San Joaquin Valley
Unified Air Pollution Control District

Best Available Control Technology (BACT) Guideline 5.4.13*

Last Update 10/6/2009

Wine Storage Tank

Pollutant	Achieved in Practice or contained in the SIP	Technologically Feasible	Alternate Basic Equipment
VOC	1. Insulation or Equivalent**, Pressure Vacuum Relief Valve (PVRV) set within 10% of the maximum allowable working pressure of the tank; "gas-tight" tank operation; and continuous storage temperature not exceeding 75 degrees F, achieved within 60 days of completion of fermentation.	1. Capture of VOCs and thermal or catalytic oxidation or equivalent (98% control) 2. Capture of VOCs and carbon adsorption or equivalent (95% control) 3. Capture of VOCs and absorption or equivalent (90% control) 4. Capture of VOCs and condensation or equivalent (70% control)	

**Tanks made of heat-conducting materials such as stainless steel may be insulated or stored indoors (in a completely enclosed building, except for vents, doors and other essential openings) to limit exposure of diurnal temperature variations. Tanks made entirely of non-conducting materials such as concrete and wood (except for fittings) are considered self-insulating.

BACT is the most stringent control technique for the emissions unit and class of source. Control techniques that are not achieved in practice or contained in s a state implementation plan must be cost effective as well as feasible. Economic analysis to demonstrate cost effectiveness is required for all determinations that are not achieved in practice or contained in an EPA approved State Implementation Plan.

***This is a Summary Page for this Class of Source**

Top Down BACT Analysis for Wine Storage VOC Emissions for Permit Units N-1237-662-0 through '669-0

Step 1 - Identify All Possible Control Technologies

The SJVUAPCD BACT Clearinghouse guideline 5.4.13, 3rd quarter 2013, identifies achieved in practice BACT for wine storage tanks as follows:

1) Insulation or Equivalent**, Pressure Vacuum Relief Valve (PVRV) set within 10% of the maximum allowable working pressure of the tank; "gas-tight" tank operation; and continuous storage temperature not exceeding 75 degrees F, achieved within 60 days of completion of fermentation.
***Tanks made of heat-conducting materials such as stainless steel may be insulated or stored indoors (in a completely enclosed building, except for vents, doors and other essential openings) to limit exposure to diurnal temperature variations. Tanks made entirely of non-conducting materials such as concrete and wood (except for fittings) are considered self-insulating.*

The SJVUAPCD BACT Clearinghouse guideline 5.4.13, 3rd quarter 2013, identifies technologically feasible BACT for wine storage tanks as follows:

2) Capture of VOCs and thermal or catalytic oxidation or equivalent (98% control)
3) Capture of VOCs and carbon adsorption or equivalent (95% control)
4) Capture of VOCs and absorption or equivalent (90% control)
5) Capture of VOCs and condensation or equivalent (70% control)

Step 2 - Eliminate Technologically Infeasible Options

None of the above listed technologies are technologically infeasible.

Step 3 - Rank Remaining Control Technologies by Control Effectiveness

Rank by Control Effectiveness		
Rank	Control	Overall Capture and Control Efficiency
1	Capture of VOCs and thermal or catalytic oxidation or equivalent	98%
2	Capture of VOCs and carbon adsorption or equivalent	95%
3	Capture of VOCs and absorption or equivalent	90%
4	Capture of VOCs and condensation or equivalent	70%
5	Insulation or Equivalent, Pressure Vacuum Relief Valve (PVRV) set within 10% of the maximum allowable working pressure of the tank; "gas-tight" tank operation; and continuous storage temperature not exceeding 75 degrees F, achieved within 60 days of completion of fermentation	Baseline (Achieved-in-Practice)

Step 4 - Cost Effectiveness Analysis

A cost-effective analysis is performed for each control technology which is more effective than meeting the requirements of District Rule 4694 plus tank insulation (achieved-in-practice BACT), as proposed by the facility.

Basis and Assumptions

- The proposed new tanks consist of groups of tank sizes ranging from 6,500 gallon capacity each up to 210,000 gallons each. This BACT analysis will be first performed based on considering only the 210,000 gallon tanks. If it is shown that a control device is not cost effective for these tanks, it will be assumed that it will not be cost effective for the smaller tanks (since the potential emissions are linear with tank size and there will be a loss of economy of scale for smaller sizes).

