This information is provided in response to question 5 of "Risk Mitigation Options for Methyl Bromide's Uses in Enclosures, Chambers, Structural Food Processing / Storage Facilities in Support of the Reregistration Eligibility Decision (RED)" published on March 20, 2006 by Steven Weiss in docket OPP-2005-0123.

VALUE RECOVERY, INC. DATA FOR CHEMICAL DESTRUCTION OF METHYL BROMIDE FROM VENTILATION AIR STREAMS.

Introduction

Presented is a comprehensive overview showing Value Recovery's approach to irreversibly destroying methyl bromide from fumigation ventilation streams for Q/PS, Structural and Soil fumigations. Methyl bromide belongs to a larger class of chemicals known as alkyl halides that readily undergo nucleophillic substitution reactions. Value Recovery exploited this fundamental feature in methyl bromide's structure to use it as a strategy to destroy it chemically. In order for this process to gain wide acceptance, removing methyl bromide from ventilation streams should have minimal influence on existing operations. Our solution to the emissions reduction problem has only one moving part, a blower fan, and all process other equipment is made of plastic, namely PVC, polyethylene and polypropylene. The blower fan has a Teflon coating. The cost of this process are estimated to be below 5% of the fumigation cost for quarantine and structural fumigations based on commercial trials and less than 13% of the fumigation cost for soil applications that have not yet advanced to field trials.

1. Hazardous Scrubbing Liquid

One system takes advantage of sulfides and quaternary ammonium salts as a catalyst and results in employing a "hazardous" scrubbing liquid. This system was used to scrub methyl bromide from the ventilation stream produced from fumigating surrogate anthrax spores done under the direction of the University of Florida and Cobra Termite Control. The equipment consisted of very small "gas washing bottles" that showed proof of concept for the approach. The inlet concentration for this system was greater than 80,000 ppm and the outlet concentration averaged 4 ppm for a destruction efficiency greater than 99.99%. While this small system may not have industrial practicality, it does demonstrate the concept that methyl bromide can be made to react at extremely high rates in one "pass". (Here one pass means that the gas is not recycled and passes directly from the inlet through the scrubbing liquid to the outlet). A summary of these results is shown in Figure 1 & 2. These results were presented at the 2003 MBAO meeting in Orlando, Florida.

2. Non-Hazardous Scrubbing Liquid

Further refinement of our system resulted in a non-hazardous chemical reagent that produces non-hazardous reaction products. The complete reaction equation is shown in Figure 3. We employ ammonium thiosulfate (also thiosulfate of other cations) as a non-

hazardous reacting nucleophile and use it dissolved in water as our scrubbing liquid. For now the exhausted or spent scrubber liquid is considered to be a non-hazardous aqueous waste and is disposed of at a local sewer plant or POTW. Our economics include the cost of this disposal. The amount of scrubber liquid generated is so small that BOD or COD limits are of no concern. Figures 4 & 5 show data from a commercial scrubbing trial using our non-hazardous liquid performed at the Port of Wilmington, DE in September and October 2004. The equipment is shown in Figure 6.

Figures 1 & 2

Lab scale gas washing bottle results done at University of Florida. Office trailer filled with surrogate anthrax spores. Sample stream withdrawn into scrubbing liquid.

Sampling Data of Value Recovery Scrubbing System at U Florida Fumigation Field Test
28-Feb-03

Run Time Hrs	Sample No.	Flowrate cc/min	Trailer Loading Oz/Ft^3 (Inlet)	Trailer (Inlet) Ppm		Outlet ppm	Percent Removed	Comments
0.0	na	170	320	82560		na	Na	Start MeBr Feed
0.3	1	185	320	82560		7.5	99.991%	
0.8	2	170	320	82560		3.8	99.995%	
1.3	3	175	314	81012		3.3	99.996%	Halfway between 10 and 15
1.8	4	250	310	79980		2.5	99.997%	Flowrate above 250
3.1	6	250	284	73272		2.0	99.997%	
3.4	7	250	284	73272		1.8	99.998%	
3.7	8	250	284	73272		2.0	99.997%	Written as 5 to 10 ppm
4.0	9	250	284	73272		2.0	99.997%	
4.8	10	250	284	73272		12.5	99.983%	
					Avg	4.1	99.995%	

Notes:
Sample No. 5 tube was not used
Trailer Loading is Methyl Bromide Concentration taken from the average of two readings

