

Under a nitrogen flow rate of 100 mL/min, 1 µL of each standard solution was injected into a Tenax TA sampling tubes and then the tubes were purged for 3 minutes, resulting in component masses of 50, 100, 400, 800, 1200, 2000 ng standard tubes. Perform the analysis according to the conditions in Table 1 and make external calibration curves. The linearity is shown in Figure 4 and Table 2.

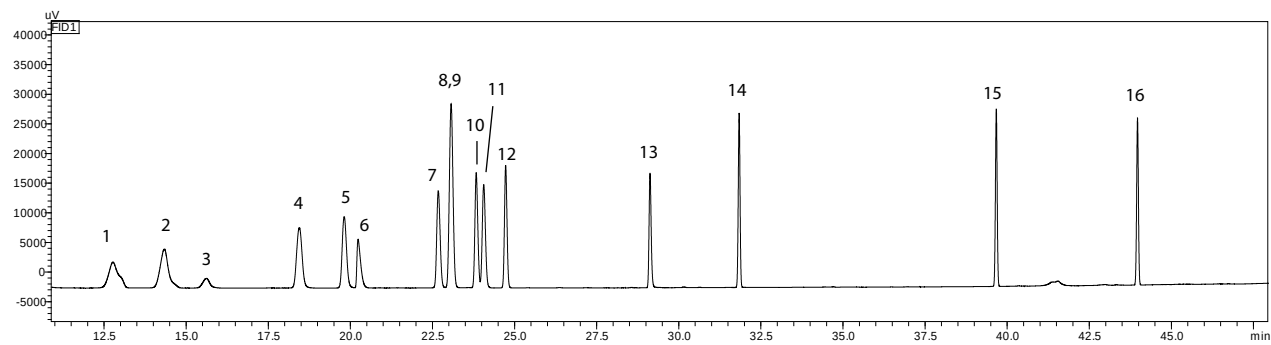


Fig. 3 Chromatogram of 16 VOCs Standard Tube

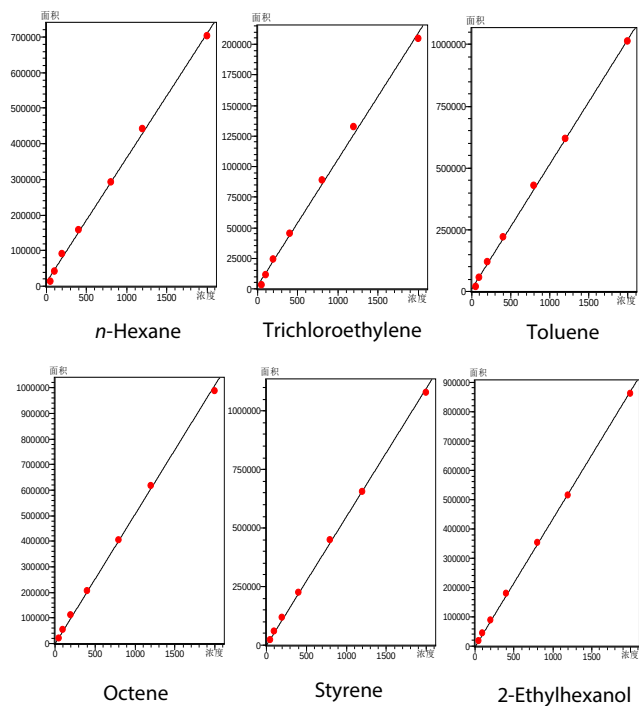


Fig. 4 Representative Calibration Curves for VOCs

Table 2 Compound Information and Linearity of VOCs

No.	Compounds	RT(min)	R
1	<i>n</i> -Hexane	12.77	0.9992
2	Benzene	14.341	0.9987
3	Trichloroethylene	15.622	0.9985
4	Toluene	18.446	0.9995
5	Octene	19.814	0.9995
6	Butyl acetate	20.236	0.9992
7	Ethylbenzene	22.678	0.9998
8	<i>p</i> -Xylene	23.068*	0.9996
9	<i>m</i> -Xylene		
10	<i>o</i> -Xylene	23.833	0.9996
11	Styrene	24.061	0.9998
12	<i>n</i> -Nonane	24.728	0.9997
13	2-Ethylhexanol	29.125	0.9998
14	<i>n</i> -Undecane	31.838	0.9998
15	<i>n</i> -Tetradecane	39.669	0.9994
16	<i>n</i> -Hexadecane	43.968	0.999