- All control options share an identical requirement for a collection system.

- The common collection system consists of stainless steel plate ductwork (stainless steel is required due to food grade product status) with isolation valving, connecting four tanks to a common manifold system which ducts the combined vent to the common control device. The cost of dampers and isolation valving, installed in the ductwork, will be included in the cost estimate.

- A minimum duct size is established at six inches diameter at each tank to provide adequate strength for spanning between supports. The main header is twelve inches diameter to handle the potential for simultaneous venting.

- The Total Capital Investment for the system described above has been determined to be \$78,537 (see Appendix D, "Collection of VOCs and control by thermal or catalytic oxidation (> 88% collection & control)"

- For a storage operation, the maximum vent rate from a tank is equal to the maximum liquid fill rate. A typical winery general purpose pump is assumed to be equipped with a 20 hp electric motor. Based on an electric motor efficiency of 90%, a centrifugal pump efficiency of 65% and a differential head of 22 psi (40' hydrostatic head plus 5 psi dynamic loss), maximum vent rate from each tank is determined to be 122 cfm. Total simultaneous rate from all four tanks is 4 x 122 = 488 scfm.

- Rated design capacity of all control devices is established at 110% of the maximum flow rate or 488 x 110% = 537 cfm (typical overdesign margin for process equipment)

- Escalation of cost data to 2014 is included in all cost estimates at an average annual rate of 2.75%.

Capture of VOCs and thermal or catalytic oxidation or equivalent (98%)

Capital Investment for Control Device

Pricing of the RTO is based on pricing obtain from Adwest Technologies in September of 2014. The cost of a 537 cfm RTO is estimated at $145,500.

Total Capital Investment (TCI)

Total Capital Investment is calculated based only on the capital investment for ductwork and the purchase price of the TO, ignoring all other costs.

TCI = capital investment for ductwork + purchase price of control device

TCI = $78,537 + $145,500 = $223,537

Annualized Capital Costs

Annualized Capital Investment = Initial Capital Investment x Amortization Factor

Amortization Factor = $\left[\frac{0.1(1.1)^{10}}{(1.1)^{10}-1}\right]$ = 0.163 per District policy, amortizing over 10 years at 10%

Therefore,

Annualized Capital Investment = $223,537x 0.163 = $ 36,437

Total Annual Cost

Total Annual Cost is evaluated based only on the Annualized Capital Investment:

Total Annual Cost = Annualized capital investment = $36,437

Emission Reductions

Annual Emission Reduction = Uncontrolled Emissions x 0.98
= 3,003 lb-VOC/year x 0.98
= 2,943 lb-VOC/year
= 1.5 tons-VOC/year

Cost Effectiveness

Cost Effectiveness = Total Annual Cost ÷ Annual Emission Reductions

Cost Effectiveness = $36,437/year ÷ 1.5 tons-VOC/year
= $24,291/ton-VOC

The analysis demonstrates that the annualized purchase cost of the required collection system ductwork and the control device purchase price alone results in a cost effectiveness which exceeds the District's Guideline of $17,500/ton-VOC. Therefore this option is not cost-effective and will not be considered for this project.

Capture of VOCs and carbon adsorption or equivalent (95%)

Assumptions

- Since this facility is not equipped with a boiler for regeneration of activated carbon, the analysis will be based on using 2000 lb non-regenerable fixed-bed absorbers (canisters).
- At a carbon utilization of 20%, the minimum amount of carbon in each adsorber row is 1,361/20% = 6,804 lb. Therefore each row will consist of four non-regenerable adsorbers, or a total of eight adsorbers in the array.
- Purchase cost of a 2000 lb carbon adsorber vessel is $2,500 per David Drewelow of Drewelow Remediation Equipment.
- Delivery and installation of a 1,000 cfm blower package for carbon adsorption is $80-85,000 and delivery and installation of a 50cfm blower package for carbon adsorption is $20-25,000 per David Drewelow of Drewelow Remediation Equipment. Assuming $80,000 and $20,000 respectively for the above-mentioned systems, interpolating for a 537 cfm system, yields $50,760.

