Experiment to Confirm the Optimum Dosage Ratio of Hydrogen Peroxide to VTX Catalyst in the Treatment of MtBE

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Objective: Apply variable amounts of VTX catalyst to a fixed amount of hydrogen peroxide to confirm the optimum effective ratio of hydrogen peroxide to VTX catalyst in degrading MtBE.

Procedure: Eight 100ppm MtBE (0.01mL) in 100mL HPLC grade water was prepared in a volumetric flask. Each of these flasks received respective dosage of additives and were mixed by inversion twenty times. In addition to the control, seven catalyst solutions were prepared as outlined in Table 1 below.

After a 24-hour period 1µL of each solution flask was injected into a Hewlett Packard 5973 Gas Chromatograph/Mass Selective Detector (GC/MS) for analysis.

Table 1. Catalyst Solutions Prepared in 100mL Volumetric Flasks with HPLC Grade Water

Flask	MtBE (mL)	VTX Catalyst (mL)	H_2O_2 (mL)
"blank"	0.01	0.00	0.00
1	0.01	0.10	0.10
2	0.01	0.20	0.10
3	0.01	0.30	0.10
4	0.01	0.40	0.10
5	0.01	0.60	0.10
6	0.01	0.80	0.10
7	0.01	1.00	0.10

The molarity of the VTX Catalyst and hydrogen peroxide stock solutions were 0.1 M and 11.65 M, respectively. The approximate concentration of hydrogen peroxide at the 0.1 ml/100 mls MtBE water would have been ~400 ppm.

The GC/MS conditions were as shown in Table 2:

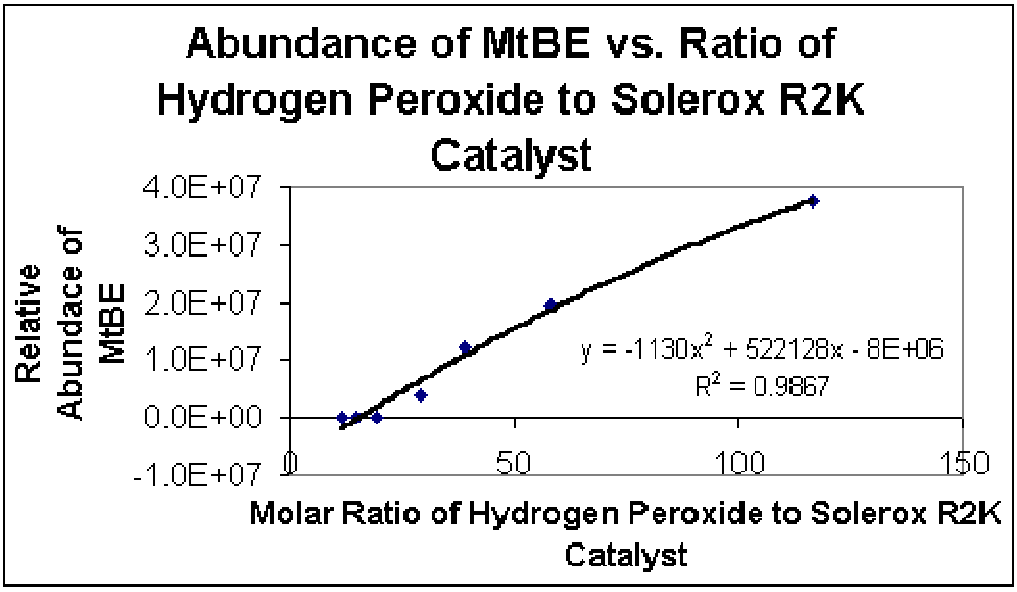
Table 2. GC/MS Conditions

Injection	250°C, 1µL, split less, purge after 1.0 min
Detector	Mass Selective Detector (scanning mode 20-300amu)
Oven Temperature Program	40°C(3min) to 150°C(5min) @ 20°C/min
Liner	SPME
Carrier Gas	Helium
Column Flow	1mL/min

Results: After approximately 24 hours of the degradation there was a 22.2, 59.4, 75.0, and 91.7 percent decrease in MtBE after a 24-hour period using 0.1, 0.2, 0.3, and 0.4mL of VTX Catalyst, respectively. The flask containing 0.6, 0.8 and 1.0mL of VTX contained non-detectable amounts of MtBE. The rate of

degradation of MtBE as a function of the molar ratio of VTX Catalyst to H_2O_2 can be seen visually in Graph 1 below.

Graph 1. Relative Abundance of MtBE vs. Ratio of H2O2/VTX Catalyst.



There was an aparent contaminant peak for acetic acid detected in the blank as well as in the treated solutions. An unknown peak, perhaps isobutene, was detected in each of the catalyst flasks but not in the control. There were very small acetone peaks detected in all of the catalyst flasks.

Conclusions: After 24 hours a 100ppm MtBE solution was entirely consumed as was determined by GC/MS analysis using the dosage of 0.6mL of the catalyst to 0.1mL (~400 ppm) of hydrogen peroxide. The molar ratio of hydrogen peroxide to VTX catalyst at this dosage was 19.4. According to the equation in Graph 1 the optimum dosage ratio under the conditions of this study is 15.9. This is equivalent to 0.73mL of the catalyst to 0.1mL (~400) of hydrogen peroxide.

It was obvious from this study that increasing amounts of VTX catalyst improved the efficiency of the process for degrading MtBE. An analysis should now be done to determine the most desirable ratio from a cost standpoint.