Supplementary material for

Emission Characteristics of VOCs from Lubricant Oils Widely Used in Industrial Buildings by a Dynamic Headspace Sampling Method

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S1. Basic information of lubricant oil samples

To provide more detailed information on the tested lubricant oils, the available information on oil type, grade, typical application, base oil or production type, viscosity grade, physicochemical, and specifications is summarized in Table S1. The information was collected from product labels, procurement records, available product specifications, and relevant Chinese national standards. These data are provided to help readers better understand the background of the tested oil samples and to facilitate comparison with future studies.

S2. Bray–Curtis distance analysis of VOC species profiles

To quantitatively evaluate the compositional differences among the VOC profiles of the four tested lubricant oils, a Bray–Curtis distance analysis was conducted. The specific calculation method, including the formula and the interpretation of the distance values, is detailed in this section. Furthermore, the calculated pairwise distances are summarized as a distance matrix in Table S2. These data and analyses are provided to help readers intuitively understand the relative similarities and variations in VOC emissions across the different oil samples.

S1. Basic information of lubricant oil samples

Table S1. Basic information and physicochemical specifications of the four lubricant oil samples used in this study.

Oil code	Oil type	Grade	Typical application	Base oil / production type	Viscosity grade	Kinematic viscosity	Pour point	Flash point (open cup)	Water and mechanical impurities	Standard
Oil 1#	Turbine oil	L-TSA 68	Steam turbines, water turbines, and other industrial turbines	Deeply refined base oil with antioxidant and rust inhibitor additives	ISO VG 68	40 °C: 61.2–74.8 mm²/s, with a nominal value of 68 mm²/s	≤ -7 °C	≥ 195 °C	No water and no mechanical impurities	GB 11120-1989
Oil 2#	Hydraulic oil	532 hydraulic oil	Hydraulic systems	Hydrotreated mineral base oil	ISO VG 32	40 °C: approximately 31.5 mm²/s	≤ -40 °C	approximately 206 °C	Trace water and no mechanical impurities	GB 11118.1-2011
Oil 3#	Diesel engine oil	CD 40	Diesel engine	Refined mineral oil, synthetic oil, or their blend with additive packages	SAE 40	100 °C: 12.5–<16.3 mm²/s	≤ -10 °C	≥ 225 °C	Trace water; mechanical impurities ≤ 0.01%	GB 11122-2006
Oil 4#	Air compressor oil	L-DAB 150	Medium-duty air compressors	Mineral oil-based air compressor oil	ISO VG 150	40 °C: 135–165 mm²/s	≤ -3 °C	≥ 215 °C	Trace water; mechanical impurities ≤ 0.01%	GB 12691-1990

ISO VG: International Organization for Standardization Viscosity Grade.
SAE: Society of Automotive Engineers viscosity grade.

S2. Bray–Curtis distance analysis of VOC species profiles

Bray–Curtis distance was used to quantify the compositional differences among the VOC profiles of the four lubricant oils. The Bray–Curtis distance between oil sample i and oil sample j was calculated as follows:

$$BC_{ij} = \frac{\sum_k |x_{ik} - x_{jk}|}{\sum_k (x_{ik} + x_{jk})}$$

where x_{ik} and x_{jk} represent the relative abundance of VOC species k in oil samples i and j, respectively. The Bray–Curtis distance ranges from 0 to 1, with a smaller value indicating a more similar VOC profile and a larger value indicating a greater compositional difference.

Table S2. Bray–Curtis distance matrix among the VOC profiles of the four lubricant oils.

	Oil 1#	Oil 2#	Oil 3#	Oil 4#
Oil 1#	0.000	0.407	0.562	0.516
Oil 2#	0.407	0.000	0.386	0.697
Oil 3#	0.562	0.386	0.000	0.541
Oil 4#	0.516	0.697	0.541	0.000

The pairwise Bray–Curtis distances ranged from 0.386 to 0.697. The smallest distance was observed between Oil 2# and Oil 3# (0.386), while the largest distance was observed between Oil 2# and Oil 4# (0.697). These results indicate that the four lubricant oils had different VOC composition profiles.