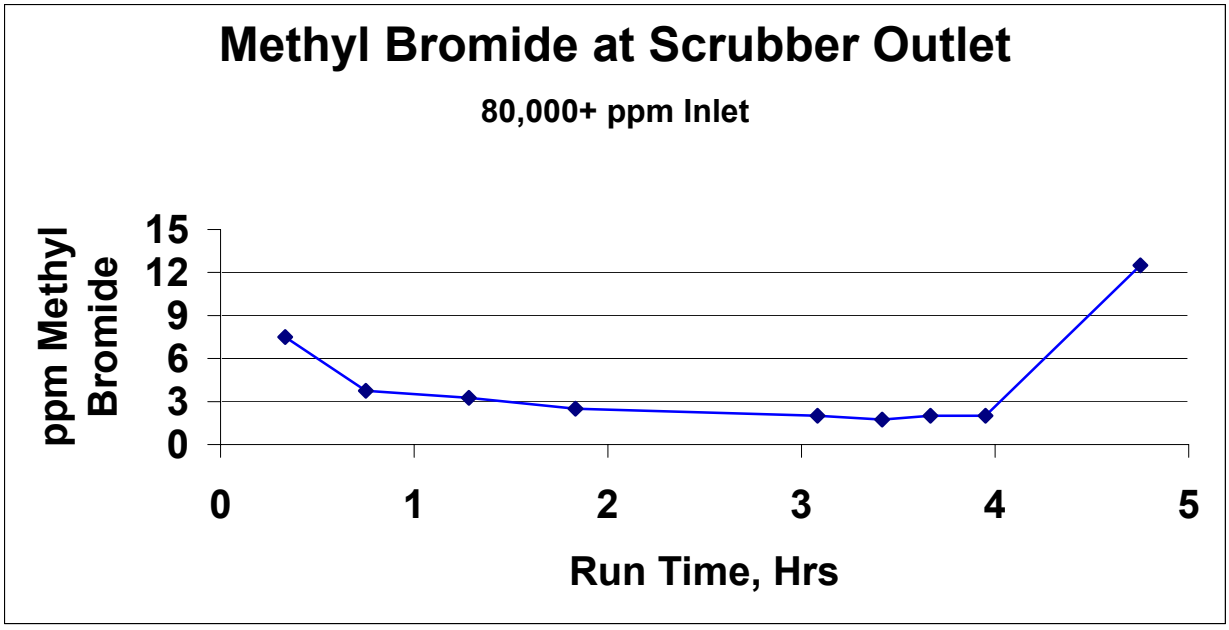


Figure 3

Reaction:

$(NH4)_2S_2O_3 + CH_3Br$ -----→ $NH_4CH_3S_2O_3 + NH_4Br$

Ammonium Thiosulfate + Methyl Bromide -→ Ammonium Methylthiosulfate +
Ammonium Bromide

Figure 4

Results of Container Scale Fumigations Performed
at Port of Wilmington, DE October 2004