■ Repeatability and LODs

Inject 1 μL of 50 $\mu\text{g}/\text{mL}$ standard solution into Tenax TA tubes under 100 mL/min nitrogen flow to make 50 ng per component standard tubes. Six tubes were prepared and analyzed with the repeatability results shown in Table 3.

LODs were calculated as three times the baseline noise based on 50 ng standard tubes and are listed in Table 3.

Table 3 Repeatability and LODs of VOCs

No.	Compounds	RSD(%)	LODs ($\mu\text{g}/\text{m}^3$)
1	<i>n</i> -Hexane	2.66	1.47
2	Benzene	3.47	1.16
3	Trichloroethylene	4.10	4.72
4	Toluene	4.48	0.75
5	Octene	5.07	0.64
6	Butyl acetate	5.04	0.83
7	Ethylbenzene	4.86	0.45
8	<i>p</i> / <i>m</i> -Xylene	4.70	0.46
9	<i>o</i> -Xylene	4.48	0.36
10	Styrene	4.69	0.41
11	<i>n</i> -Nonane	5.36	0.35
12	2-Ethylhexanol	4.89	0.40
13	<i>n</i> -Undecane	4.60	0.25
14	<i>n</i> -Tetradecane	4.03	0.25
15	<i>n</i> -Hexadecane	7.36	0.26

■ Actual Sample Analysis

Collect 5 L indoor air sample with a Tenax-TA tube at 500 mL/min and analyze it with the developed method. The concentration ($\mu\text{g}/\text{m}^3$) of target compounds and TVOC in sample are listed in Table 4. The chromatogram is shown in Figure 5.

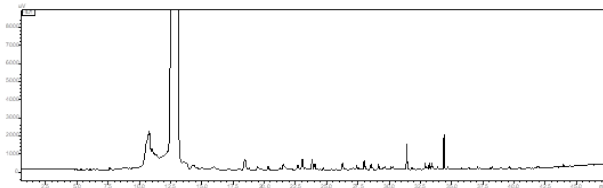


Fig. 5 Chromatogram of Actual Sample

*Note: *p*-Xylene co-elutes with *m*-Xylene and the integration is combined.

Table 4 Concentrations of VOCs in Actual Samples ($\mu\text{g}/\text{m}^3$)

No.	Compounds	Conc.
1	<i>n</i> -Hexane	1340
2	Benzene	1.7
3	Trichloroethylene	N.D.*
4	Toluene	2.6
5	Octene	N.D.
6	Butyl acetate	1.4
7	Ethylbenzene	1.7
8	<i>p</i> -/ <i>m</i> -Xylene	2.3
9	<i>o</i> -Xylene	1.6
10	Styrene	1.2
11	<i>n</i> -Nonane	N.D.
12	2-Ethylhexanol	2.0
13	<i>n</i> -Undecane	N.D.
14	<i>n</i> -Tetradecane	N.D.
15	<i>n</i> -Hexadecane	N.D.
16	Unidentified Compounds	12.3
17	TVOC*	1360

* N.D. stands for "Not Detected". TVOC is the sum of the measured contents of 16 VOCs and the contents of the unidentified compounds. The concentration of unidentified compounds are calculated using the toluene correction factor.

■ Conclusion

A method for TVOC determination in indoor air using Tenax TA sampling tubes was established by thermal desorption/extraction injection with MMI multi-functional inlet. All 16 VOCs showed good linearity in the range of 50 ng–2000 ng ($R > 0.998$). RSDs of six parallel 50 ng tests were 2.66%–7.36%. At 5 L sampling volume, MDLs were 0.25–4.72 $\mu\text{g}/\text{m}^3$, which meet the requirements of TVOC testing in Appendix E of GB 50325-2020.

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