THE CAPTURE AND DESTRUCTION OF METHYL BROMIDE VAPORS FOLLOWING POSTHARVEST FUMIGATION

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Abstract. The goal of this project to develop methods for the efficient removal of methyl bromide from ventilation streams of post-harvest fumigation chambers. The effectiveness of several adsorbents in capturing methyl bromide was examined, as well as the destruction of methyl bromide both following adsorption and concurrent with adsorption onto activated carbon.

MB Recapture. Two apparatuses were used to study the capture of methyl bromide on to a solid adsorbent. The first, the bench scale adsorption column (BSAC), described by Leesch et. al[1], hold approximately 5lbs of carbon and is designed to accommodate 1/3500 the flow expected from the aeration of a 2040m^3 fumigation chamber. The column is challenged in 30min periods, while monitoring the temperature of the carbon along the length of the column (the adsorption of methyl bromide causes an increase in temperature), as well as monitoring the methyl bromide concentration of the air exiting the column by gas chromatography (GC). In between challenges, head space samples from down the length of the column are also analyzed to chart the progression of methyl bromide.

The second apparatus used is the parallel adsorbent column test apparatus (PACT) which is used to compare the effectiveness of up to six different adsorbents or methyl bromide destruction methods simultaneously. A single flow of methyl bromide diluted in air is split between six columns, each approximately 1/315 the size of the BSAC, by a gas manifold. The flow exiting each column is either passed through a solvent desorption tube, or into a gas collection bag to determine how much methyl bromide has broken through the column and/or to determine what, if any, by-products have been formed. The most successful adsorbents and destruction techniques will then be scaled up for testing with the BSAC.

A tube furnace was also used to make activated carbons from agricultural by-products and to test methods to reactivate used carbon.

Methyl Bromide Destruction. Activated carbon was saturated with methyl bromide by filling the headspace of an air tight chamber containing the carbon with methyl bromide vapor and letting it sit until the methyl bromide concentration in the chamber equilibrated. The methyl bromide dosed carbon was then loaded into the PACT and dosed with ozone and an ozone / ethylene mixture to test the effectiveness of ozone, ozone / OH radical in destroying adsorbed methyl bromide. The treated carbon was then challenged with methyl bromide to determine if ozone / OH treated carbon required additional reactivation before

being reused.

Simultaneous methyl bromide capture and destruction , based on the work of Gan and Yates[2], was tested by loading the PACT with activated carbon and nucleophiles of differing identities, molar ratios, and concentration profiles (front or back of the column loaded with higher relative amounts of nucleophile).

Alternate Adsorbents. Leesch et. Al [1], examined the suitability of several commercially available activated carbons for the capture of methyl bromide emissions, but it has been shown[3-5] that certain agricultural by-products can also be used as sources of activated carbon. Almond shell, walnut shell, plum pits and other by-products were pyrolyzed at 800°C under an inert gas flow, then activated by purging with either steam or CO_2. The activated carbons produced were ground and sorted to a uniform size (20-40 mesh) and challenged with methyl bromide in the PACT until breakthrough was observed. The spent carbon was then reactivated by heating to 300C while purging with nitrogen and rechallenged.

References.

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