Ventilation and Silos

Carbon monoxide poisoning deaths in the United States, 1999 to 2012

Sircar, K., Clower, J., kyong Shin, M., Bailey, C., King, M., & Yip, F. (2015). Carbon monoxide poisoning deaths in the United States, 1999 to 2012. *The American journal of emergency medicine*, *33*(9), 1140-1145.

Unintentional, non-fire related (UNFR) carbon monoxide (CO) poisoning deaths are preventable. Surveillance of the populations most at-risk for unintentional, non-fire related (UNFR) carbon monoxide (CO) poisoning is crucial for targeting prevention efforts. This study provides estimates on UNFR CO poisoning mortality in the United States and characterizes the at-risk populations. We used 1999 to 2012 data to calculate death rates. We used underlying and multiple conditions variables from death records to identify UNFR CO poisoning cases. For this study, we identified 6136 CO poisoning fatalities during 1999 to 2012 resulting in an average of 438 deaths annually. The annual average age-adjusted death rate was 1.48 deaths per million. Fifty four percent of the deaths occurred in a home. Age-adjusted death rates were highest for males (2.21 deaths per million) and non-Hispanic blacks (1.74 deaths per million). The age-specific death rate was highest for those aged ≥ 85 years (6.00 deaths per million). The annual rate of UNFR CO poisoning deaths did not change substantially during the study period, but we observed a decrease in the rate of suicide and unintentional fire related cases. CO poisoning was the second most common non-medicinal poisonings death. Developing and enhancing current public health interventions could reduce ongoing exposures to CO from common sources, such as those in the residential setting.

Modeling ventilation time in forage tower silos

Bahloul, A., Chavez, M., Reggio, M., Roberge, B., & Goyer, N. (2012). Modeling ventilation time in forage tower silos. *Journal of Agricultural Safety and Health*, *18*(4), 259-272.

The fermentation process in forage tower silos produces a significant amount of gases, which can easily reach dangerous concentrations and constitute a hazard for silo operators. To maintain a non-toxic environment, silo ventilation is applied. Literature reviews show that the fermentation gases reach high concentrations in the headspace of a silo and flow down the silo from the chute door to the feed room. In this article, a detailed parametric analysis of forced ventilation scenarios built via numerical simulation was performed. The methodology is based on the solution of the Navier-Stokes equations, coupled with transport equations for the gas

concentrations. Validation was achieved by comparing the numerical results with experimental data obtained from a scale model silo using the tracer gas testing method for O2 and CO2 concentrations. Good agreement was found between the experimental and numerical results. The set of numerical simulations made it possible to establish a simple analytical model to predict the minimum time required to ventilate a silo to make it safe to enter. This ventilation time takes into account the headspace above the forage, the airflow rate, and the initial concentrations of O2 and CO2. The final analytical model was validated with available results from the literature.

Agricultural lung diseases

Kirkhorn, S. R., & Garry, V. F. (2000). Agricultural lung diseases. *Environmental health perspectives*, *108*(suppl 4), 705-712.

Agriculture is considered one of the most hazardous occupations. Organic dusts and toxic gases constitute some of the most common and potentially disabling occupational and environmental hazards. The changing patterns of agriculture have paradoxically contributed to both improved working conditions and increased exposure to respiratory hazards. Animal confinement operations with increasing animal density, particularly swine confinement, have contributed significantly to increased intensity and duration of exposure to indoor air toxins. Ongoing research has implicated bacterial endotoxins, fungal spores, and the inherent toxicity of grain dusts as causes of upper and lower airway inflammation and as immunologic agents in both grain and animal production. Animal confinement gases, particularly ammonia and hydrogen sulfide, have been implicated as additional sources of respiratory irritants. It has become evident that a significant percentage of agricultural workers have clinical symptoms associated with long-term exposure to organic dusts and animal confinement gases. Respiratory diseases and syndromes, including hypersensitivity pneumonitis, organic dust toxic syndrome, chronic bronchitis, mucous membrane inflammation syndrome, and asthmalike syndrome, result from ongoing acute and chronic exposures. In this review we focus upon the emerging respiratory health issues in a changing agricultural economic and technologic environment. Environmental and occupational hazards and exposures will be emphasized rather than clinical diagnosis and treatment. Methods of prevention, from both engineering controls and personal respiratory perspectives, are also addressed.