

ABSTRACT OF THESIS

CARBON MONOXIDE LEVELS IN POTATO PROCESSING FACILITIES IN THE SAN LUIS VALLEY

Exposure to carbon monoxide (CO) decreases the amount of oxygen the body is capable of carrying in the red blood cells. This lack of oxygen leads to a variety of symptoms, which can include headache, vomiting, nausea, seizures, angina, pulmonary edema, unconsciousness, and even death. This is particularly relevant when applied to the potato processing facilities in the San Luis Valley that utilize propane-fueled forklifts for transport of their goods. Incomplete combustion of propane causes the emission of carbon monoxide into the facility's ambient air. This study stems from a previous incident where the Occupational Health and Safety Administration (OSHA) cited a potato processing facility in the San Luis Valley for exceeding the permissible exposure limit (PEL) of 50 parts per million CO for an 8-hour work shift. This facility contacted the High Plains Center for Agricultural Health and Safety (HICAHS) at CSU to seek aid in alleviating this problem. This incident raised questions as to the possibility of other sites exceeding the PEL for carbon monoxide as a result of using propane-fueled forklifts.

Twelve sites were evaluated in this study. The following parameters were evaluated: CO exposure by site, CO exposure by job title, presence of additional sources of CO, the relationship between CO and symptoms, and emissions from the forklifts. Personal and area dosimetry was performed using Biometrics, Inc. Toxilog dataloggers. Emission testing was performed with the KAL Equip Model 5000 Four Gas Emissions Analyzer.

Results showed that the use of propane-fueled forklifts did contribute to the ambient concentrations of carbon monoxide in the facility's air. There was no statistically significant correlation between the 8-hour time weighted average

(TWA) and job title ($p = 0.17$). There was a statistically significant correlation between site and the 8-hour TWA ($p < 0.0001$). There was no statistically significant correlation between the 5-minute ceiling and job title ($p = 0.40$). There was a statistically significant correlation between the 5-minute ceiling and site ($p < 0.0001$).

These results show that between sites, there was a difference in CO exposures and that job title was not descriptive of the degree of CO exposure. The only symptom of CO exposure that was shown to be significant when looking at job title was headaches ($p < 0.05$). The presence of other CO producing devices was shown to significantly increase the TWA ($p < 0.0001$) and the 5-minute ceiling ($p < 0.008$). Both idle and load CO readings were found to be statistically significant when related to TWA. Idle CO had a $p < 0.0001$ and load CO had a $p = 0.003$. Only load CO levels were found to be statistically significant contributors to the 5-minute ceiling value. Load CO had a $p = 0.009$. The ventilation systems present at the facilities were shown to significantly reduce CO levels for the 8-hour TWA ($p = 0.05$). Though the ventilation present was not local ventilation that could directly affect short-term exposures, applying the presence of ventilation to the 5-minute ceiling value is warranted ($p = 0.02$).

Thirteen employees of 93 (14%) were exposed to CO levels in excess of the OSHA PEL of 50 ppm for CO for an 8-hour work shift. When the recommended 5-minute ceiling value of 200 ppm for CO was addressed, 12 of 93 employees (13%) exceeded this recommended limit. If the NIOSH recommended exposure limit of 35 ppm CO for an 8-hour work shift was addressed, 24 employees of 93 (26%) exceeded this value. The ACGIH has set a recommended exposure limit for carbon monoxide of 25 ppm. 37 employees of 93 (40%) exceeded this value. Strictly addressing compliance, 14% of the sample population was in violation of current

OSHA regulatory limits. If employee health were the major concern, it would be wise to choose the organizational recommended exposure limit for CO that is lowest. In this case, the ACGIH recommended CO limit of 25 ppm for an 8-hour work shift should be used. Forty percent of the sample population exceeded the ACGIH recommended limit. To keep exposures to a minimum, utilization of ventilation, more frequent tune-ups, and changing the forklift operator's technique is recommended.

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