Total Capital Investment (TCI)

Total Capital Investment is calculated based only on the capital investment for ductwork, ignoring all other costs.

TCI = capital investment for ductwork

TCI = $78,537

Annualized Capital Costs

Annualized Capital Investment = Initial Capital Investment x Amortization Factor

Amortization Factor = $\left[\frac{0.1(1.1)^{10}}{(1.1)^{10}-1}\right]$ = 0.163 per District policy, amortizing over 10 years at 10%

Therefore,

Annualized Capital Investment = $78,537 x 0.163 = $ 12,800

Total Annual Cost

Fixed-bed absorbers cost:

VOC adsorbed annually = 90% x 3,003 = 2,853 lb-VOC/year

Annual carbon requirement at 20% carbon utilization = 2,853/20% = 14,264 lb-Carbon/year

Number of carbon beds per year = 14,264/2,000 = 8 carbon absorbers/year

Annual purchase cost for absorbers = 8 x $2,500 = $20,000

Total Annual Cost = Annual carbon cost + Annualized capital investment

Total Annual Cost = $20,000 + $12,800 = $32,800

Emission Reductions

Annual Emission Reduction = Uncontrolled Emissions x 0.95
= 3,003 lb-VOC/year x 0.95
= 2,853 lb-VOC/year
= 1.4 tons-VOC/year

Cost Effectiveness

Cost Effectiveness = Total Annual Cost ÷ Annual Emission Reductions

Cost Effectiveness = $32,800/year ÷ 1.4 tons-VOC/year
= $23,429/ton-VOC

The analysis demonstrates that the annualized purchase cost of the required collection system ductwork and the annual carbon absorber cost alone results in a cost effectiveness which exceeds the District's Guideline of $17,500/ton-VOC. Therefore this option is not cost-effective and will not be considered for this project.

Capture of VOCs and absorption or equivalent (90%)

The total capital investment costs and operating costs for an absorption system used in this evaluation are based on the information given in District project N-1133659. The scrubber under project N-1133659 was evaluated for the control of 84,864 pounds of VOC emissions. The potential VOC emissions from this project are 3,003 pounds, equivalent to approximately 3.5% of the emissions evaluated for control under project N-1133659.

Generally, when estimating costs from a known value, the rule of six-tenths is used to account for economy of scale. However, since the control device required for this project is smaller than the control device in the base project, the cost for the control device in this project will be scaled linearly. Scaling linearly results in lower capital cost and lower cost effectiveness. Therefore, the capital and installation costs provided in the cost estimate will be adjusted by a factor of 0.035 for purposes of this analysis.

Captal Cost for each Water Scrubber unit is as follows: Reactor and Portable Pumping Skids are $60,000 and $7,500 respectively. The total captial cost for all units is $1,215,000 controlling 84,864 lbs-VOC. Therefore, the total capital cost for an equivalent system for this project is estimated to be $42,525.

Scrubber	
Cost Description	Cost ($)
Refrigerated Scrubber System	$42,525
The following cost data is taken from EPA Control Cost Manual, Sixth Edition (EPA/452/B-02-001).	
Direct Costs (DC)	
Base Equipment Costs (Scrubber System) See Above	$42,525
Instrumentation ($2,000 per unit; worst case, assume 1 unit)	$2,000
Sales Tax 3.3125%	$1,409
Freight (included)	-
Purchased equipment cost	**$45,934**
Foundations & supports (not required)	-
Handling & erection 2%	$ 919
Electrical 1%	$ 459
Piping 1%	$ 459
Painting (not required)	-
Insulation (not required)	-
PLC & Programming (not requested by applicant)	-
Recovered Ethanol Storage Tank (installed)	$5,000
Direct installation costs	**$6,837**
Total Direct Costs (TDC)	**$52,771**
Indirect Costs (IC)	
Engineering (5% of TDC)	$2,639
Construction and field expenses (2% of TDC)	$1,055
Permits (Building Department) (Allowance)	$10,000
Contractor fees (2% of TDC)	$1,055
Start-up (1% of TDC)	$ 528
Source Testing (1 unit x $15,000/unit)	$15,000
Owner's Cost (Allowance)	$5,556[12]
Total Indirect Costs	**$35,833**
Subtotal Capital Investment (SCI)	**$88,604**
Project Contingency (20% of SCI)	$17,721
Total Capital Investment (TCI) (DC + IC)	**$106,325**

[12] From project N-1133659 for 18 units, Owner's Cost = $100,000 (or $5,556/unit)

Annualized Capital Investment = Initial Capital Investment x Amortiziation Factor

Annualized Capital Investment = $106,325 x 0.163 = $17,331.

