Title Control of stored grain fungi and off odors with ozone in a grain treatment system

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Abstract

Stored grain products, such as corn, can harbor multiple microorganisms, including fungi such as *Aspergillus* species that produce toxins harmful to both humans and animals. In previous studies, we have demonstrated that ozone-treatment can significantly reduce the level of viable microorganisms on the surface of corn kernels. Ozone is a strong oxidizing agent, which is used in a growing number of industrial applications to control harmful microbes and volatiles. The ultimate goal of this project is to develop a semi-continuous flow grain treatment system and predictive model that will reduce microorganisms on grain kernel surfaces with ozone. To achieve this goal, better understandings of the properties of ozone are needed, especially with respect to the half-life of ozone and time/concentration criteria to reduce microbes on corn.

The focus of this project was to determine the concentration-time product (CTP) of ozone required to eliminate various levels of microbial growth on grain kernels and to determine the half-life time of ozone in air as a function of air speed (0 to 220 cfm), temperature (4 to 40°C) and relative humidity (0 to 80%).

Half-life time (HLT) of ozone was determined in a plexiglass cylinder equipped with a combination temperature/humidity sensor and fans of varying speeds. HLT averaged 1524 minutes (25.4 h) in still air at room temperature (24°C) and zero humidity, which was substantially longer than previously published data (i.e., 30-40 minutes). As air speed, temperature and humidity increased, HLT decreased to 39, 796 and 451 minutes, respectively. The results suggest that ozonation will be more effective in still air at low temperature and humidity (e.g., headspace ozonation of rail cars in the early spring) than at high flow rates of ozonated air at high temperature and humidity (e.g., grain storage silo in the middle of summer).

To examine the effect of ozone on surface microbes, samples of freshly-harvested and stored corn were treated with ozone for 1 and 3 hours at average ozone concentrations of 1752 ppm, 915 ppm and 37 ppm. Microorganisms were significantly decreased by 28 to 57% after corn samples were ozonated for 1 h at 37 to 1752 ppm and 45 to 80% for 3 h at 37 to 1752 ppm.

Linear regression analysis of the CTP data indicated that percent mold reduction increased at a rate of 0.0088 times the CTP. The modified Gompertz equation applied to the microbial inactivation data indicated that a 0.5 to ~1 log mold reduction on corn kernels was attained for ozone concentrations between 37 and 1752 ppm. When compared to preliminary field data from a semi-continuous flow grain treatment system, the laboratory data and the model-predicted values were reasonably close with respect to the microbial load reduction observed on corn samples taken from the system.