Carlos is a faculty member of the Department of Grain Science and Industry of Kansas State University that works at the International Grains Program (IGP) as an outreach specialist and instructor focusing in the areas of grain storage, quality and processing, U.S. grain grading and export systems, and feed manufacturing. He serves as the coordinator for the Spanish-Speaking Outreach Program and main contact with the Latin American grain industry. He also collaborates in research and extension at the Stored Product Protection Research group and Feed Technology group of the Department of Grain Science and Industry. Carlos has traveled throughout Latin America, North Africa, and Europe as a technical consultant, translator, and speaker in several short courses and seminars in the areas of grain storage and feed manufacturing. He has also presented his research at several scientific and professional conferences, and in scientific journals. Carlos is a Costa Rican who obtained his master's degree in Agricultural and Biological Engineering from the University of Illinois at Urbana-Champaign and his bachelor's degree in Mechanical Engineering from the University of Costa Rica.

Dissertation

Agricultural & Biological ENGINEERING

Speaker: Carlos Campabadal

Title: Ozonation Systems as a Non-Chemical Alternative for Stored Grain

Major Professor(s): Dr. Richard Stroshine and Dr. Dirk Maier

Date: Tuesday, October 29, 2013

Time: 9:00 am

Location: NLSN Room 2187 (Food Science Building)

Abstract: The use of ozone as a non-chemical alternative in stored product protection of grain was studied by conducting scale-up demonstrations using a fixed bed ozonation system and developing a semi-continuous counterflow and continuous flow ozonation treatment systems. The objectives of this research was to determine the efficacy of ozonation to control insect pests without affecting end-use quality, prove the concept of the semi-continuous counterflow ozonation system to ozonate grain at a faster rate and quantify its effect on mold growth reduction, evaluate the efficacy of a modified screw conveyor for pest control by treating grain in a continuous-flow ozonation treatment system, and to determine technically feasible scale-up configurations of each ozonation treatment system and to determine which is most cost-effective. Ozonation treatment in fixed bed systems resulted in 100% insect mortality for adults of maize weevil (MW) and red flour beetle (RFB) with no end-user quality effect on grain. The semi-continuous counterflow system was proven as an effective system to treat grain by the control of three key variables of airflow, ozone mass flow, and exposure time. Also, it reduce mold in stored grain by more than 50% using a range of ozone cumulative CTP between 340 to 565 ppm-h. The continuous flow system proved to be an effective treatment system with an average grain retention time of 1.8 minutes and ozone concentration of 47,800 ppm that resulted in 100% insect mortality for adult MW and RFB. The scale-up and economic analysis showed that continuous flow and the semi-continuous counterflow systems were predicted to have the lowest treatment cost of 1.21 $/MT compared to fixed bed ozonation system (1.33 $/MT). Also, they were 55% more expensive than contract fumigation, and 29 and 43% less expensive than ambient aeration and grain chilling, respectively.

Application: Three grain treatment systems for using ozone in a fixed bed, semi-continuous counterflow and continuous flow systems were developed and proven to be effectively used for pest control with 100% insect mortality and mold growth reduction without affecting end-use quality of the treated grain at farm-level and grain processing facilities. The semi-continuous counterflow and continuous flow systems had the same the lowest cost of 1.21 $/MT compared to fixed bed systems with 1.33 $/MT and are 55% more expensive than traditional fumigation and 29 and 43% less expensive than aeration and grain chilling that are other non-chemical alternatives for pest control.