COMMERCIAL FUMIGATIONS WITH PROFUME® GAS FUMIGANT IN THE UNITED STATES, 2004-2005

Robert E. Williams, Dow AgroSciences LLC, Atascadero, CA

ProFume® gas fumigant (99.8% sulfuryl fluoride) manufactured by Dow AgroSciences LLC was registered in the U.S. on 29 January 2004 for post-harvest control of several stored product insect and rodent pests in cereal grain and dried fruit and tree nut facilities. Since then more than 75 commercial fumigation jobs have been conducted at more than 40 job sites, consisting of at least 29 wheat facility fumigations, 10 rice facility fumigations, 1 seed facility fumigation, 1 warehouse fumigation in combination with methyl bromide for quarantine treatment of Asian Long-horned Beetle, 11 bin fumigations in 5 jobs (8 rice, 2 wheat & 1 corn) and 16 seed chamber fumigations in 8 jobs. Mean fumigated volumes were 635 Mcf for wheat facilities, 1,284 for rice facilities, 520 Mcf for the seed facility, 77.4 Mcf per bin, and 5 Mcf per chamber.

The Fumiguide® Program for ProFume Gas Fumigant provided by Dow AgroSciences to licensed and trained fumigators was used to calculate target dose rates based on input parameters of target pest and level of infestation, exposure time, temperature, and estimated gas retention time (Half-Loss Time, or HLT) . Fumiguide dosage ranged from "Low" to "High". Mean input conditions were 24.5-h target exposure time, 79º F, and 13.2-h estimated HLT (9.0-h for mills and warehouses, 9.9-h for bins & 26.8-h for chambers). The corresponding mean Fumiguide calculation for target CT (Concentration x Time) dosage was 586 oz-h (equivalent to ca. 1.8 lb/Mcf), ranging in mills, warehouses and bins between 295 and 383 oz-h for "Low" rates and 546 and 712 oz-h for "High" rates and in shorter-exposure chambers to 1106 oz-h for "High" rates.

Gas concentration monitoring was conducted and time-dependent values were input into the Fumiguide for calculation of "add gas" if needed (generally due to underestimation of HLT), plus actual HLTs and accumulated CT dosages. Mean actual exposure conditions calculated by the Fumiguide were 22.2-h exposure time and 14.3-h HLT. Considering "add-gas", the mean accumulated CT was 679 oz-h, which ranged in mills, warehouses and bins from 327 to 534 oz-h for "Low" rates and 486 to 880 oz-h for "High" rates to 1105 oz-h for "High" rates in shorter-exposure chambers.

Each of the fumigation parameters contributed individually to the complicated calculation of the final dosage needed to achieve the target CT. Different target pests have different temperature-dependent susceptibilities to fumigants. Depending on temperature, either the red flour beetle, confused flour beetle or warehouse beetle might be the most tolerant species requiring the greatest dose. Moths generally are more susceptible than beetles.

With the selection of target pest, the Fumiguide offered the fumigator a choice between “Low” and “High” dose rates. The “Low” rate generally is recommended for maintenance fumigations of low to moderate infestation levels, while the “High” rate might be suggested for cleanout of high infestation levels. The fumigator also can select any dose rate within the range between the “Low” and “High” rates to meet any site-specific need.

Temperature has a differential affect on the lb/Mcf needed to achieve the desired target CT. Temperature can significantly influence “High” rates, but has a relatively small impact on “Low” rates. Regardless of rate, though, higher temperatures require less fumigant to achieve the desired CT.

Regardless of pest or Fumiguide dose rate, exposure time influences the lb/Mcf needed to achieve the desired CT. Shorter exposure times require more fumigant than longer exposure times. Exposure time often was increased with the “High” rates in these commercial jobs, presumably to offset some of the added cost of more fumigant needed to achieve the higher target CTs. For short 12-h fumigations, the “High” rates averaged 5.2 lb/Mcf or greater, while for long 36-h fumigations, the “High” rates averaged 4.8 lb/Mcf or lower. Across all exposure times, final “Low” rates averaged between 2.2 and 4.3 lb/Mcf, while final “High” rates averaged between 2.4 and 5.7 lb/Mcf.

HLT can significantly impact the amount of fumigant needed to achieve the desired CT. With low HLTs, gas is lost from the fumigated area more rapidly and more gas is needed to compensate for this loss. In these commercial jobs, lower HLTs of 5-h or less for “Low” rates averaged more than 3.9 lb/Mcf with a maximum of 5.4 lb/Mcf for a 3-h HLT. HLTs of 11-h or more for “Low” rates averaged less than 2.0 lb/Mcf, with a minimum of 1.5 lb/Mcf for a 15-h HLT.

Surveys of both fumigators and millers involved in these fumigations conducted at multiple intervals post-fumigation clearly indicated a high percentage of fumigation performance satisfaction. As with any market launch of a new product, unplanned issues invariably arose due to misunderstandings of expectations. Such issues that have challenged ProFume are being successfully addressed. The overall overwhelmingly positive experience of more than 40 millers involved with more than 75 fumigations indicates that ProFume has had a successful launch into the U.S. post-harvest stored product fumigation market, indicating that ProFume can be considered a viable alternative to methyl bromide.