CHARACTERIZING NEAR CAB AIR QUALITY IN CONSTRUCTION EQUIPMENT

Sherif Elkhouly; Phil Lewis, PhD, PE

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Intoduction

- The construction industry in the United States (US) represents a major component of the national economy; providing employment to some 7.2 million workers and accounting for 10% of GDP
- The rapid pace of technological development in the industry can accelerate the development of new construction equipment, methods, and management techniques
- The construction industry has 426,600 operators for earthmoving and nonroad heavy-duty diesel (HDD) equipment out of 7.2 million construction workers
- This number is projected to grow by 12% (to about 500,000 operators by 2026)
- The Occupational Safety and Health Administration (OSHA) and the National Institute for Occupational Safety and Health (NIOSH) are responsible for developing and enforcing regulations to minimize environmental risk exposure and health hazards to construction equipment operators including those from pollutants emitted

Research Objective

- The objective of this research was to measure and characterize air pollution in the near-cab and in-cab environment of HDD equipment
- The pollutants investigated include oxides of nitrogen (nitric oxide [NO] and nitrogen dioxide [NO2]), carbon dioxide (CO2), carbon monoxide (CO) and particulate measurements including PM2.5 and black carbon (BC)
- Although there are no permissible exposure limits (PELs) specifically for HDD equipment operations, we compared our measurements to the general occupational exposure limits for these pollutants given by OSHA and NIOSH
- All of the construction equipment included in this research was located in College Station, Texas and surrounding area.

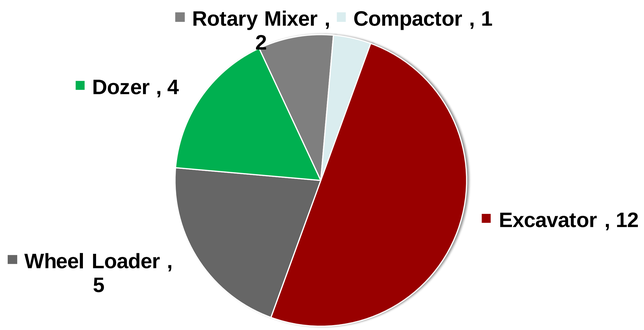

Figure 2. Distribution of the 24 HDD equipment tests.

Methodology

- This research measured specific components of diesel exhaust and whether these are present near the operator cab area to potentially cause a health hazard for operators
- The research focused on three criteria pollutants—carbon monoxide, nitrogen dioxide, and PM2.5—as well as BC, nitric oxide, and carbon dioxide
- Instrument installation, data entry, and processing were performed by professional research specialists at TTI
- Data collection was done from 7:00 a.m. to 5:00 p.m. to ensure that HDD equipment fleet was in full productivity
- Data collection occurred from April 2018 to July 2018
- The sampling equipment was placed in the operator cab area on the side behind the operator seat (e.g. Figure 1)
- The instruments were returned at 5:00 p.m. to retrieve the data, recharge the instrument, and calibrate
- Data were analyzed using JMP Pro 14.1 software and Microsoft Excel to calculate descriptive statistical inferences.

Figure 1. Sampling instruments placed inside various operator cabs at job sites.
(A) Excavator in progress at job site
(B) Sampling instrument box.
(C) Interior of the sampling box showing the MX6 iBrid and the microAeth AE51.
(d) Charging process and docking and calibration station of MX6 iBrid.

Results

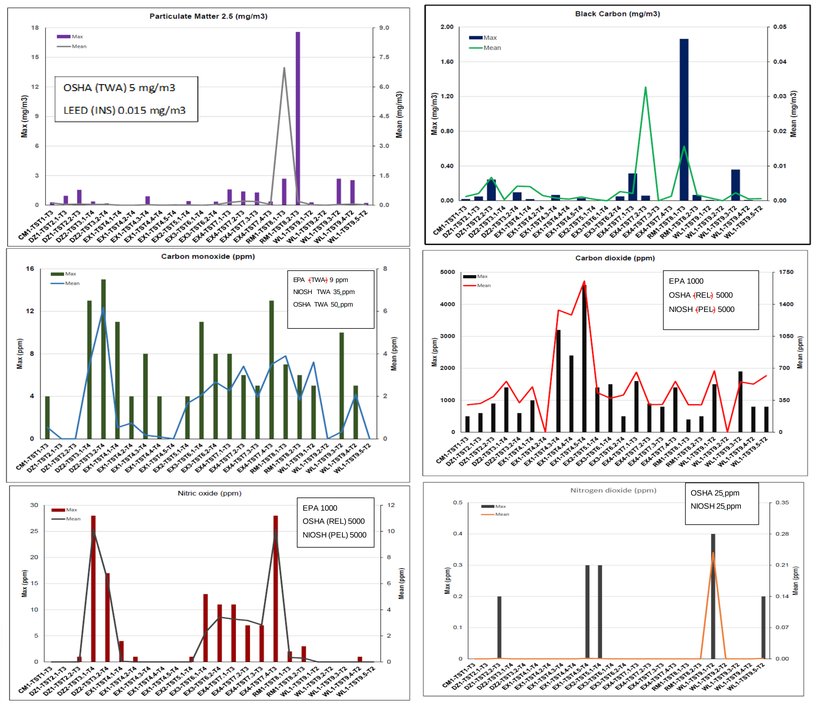

Figure 4. Distribution of Pollutants maximum levels according to equipment type.

Conclusion

- PM2.5 measured mean and maximum levels were measured above the national benchmarks for OSHA and LEED.
- Although these benchmarks were set for ambient air, not for indoor air quality, the measured levels exceed them, which could put the equipment operators at risk. BC levels were proportional to PM2.5, but given the lack of national benchmarks, interpretation of the measured levels seems implausible.
- Carbon monoxide (CO) and Carbon dioxide (CO2) levels were measured below the OSHA and NIOSH benchmarks, but for (CO) some readings exceed the EPA NAAQS standards, warranting more investigation. For (CO2) the maximum carbon dioxide level exceeds the EPA NAAQS standards.
- For nitric oxide (NO), two readings exceed the benchmarks, so the maximum measured levels exceed both OSHA and NIOSH benchmarks even though the mean of the measurements does not. On the other hand, all readings for nitrogen dioxide (NO2) emissions were measured below the national benchmarks for OSHA, NIOSH, and EPA NAAQS standards.