saif

Industrial Hygiene Report

Prepared for: Hillsboro School District

Location: Lincoln Street Elementary School

Sampling Dates: 11/27/2017 - 12/2/2017

Date of Report: 1/16/2018

This report provides an interpretation of indoor air quality (IAQ) data gathered from Lincoln Street Elementary School in Hillsboro, Oregon. The IAQ data was obtained without any involvement from SAIF and the validity of resulting statements and recommendations relies on Hillsboro School District's IAQ equipment and sampling process.

All sampled rooms were below OSHA's Permissible Exposure Limits and the American Conference of Governmental Industrial Hygienists' recommended 8-hr Time Weighted Average threshold limit values for both Carbon Monoxide and Carbon Dioxide.

Sampling Environment

Lincoln Street Elementary School provides typical educational space for kindergarten through sixth grade students. According to Hillsboro School District sampling was conducted in four classrooms (167, 168, 261, and 270), each with typical occupancy load during sampling.

Sampling Apparatus and Methodology

A GrayWolf IQ-410 unit *(serial# 05-1297, last factory calibrated on 1/3/2017 but not field pre- and post-calibrated before and after sampling)* was used to obtain measurements of Carbon Dioxide (CO_2), Carbon Monoxide (CO), temperature and relative humidity. The monitor was used for data logging sampling for about 24 hours in each classroom, taking readings every two minutes. The four parameters mentioned above are generally used to evaluate the overall air quality and comfort levels of indoor air in office spaces and classrooms.

Sampling Results and Interpretation

Sampling results show that Carbon Dioxide, temperature and relatively humidity fall outside of the guidelines provided by the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) during some of the normally occupied times at this school. However, both Carbon Dioxide and Carbon Monoxide were below Oregon OSHA Permissible Exposure Limits.

Table 1: Indoor Air Quality Parameters and Results

Classroom	Carbon Dioxide Max	Carbon Monoxide Max	Temperature Ranges	Humidity Ranges
167	1,053 ppm	0.8 ppm	69° - 75° F	36 - 41 %
168	1,194 ppm	2.8 ppm	73° - 75° F	37 – 40 %
261	1,300 ppm	2.8 ppm	67° - 76° F	36 – 46 %
270	1,233 ppm	5.4 ppm	54° – 75° F	37 – 89 %

- *Color coding: Green = within recommended ranges and below required limits, Yellow = Outside of recommended ranges, Red = Exceeds OSHA Permissible Exposure Limits (PELs).*
- *Table only includes data from typically occupied time periods (7:30am – 4:00pm)*
- *Refer to time history report and graph for sample times and details (note am/pm reversed in these samples)*
- *Samples for rooms 168 and 270 were both less than 8 hours and the sample for 261 spanned almost 48 hours.*
- *Pre/post field calibration and outdoor samples wasn't part of the sampling process so these results should be viewed as simple indicators and additional sampling may be needed to better assess conditions.*

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Carbon Dioxide (CO_2)
Carbon Dioxide is a normal constituent of exhaled breath and is typically found in outdoor atmospheres at concentrations of 300-400 parts per million (ppm). CO_2 levels are typically higher inside in buildings than outside due to human occupancy. According to the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE 62.1-2010), it is desirable to maintain a steady-state CO_2 concentration in a space of no greater than about 700 ppm above outdoor air levels (1,000 - 1,100 ppm). If concentrations exceed this, it's indicative of adequate amounts of outdoor air not being provided for dilution ventilation and comfort. This recommendation does not mean that exceeding 700 ppm above outdoor readings is hazardous, but rather that complaints may arise and hence, that additional outdoor make-up air needs to be provided to the building. The Oregon OSHA Permissible Exposure Limit for CO_2 is 5,000 ppm. The American Conference of Governmental Industrial Hygienists' (ACGIH) recommended 8-hr Time Weighted Average (TWA) threshold limit value (TLV) is 5,000 PPM.

Carbon Monoxide (CO)
Carbon monoxide is a colorless, odorless, and tasteless poisonous gas produced by the incomplete burning of any material containing carbon – gasoline, natural gas, oil, propane, coal, or wood. It is harmful because it displaces oxygen in the blood and deprives the heart, brain, and other vital organs of oxygen. It is one of the leading causes of poisoning by inhalation and is a common workplace hazard. Mild exposure to carbon monoxide can cause nausea, dizziness, or headache. Prolonged or high exposure may worsen symptoms and include vomiting, confusion, collapse, loss of consciousness, and muscle weakness. Symptoms vary from person to person. Severe exposure can result in permanent brain and heart damage or death. Heart and lung conditions, vascular disease, anemic conditions, barbiturate and alcohol use, and smoking increase susceptibility to carbon monoxide poisoning. Symptoms of mild poisoning include headaches and dizziness at concentrations less than 100 ppm. Oregon OSHA's permissible exposure limit (PEL) is 50 PPM and the ACGIH TLV-TWA is 25 ppm. Carbon monoxide is produced from the partial combustion of carbon-containing compounds, notably in internal-combustion engines. Carbon monoxide is a significantly toxic gas and has no odor or color. It is the most common type of fatal poisoning in many countries. Exposures can lead to significant toxicity of the central nervous system and heart.

Temperature:
The OSHA technical manuals recommend temperature for a comfortable indoor work environment to range between 68°F and 76°F. ASHRAE recommends indoor temperatures to be within 68.5°F to 75°F during winter months, and within 75°F to 80.5°F during summer months.

Relative Humidity and Moisture:
OSHA technical manuals recommend maintaining the relative humidity between 20% and 60% to help maintain a comfortable indoor air quality environment and below 70% to prevent mold growth. Molds can be found almost anywhere; the can grow on virtually any substance, providing moisture is present. Molds can grow within wood, paper, carpet and foods. When excessive moisture accumulates in buildings or on building materials, mold growth will often occur, particularly if the moisture problem remains undiscovered or unaddressed. There is no practical way to eliminate all molds and mold spores in the indoor environment. The key to control indoor mold growth is to control moisture. If mold is discovered, clean it up immediately and remove excess water or moisture.

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Conclusions
As can be seen in Table 1, all four sampled classrooms at Lincoln Street Elementary School were below the Oregon OSHA Permissible Exposure Limits (PEL) for both Carbon Monoxide (CO) and Carbon Dioxide (CO_2). However, rooms 168, 261 and 270 each had time periods that were outside of the recommended range for CO_2. Also, room 261 showed times with slightly low temperatures and room 270 showed time periods with elevated Carbon Monoxide, low temperatures and high humidity. These levels aren't unsafe for occupants but may provide for an uncomfortable work environment.

Recommendations
- Inspect the school's HVAC system and adjust to increase the amount of outdoor air being delivered to classrooms 168, 261, and 270 in order to reduce Carbon Dioxide levels down to 1,000 - 1,100 ppm or below.
- Although there was only a single data point showing CO levels at above 5 ppm you may still want to check for potential CO sources in and nearby room 270 and address as needed. You should also verify that the temperature control unit in that room works properly and is placed in a desirable location and adjust system to bring classroom within the recommended temperature range. Finally, high humidity readings should be checked out as they could be indicative of water intrusion although there were only five readings above 70% around 9:00am.
- Verify that the temperature control unit in room 261 works properly and is placed in a desirable location and adjust system to bring classroom within the recommended temperature range.

Please let me know if you have any questions or concerns of if I can be of any further assistance.

Sincerely,

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