# Methyl Bromide Scrubbing Technology

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Methyl bromide's reactivity has not been thoroughly explored as a capture and destroy removal strategy to protect the ozone layer. This critical attribute – reactivity – is both methyl bromide's most beneficial attribute with respect to fumigation efficacy and its Achilles heel with respect to environmental impact. When used as a fumigant, methyl bromide can interrupt an organism's internal chemical reactions thus shutting down the organism. In the upper atmosphere, it reacts at low temperatures with ozone destroying its ability to provide protective filtering of UV light from the sun. Harnessing methyl bromide's reactivity in the form of a scrubbing solution that has been designed to provide exceptionally high reaction rates is the key to a new capture and destruction strategy that may supply the missing link in the methyl bromide phase out program.

Value Recovery, Inc. of Bridgeport New Jersey believes that exploiting methyl bromides strong suit, its reactivity, can be an effective, safe and cheap way to keep methyl bromide from ever reaching the upper atmosphere. Applying this reactivity occurs in a "reactive scrubber". Methyl bromide laden air is forced through the reactive scrubbing solution and the air emerges essentially free of Methyl Bromide. A water-soluble organic compound or anion in the scrubbing liquor reacts with the methyl bromide to form an organic product and sodium bromide.

The technology used is based on phase transfer catalysis or PTC whose salient feature is to bring reactants from different phases together to react when they normally would not have a chance of reacting. PTC has been around for over 30 years and is the subject of over 2,000 patents and 10,000 peer reviewed journal articles. Elite academics and specialty chemical companies use PTC to make high molecular weight pharmaceutical chemicals and other similar sophisticated molecules. PTC participates in at least one manufacturing step in over $10 billion worth of specialty chemical sales. Value Recovery is the only company dedicated to applying PTC to the environmental field. The company has identified over 180 million kgs/yr of production related waste documented in the U.S. Toxic Release Inventory that could be transformed into saleable products using PTC technology. Funding for this work was initiated under the Department of Energy.

A small scale field demonstration of the technology was done on February 28, 2003 in conjunction with Dr. Rudi Scheffrahn of the University of Florida who is advocating using methyl bromide to destroy anthrax spores. During the fumigation of an office trailer on the university campus containing surrogate anthrax spores, a slipstream containing over 20,000 ppm (>80 oz./ 1000 $ft^3$) of methyl bromide was charged to small gas washing bottles containing the reactive

scrubber solution. The outlet concentration averaged 4 ppm and a steady state value of 2 ppm was achieved in a four hour test demonstrating over 99.9% removal in less than 1 second of contact time. The air feed rate in a gas washing bottles was very low so these experiments do not represent a conclusive test in terms of commercial viability. However, the results do show that the reaction rate is exceptionally fast and the reaction rate does not control the overall removal rate of methyl bromide from air. Thus the approach is similar to scrubbing acid gases such as hydrochloric acid with sodium hydroxide to make sodium chloride (table salt) and water. This process also uses a reactive scrubber principle where the acid-base reaction is very fast.

The use of non-hazardous scrubber liquor combined with production of non-hazardous byproducts makes this a very attractive option. The components of the scrubbing liquor are both relatively cheap and easy to acquire. The next steps for development of the technology are to scale the process up to conventional scrubber contacting equipment and to validate the technology through the appropriate environmental authorizing authorities.

This talk will outline how Phase Transfer Catalysis can be applied to methyl bromide scrubbing plus show some experimental data, outline the scale-up challenges and provide summary economics.

Advantages of this approach are:

- Instantaneous capture and destroy of methyl bromide
- 99% removal in conventional, inexpensive contacting equipment
- Converts methyl bromide to sodium bromide and water soluble non-hazardous organics.
- Methyl bromide is converted to a concentrated aqueous phase that can be pumped.

Disadvantage of this approach are:

- Requires chemical process equipment on site
- Air flows above ~ 5,000 CFM require fixed equipment. Below 5,000 CFM one can use portable scrubbers.

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