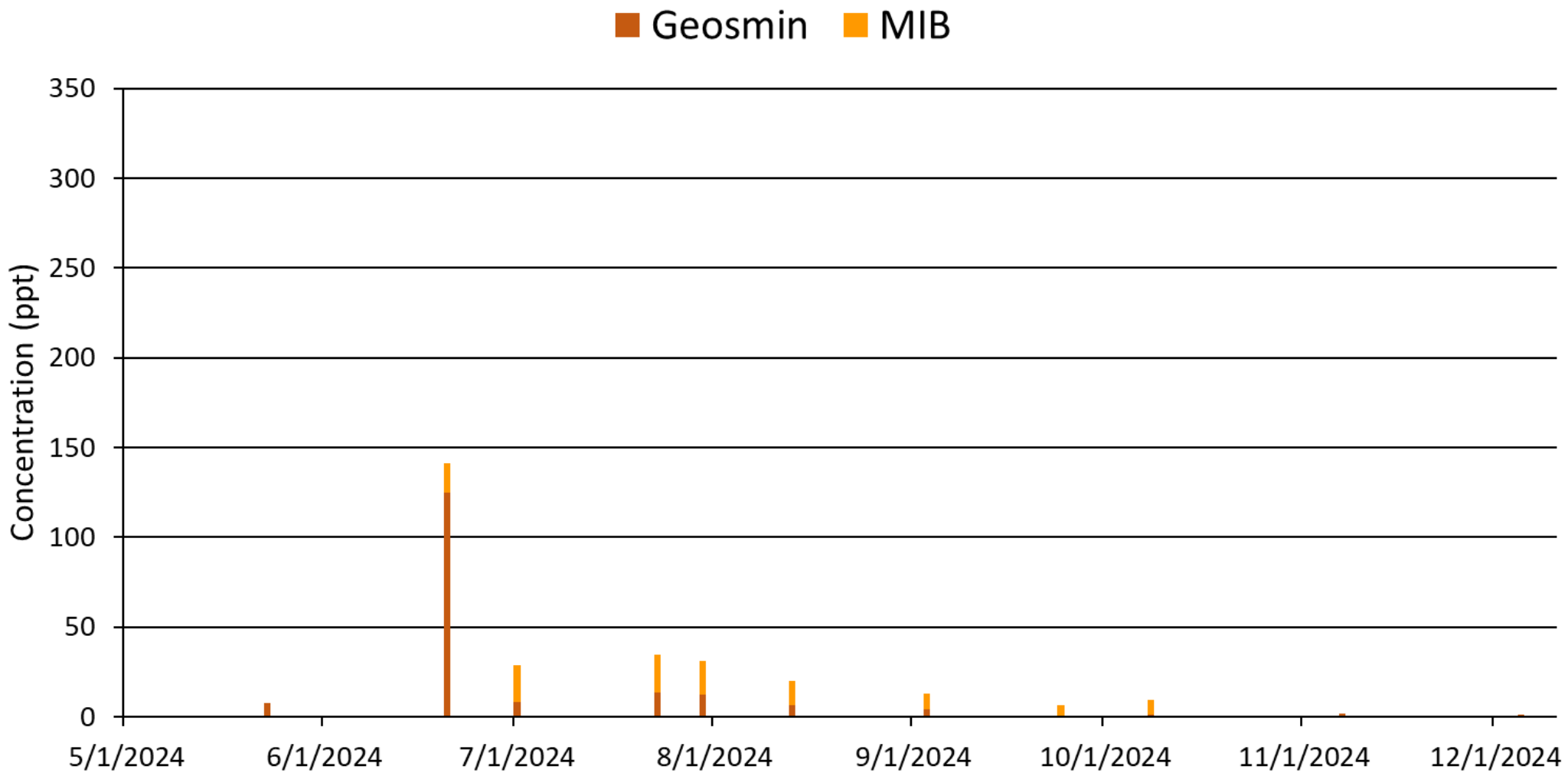
Sample	Dimethyl sulfide Method	Dimethyl sulfide Results	
Name	Exp. Conc.	Final Conc.	Accuracy
CAL1	250.0000	336.1037	134.4
CAL2	500.0000	576.8442	115.4
CAL3	1000.0000	851.2155	85.1
CAL4	2500.0000	2534.0401	101.4
CAL5	3750.0000	4036.8460	107.6
CAL6	5000.0000	4923.2031	98.5
CAL7	10000.0000	9630.9391	96.3
CAL8	15000.0000	14842.7020	99.0
CAL9	20000.0000	20268.1064	101.3

Interlaboratory Comparison Results

Example Compound	Odor Threshold Concentration (ppt)	Calibration Range (ppt)	Laboratory Fortified Blank Spike Level (ppt)	Average Recovery (%)	Standard Deviation (%)
DMTS	10	5 – 400	75	107	4.0
C3HA	1,000 – 2,000	25 – 20,000	375	101	7.4
β-ionone	7	0.5 – 40	7.5	106	4.3

Standard Methods Online: https://www.standardmethods.org/doi/10.2105/SMWW.2882.117