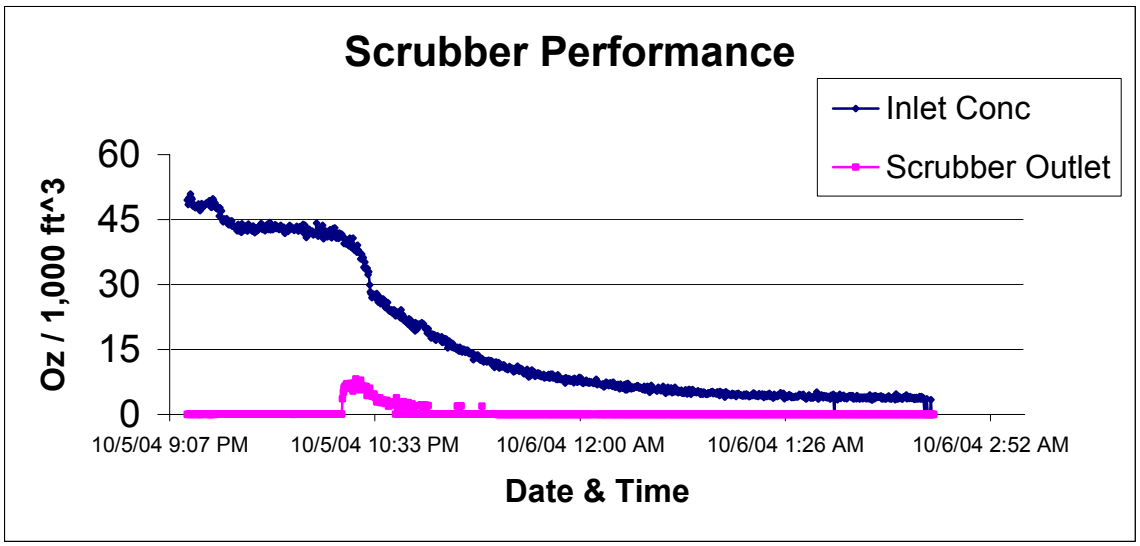
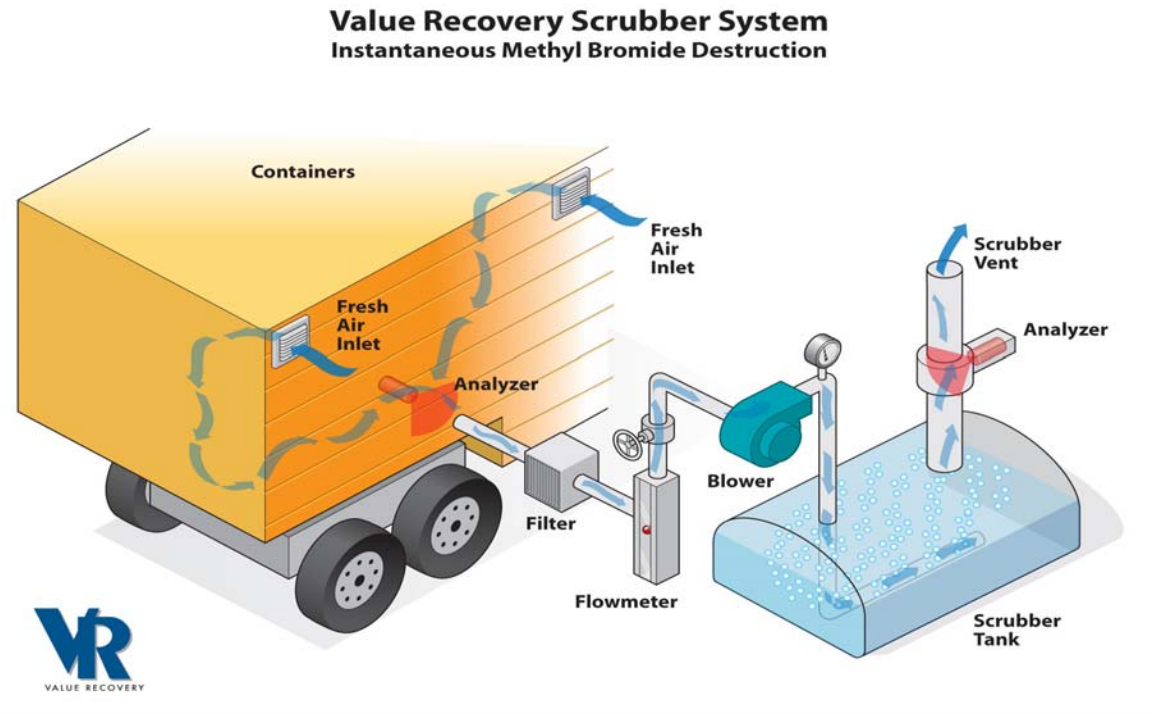


Figure 5

Performance Data
23-Sep-04

Time Hrs:Min	Inlet Oz/1000 ft3	Outlet Oz/1000 ft3	% Inlet Destroyed
18:06	45.7	6.1	86.6%
18:07	44.3	5.7	87.1%
18:08	41.0	5.5	86.6%
18:09	40.4	5.3	86.9%
18:10	40.0	4.9	87.8%
18:11	37.5	5.0	86.7%
		Average	86.9%

Figure 6



Value Recovery also performed a scrubbing trial for Quarantine/Preshipment applications at Insects Limited, Inc. located in Westfield, Indiana in February 2006. A 2,700 cubic foot (76.5 m^3) container was loaded with machinery for export under ISPM-15. We attached our scrubbing equipment (Figure 6) and pulled the methyl bromide laden gas from the container into our system via the help of a blower fan.