Wastewater Disposal Costs

The water scrubber will generate ethanol-laden wastewater containing 1.35 tons (2,703 lbs) of ethanol annually (3003 lb/year (uncontrolled emissions) x 0.90 ÷ 2000). Assuming a 10% solution, approximately 4,083 gallons of waste water (2,703 lb-ethanol x 1 gal/6.62 lb ÷ 0.10) will be generated annually. Based on information from NohBell Corporation, an allowance of $0.08 per gallon is applied for disposal costs.

Annual disposal costs = 4,083 gallons x $0.08/gallon = $327

Annual Costs

Annual Costs			
Direct Annual Cost (DC)			
Operating Labor			
Operator	2 hr/day x 1 unit x 365 days = 730 hr/year	$18.50/h	$13,505
Supervisor	15% of operator		$2,026
Maintenance			
Labor	1% of TCI		$1,063
Wastewater Disposal			
	10% Solution = 4,083 gal	$0.08/gal	$327
Utility			
Electricity	1 unit x 2.5 hp x 0.746 kW/hp x 730 hr/yr = 1,361 kWh/yr	$0.102/kWh	$139
Total DC			$17,060
Indirect Annual Cost (IC)			
Overhead	60% of Labor Cost	0.6 x ($13,505 + $2,026 + $1,063)	$9,956
Administrative	2% TCI		$2,127
Property Taxes	1% TCI		$1,063
Insurance	1% TCI		$1,063
Annual Source Test	One representative test/year @		$15,000
Total IC			$29,208
Annual Cost (DC + IC)			**$46,268**

Total Annual Cost = Ductwork + Absorption System + Operating Costs
= $78,537 + $17,331 + $46,268
= $142,136

Annual Emission Reduction = Uncontrolled Emissions x 0.90
= 3,003 lb-VOC/year x 0.90 x ton/2,000 lb
= 1.4 tons-VOC/year

Cost Effectiveness = $142,136/year ÷ 1.4 tons-VOC/year
= $101,526/ton-VOC

The analysis demonstrates that the annualized purchase costs of the required collection system ductwork plus the annual cost of ethanol waste disposal results in a cost effectiveness which exceeds the District's Guideline of $17,500/ton-VOC. Therefore this option is not cost-effective and will not be considered for this project.

Capture of VOCs and condensation or equivalent (70%)

The total capital investment costs and operating costs for condensation system used in this evaluation are based on the information given in District project N-1133659. Similar assumption in "Capture of VOCs and absorption or equivalent (90%)" disscused above applies; the capital cost given in project N-1133659 willl be adjusted by a factor of 3.5% for purposes of this analysis. In addition, no value will be given for the ethanol that is recovered from the condensation system since the recovered ethanol has not been conclusively demonstrated to have a value in practice and could actually result in additional costs for disposal.

Generally, when estimating costs from a known value, the rule of six-tenths is used to account for economy of scale. However, since the control device required for this project is smaller than the control device in the base project, the cost for the control device in this project will be scaled linearly. Scaling linearly results in lower capital cost and lower cost effectiveness. Therefore, the capital and installation costs provided in the cost estimate will be adjusted by a factor of 0.035 for purposes of this analysis.

The total capital cost provided in project N-1133659 is $1,901,272 for 4 units controlling 84,864 lbs-VOC. Therefore, the total capital cost for an equivalent system for this project is estimated to be $66,545.