Method Application – Source Water



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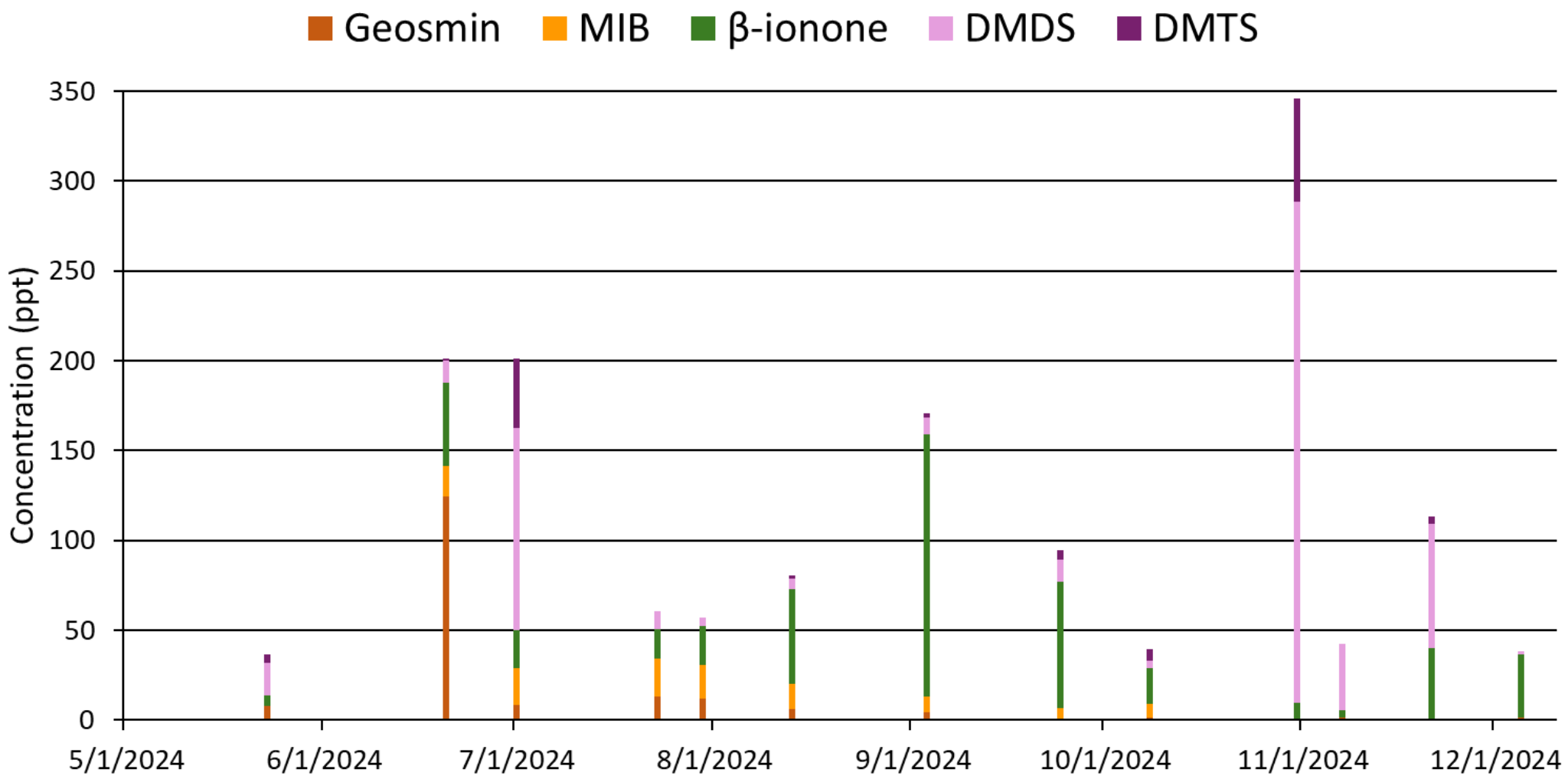
Method Application – Source Water



Method Application – Water & Wastewater Treatment

Sample Date: 10/15/2024	Plant with Conventional Treatment		Plant with Ozonation	
(ppt)	Raw	Effluent	Raw	Effluent
Geosmin	3.4	4.8	3.5	<0.5
β-ionone	7.7	6.6	34.1	2.8

Compound	July 2023 (ppt)	May 2024 (ppt)
DMS	<250	1,400
C3HO	530	4,100
DMTS	<100	28*
MIB	<5	2.6*
β-cyclocitral	6.9	<5
Indole	<500	440*
2,4,6-TCA	<5	0.8*
2,3,6-TCA	6.8	2.3*
Geosmin	11	20
β-ionone	6.4	0.9*
2,4,6-TBA	<5	0.8*

SM 6040D Updates Summary

- 2 compounds plus ISTD and surrogate → 19 compounds plus ISTD
- 1 odor category → 6 odor categories
- 2 compound classes → 7 compound classes
- Wide range of Odor Threshold Concentrations
- Assisting Public Water Systems in
  - ✓ Source water Taste & Odor profile creation
  - ✓ Proactive monitoring
  - ✓ Treatment decisions

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Thank you!