The scrubber was filled with an aqueous solution of ammonium thiosulfate and the methyl bromide irreversibly reacted to ammonium bromide and methyl ammonium thiosulfate (Figure 3). The scrubber efficiency is summarized in the following table:

Figure 7

Methyl Bromide Scrubbing of an Export Container

Insects Limited, Westfield, Indiana

9-Feb-06

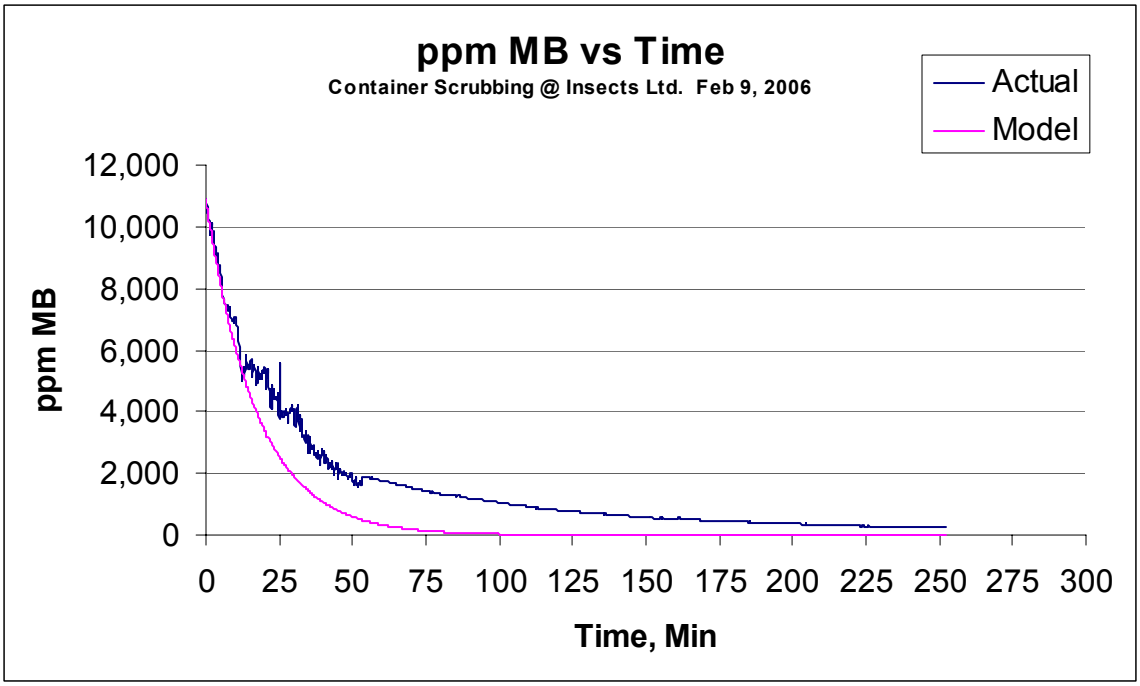
Time	Min	ppm In	ppm Out	% of Inlet Destroyed
10:54	0	10,891	na	Na
11:09	15	5,409	420	92.2%
11:17	23	4,105	350	91.5%
11:31	37	2,787	400	85.6%
11:42	48	1,991	300	84.9%

13:00	126	770	50	93.5%
13:23	149	601	35	94.2%
13:51	177	450	35	92.2%
14:23	209	342	30	91.2%
		Average		90.7%

These results are 4% higher than we reported in November, 2004 and are a result of our progress to date in improving scrubber efficiency. Our lab data shows that we should reach 95% scrubber efficiency.

The rate at which the methyl bromide was removed is shown below in Figures 8 and 9. Figure 8 depicts the concentration of methyl bromide decreasing with time in the container as compared with an exponential decay model. Figure 9 shows the mass of methyl bromide removed as the trial progressed. The deviation of the actual measurements from the exponential decay model further into the trial is indicative of the absorbed methyl bromide in the container taking longer to desorb than the methyl bromide in the air space around container contents.