Condensation	
Cost Description	Cost ($)
Cost of Refrigerated Condenser system (1 PAS Unit)	$66,545
The following cost data is taken from EPA Control Cost Manual, Sixth Edition (EPA/452/B-02-001).	
Direct Costs (DC)	
Base Equipment Costs (Condenser) See Above	$66,545
Instrumentation (included)	-
Sales Tax (included)	-
Freight (included)	-
Purchased equipment cost	**$66,545**
Labor (estimated from project N-1133659)	$326
Installation Expense (estimated from project N-1133659)	$237
Subcontracts (estimated from project N-1133659)	$72
PLC/Programming (not requested by applicant)	-
Direct installation costs	**$635**
Total Direct Costs (TDC)	**$67,180**
Indirect Costs (IC)	
Engineering (5% of TDC)	$3,359
Permits (Building Department) (Allowance)	$2,500[13]
Initial Source Testing ($15,000/unit)	$15,000
Owner's Cost (Allowance)	$5,556
Total Indirect Cost	**$26,415**
Subtotal Capital Investment (SCI)	**$93,595**
Project Contingency (20% of SCI)	$18,719
Total Capital Investment (TCI) (DC + IC + Contingency)	**$112,314**

Annualized Capital Investment = Initial Capital Investment x Amortiziation Factor

Annualized Capital Investment = $112,314 x 0.163 = $18,307.

[13] From project N-1133659 for 4 units, Permits = $10,000 (or $2,500/unit)

Annual Costs

Annual Costs			
Direct Annual Cost (DC)			
Operating Labor			
Operator	1 hr/day x 3 shifts/day x 1 unit x 365 days = 1,095 hr/year	$18.50/h	$20,258
Supervisor	15% of operator		$3,039
Maintenance			
Labor	1% of TCI		$1,123
Chiller (Glycol)			
	3,003 lb/year (uncontrolled storage emissions) x 0.90 ÷ 2000	$270/ton EtOH	$365
Utility			
Electricity		$0.102/kWh	$0
Total DC			$24,785
Indirect Annual Cost (IC)			
Overhead	60% of Labor Cost	0.6 x ($20,258 + $3,039 + $1,123)	$14,652
Administrative	2% TCI		$2,246
Property Taxes	1% TCI		$1,123
Insurance	1% TCI		$1,123
Annual Source Test	One representative test/year @ $15,000		$15,000
Total IC			$34,144
Annual Cost (DC + IC)			**$58,929**

Total Annual Cost = Ductwork + Condensation System + Operating Costs
= $78,537 + $18,307 + $52,929
= $149,773

Annual Emission Reduction = Uncontrolled Emissions x 0.70
= 3,003 lb-VOC/year x 0.70 x ton/2,000 lb
= 1.1 tons-VOC/year

Cost Effectiveness = $149,773/year ÷ 1.1 tons-VOC/year
= $136,157/ton-VOC

Total Annual Cost

Total Annual Cost is evaluated based only on the Annualized Capital Investment: and the Recovery Credit (RC) for ethanol condensed.

Credit for Recovered Ethanol

Ethanol recovered from the condensation has byproduct value as ethanol still feed. Assuming recovery as 60-proof spirit and assuming a conservatively high valuation at $5.00 per gallon:

Gallons pure ethanol recovered = 318 gallons (2,102 lb at 6.62 lb/gal)

Gallons 60 proof recovered = 1,058 gallons

Recovery credit (RC) at $5.00/gallon = $5,290

Total Annual Cost = Annualized capital investment – RC = $149,773 - $5,290 = $144,483

Emission Reductions

Annual Emission Reduction = Uncontrolled Emissions x 0.70
= 3,003 lb-VOC/year x 0.70
= 2,102 lb-VOC/year
= 1.1 tons-VOC/year

Cost Effectiveness

Cost Effectiveness = Total Annual Cost ÷ Annual Emission Reductions

Cost Effectiveness = $144,483/year ÷ 1.1 tons-VOC/year
= $131,348/ton-VOC

The analysis demonstrates that the annualized purchase cost of the required collection system ductwork and the control device purchase price alone less credit for recovered ethanol results in a cost effectiveness which exceeds the District's Guideline of $17,500/ton-VOC. Therefore this option is not cost-effective and will not be considered for this project.

Step 5 - Select BACT

All identified feasible options with control efficiencies higher than the option proposed by the facility have been shown to not be cost effective. The facility has proposed Option 1, insulated tank, pressure/vacuum valve set within 10% of the maximum allowable working pressure of the tank, "gas tight" tank operation and achieve and maintain a continuous storage temperature not exceeding 75 °F within 60 days of completion of fermentation. These BACT requirements will be listed on the permits as enforceable conditions.