Toluene as an indicator of vehicular exhaust: Impact on Air Quality

Background: According to the World Health Organization (WHO)[1], toluene ($C_6H_5CH_3$) is a Volatile Organic Compound (VOC) that is believed to be **_the most abundant hydrocarbon_** in the troposphere. Sources of anthropogenic toluene emissions include catalytic conversion of petroleum and chemical production facilities; but, vehicle exhaust was considered to be the dominant source. The adverse health effects of human exposure to toluene include dysfunction of the Central Nervous System, kidney failure and reproductive abnormalities including spontaneous abortion among pregnant women. As a result, the California Occupational Safety and Health Administration (CalOSHA) has set a Permissible Exposure Limit (PEL) of 10 ppm (Time Weighted Average) for toluene.

Omniscent's proprietary analyzer OMNI-2100: OMNI-2100 employs a novel Micro Electro-Mechanical System (MEMS) based analyzer to selectively separate and detect chemicals such as benzene, toluene, m-xylene, o-xylene with limits of detection (LODs) less than 0.5 ppb. The unique aspect of OMNI-2100 is the cloud-based **_autonomous system_** feature that does not require any carrier gas or any human supervision for operation and data collection. OMNI-2100 can run on both Wi-Fi and LTE. OMNI-2100 can be solar-powered and battery operated depending on the customer's needs. OMNI-2100 can be configured to send alarms via text and email to operators, thereby increasing industrial safety, preventing accidents and saving lives. Applications include monitoring around refineries, chemical facilities, gas stations and the impacted communities in their direct surroundings.

Proof of Concept (POC) with preliminary results: Air pollution from motor vehicle exhaust is unquestionably a major source of exposure. Omniscent placed the OMNI-2100 in the backyard of a house in Saratoga, California (Figure 1) and the toluene concentrations were observed over a course of 1 month. After reviewing several weeks of data, it was observed that the toluene level peaks around 8:00 AM to 8:15 AM on most of the school days. The traffic backed up from an elementary school 1.1 miles away from the property where we installed the OMNI-2100 (on this road) between 7:50 AM to 8:20 AM (Table 1). There are no industrial sources of toluene in this neighborhood. Further analysis of data shows that ambient toluene concentrations trended closely with human activity in this area (Figure 2). Relatively high concentrations of toluene are observed during peak traffic hours (8 am-1 pm, 5 pm-6 pm) and decrease thereafter at night (10 pm-12 am).

Figure 1: **Picture A** shows the OMNI-2100 analyzer in operation. **Picture B** shows the geographic location of the analyzer (marked with a star).

[1] http://www.euro.who.int/__data/assets/pdf_file/0020/123068/AQG2ndEd_5_14Toluene.PDF

Table 1: Increase in toluene levels during morning hours of 09/19/2019

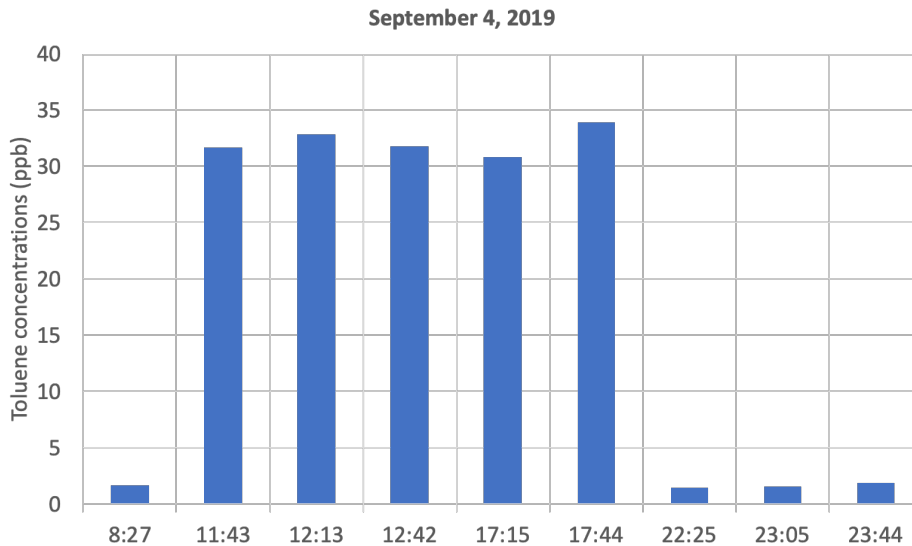| Time on 9/19/2019	Toluene concentration (ppb)
7:56 AM	0
8:27 AM	13.51
8:56 AM	0

Figure 2: Toluene concentrations throughout the day of Sept. 4th, 2019 are shown here.

Conclusions from POC:

This POC demonstrates the value of OMNI-2100 as a specialized tool for community-based air quality monitoring.

In fact, OMNI-2100 has already been used for community-based air quality monitoring of benzene, toluene, m- xylene and o-xylene by various customers including state regulatory agencies and environmental consulting firms in the US.

Other applications:

Broader applications of OMNI-2100 include fenceline monitoring in refineries, fugitive emissions in chemical facilities, leaks in gas stations and emergency response operations. This enables monitoring of VOCs remotely, thereby reducing labor cost and increasing safety.

OMNI-2100 can also be solar-powered and battery operated depending on the customer's needs.