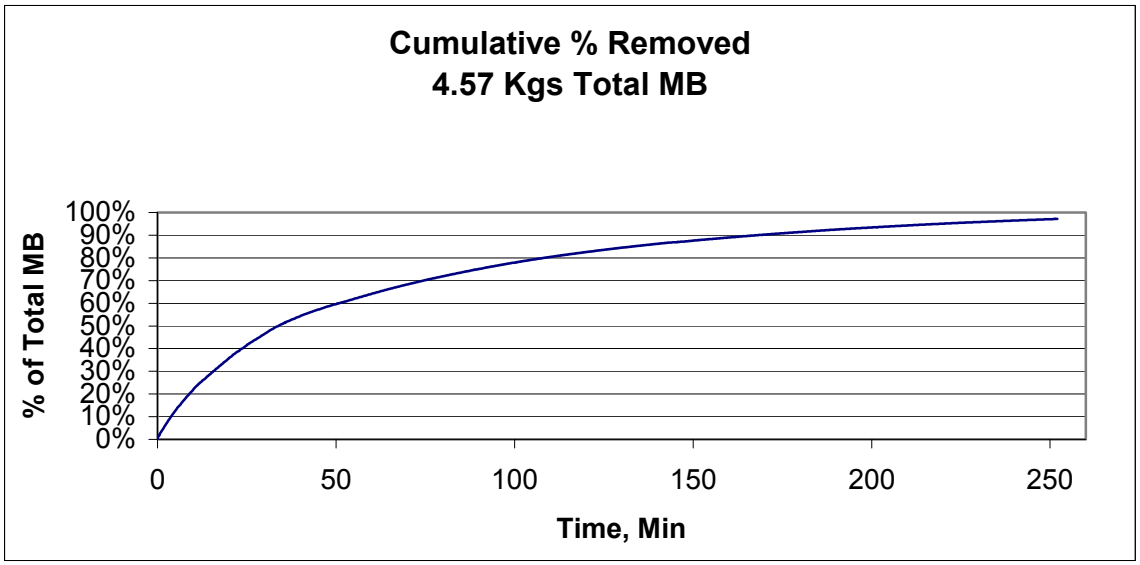
Figure 8



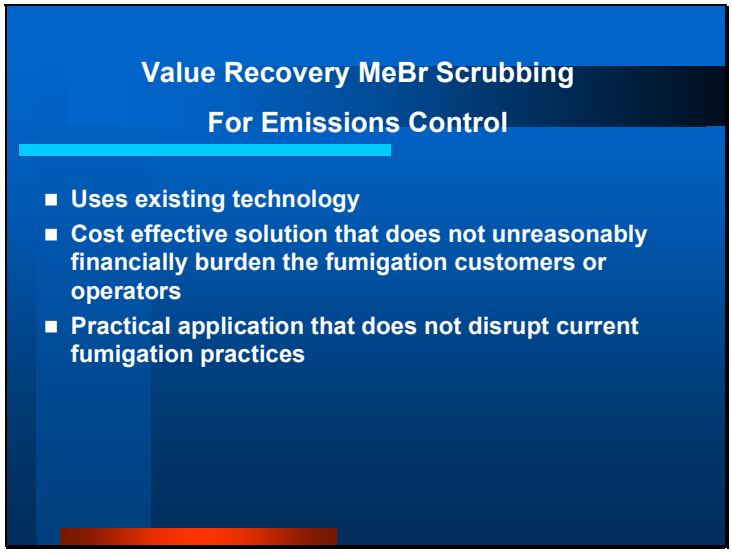
From this we conclude that a faster air ventilation rate would only decrease the amount of time for the exponential decay portion of the curve shown between time zero and t = 15 minutes. We also measured the concentration of methyl bromide in the surrounding air and found zero ppm methyl bromide at distances of 10 meters, 50 meters and 100 meters from our equipment while we were running. Since we know from our system measurements that the container was under a negative (vacuum) pressure of

approximately 10 inches of water column then we believe that there are no leaks during the scrubbing cycle since air flow was into the container.

Figure 9



Below are selected slides and explanations from a presentation given by Value Recovery, Inc. to the United States Environmental Protection Agency on May 23, 2006. (Some duplicates from the previous material were removed).



Methyl Bromide technology has been developed by Value Recovery and patents are pending. Relatively low cost for the technology has compared to fumigation cost. Equipment is meant to be hooked up to whatever source of methyl bromide is present, either centrally located fumigation enclosure or connection lines manifolded to the scrubber equipment.

Emission Control Specifications for Q/PS were given to us from the fumigation industry as follows:

1. No interruption in cargo flow
2. Ambient temperatures at normal fumigation ventilation rates (air flows)
3. Portable
4. Affordable
5. Non-hazardous aqueous solution - direct disposal of spent solution

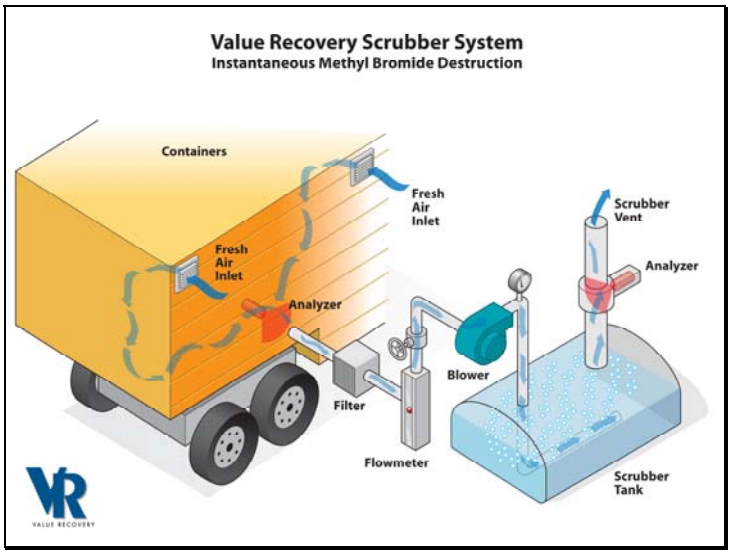
The equipment is movable when liquid is taken out and moved separately.
Direct disposal of spent solution should be possible in the future. For now it is termed a non-hazardous aqueous waste.

Reaction:

$$(NH4)_2S_2O_3 + CH_3Br \text{ -----}\rightarrow NH_4CH_3S_2O_3 + NH_4Br$$

Ammonium Thiosulfate + Methyl Bromide -→ Ammonium Methylthiosulfate + Ammonium Bromide

The chemical reaction (and destruction) of methyl bromide with water soluble component, ammonium thiosulfate used in the Value Recovery scrubber system is shown above. One can measure ammonium bromide in the scrubber solution using EPA method 300 (or other bromine anion analytical methods) to verify that methyl bromide has been scrubbed out. We have done this to verify the mass balance of methyl bromide removed. A simple test is also available for determining the strength of the ammonium thiosulfate solution.

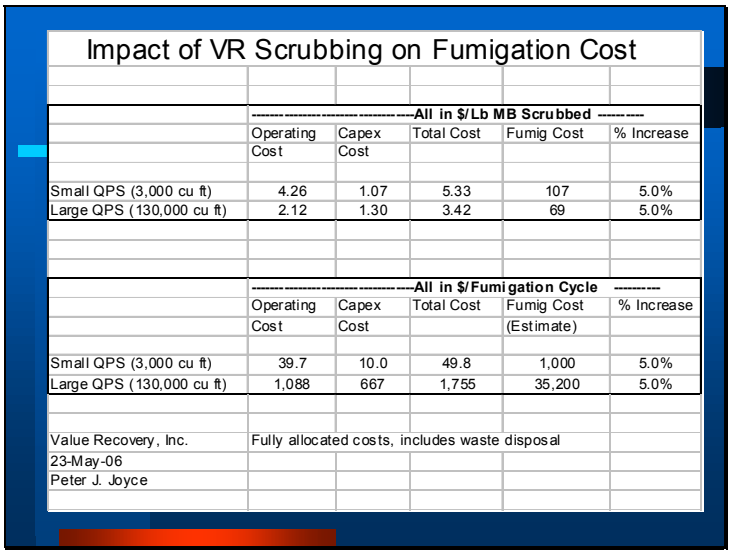


Methyl bromide is swept out of the enclosure via a forced convection air blower that pulls air into the container under a negative vacuum pressure of -7 inches of water column and into the scrubber. The negative pressure will prevent leaks during the scrubbing cycle. IR cells monitor the inlet and outlet concentration and can take data every 20 seconds, if desired, to show methyl bromide removal. The air blower is the only moving part, al other parts are made of plastic save for the instruments.

Commercial trial equipment shown for work done at the Port of Wilmington in September and October 2004. Scrubber tank on left. Blower on top of the table along

with data acquisition system. Rotometer is shown in center bottom. Sample line shown coming off of black ventilation line.

Commercial trial equipment shown for work done in Westfield, Indiana in February 2006. 125 ACFM blower shown in the lower left. Inlet piping connection from container being fumigated is shown on the lower right and passes through an air filter. Equipment is being run at temps as low as 15 F. Insulated scrubber tank shown in the background.



Impact of VR Scrubbing on Fumigation Cost

	All in $/Lb MB Scrubbed				
	Operating Cost	Capex Cost	Total Cost	Fumig Cost	% Increase
Small QPS (3,000 cu ft)	4.26	1.07	5.33	107	5.0%
Large QPS (130,000 cu ft)	2.12	1.30	3.42	69	5.0%

	All in $/Fumigation Cycle				
	Operating Cost	Capex Cost	Total Cost	Fumig Cost (Estimate)	% Increase
Small QPS (3,000 cu ft)	39.7	10.0	49.8	1,000	5.0%
Large QPS (130,000 cu ft)	1,088	667	1,755	35,200	5.0%

Value Recovery, Inc.
23-May-06
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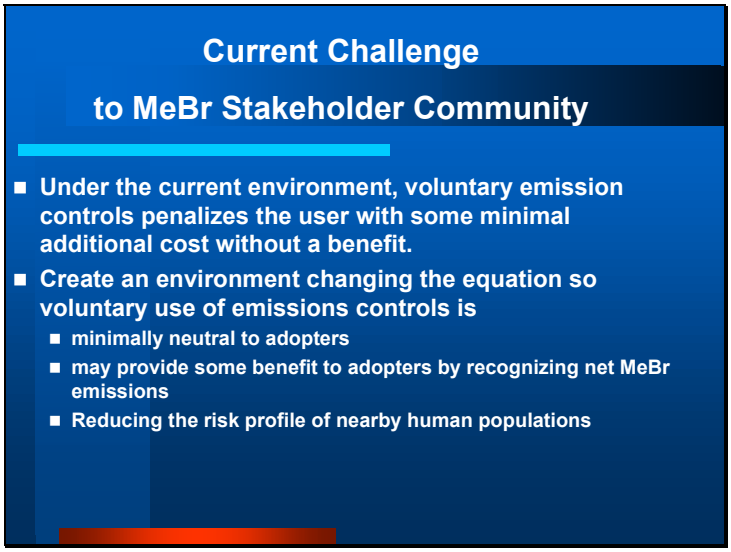
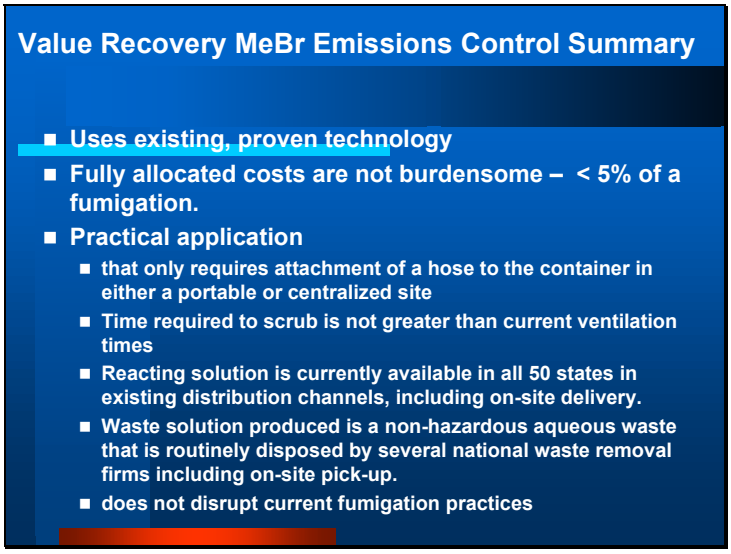
Fully allocated costs, includes waste disposal

This table shows total costs for two different sizes of fumigation equipment and are estimated to be less than 5% of the fumigation cost. Larger sizes will have similar capital and operating costs on a per lb of methyl bromide scrubbed basis.

Note - the costs shown above are fully allocated costs including the amortized cost of the equipment including shipping and operating costs including solution delivered to the site and third party waste removal by a national waste hauler. The capital cost (capex) of the equipment is amortized over five (5) years and includes an internal rate of return of 10%.





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